



# 2020 SICASH

SLIIT INTERNATIONAL CONFERENCE ON  
ADVANCEMENTS IN SCIENCES & HUMANITIES

THE PROCEEDINGS OF  
SLIIT INTERNATIONAL  
CONFERENCE ON ADVANCEMENTS IN  
SCIENCES & HUMANITIES

**“SUSTAINABILITY  
& WELL-BEING”**

**26<sup>TH</sup> MARCH 2021**

Organised by:



**FACULTY OF  
HUMANITIES & SCIENCES**



PROCEEDINGS OF THE  
SLIIT INTERNATIONAL CONFERENCE ON ADVANCEMENTS  
IN SCIENCES AND HUMANITIES [SICASH]

**“Sustainability and Well-being”**

26th March 2021

Colombo, Sri Lanka

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HUMANITIES & SCIENCES**

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## **Psychology**

- |                      |  |
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## **Message from the Chancellor**

It is with great pleasure that I convey this congratulatory message to the “SLIIT International Conference in Advancements on Sciences and Humanities” (SICASH), the very first of its kind in Sri Lanka, will be organized by the Faculty of Humanities and Sciences of Sri Lanka Institute of Information Technology (SLIIT). I understand that this conference will be an open forum for academics, professionals and students, to present their latest findings and research in the domains of Natural Sciences, Law, Education, Psychology, English Language and Literature and Nursing.

The SICASH 2020 Conference, to be held on 26th March 2020, intends to host participants from both Sri Lanka and abroad. It is with great pleasure I send this message to you on this important event.

Being one of the elite higher education institutions in Sri Lanka with affiliations and partnerships with renowned universities throughout the world, SLIIT has brought forth prominent entrepreneurs, experts and specialists in many occupational fields and the Faculty of Business has been, and will continue to be, a proud contributor to the institution’s prestige. An extremely dedicated, expert staff focused on motivating students to think critically and analytically and an environment where students can improve their ideas creatively and apply their knowledge effectively along with strict measures to maintain and improve the teaching standards and resources have been the foundations in producing individuals of the highest caliber to cater for the

I would also like to make this an opportunity to express my most sincere appreciation to SLIIT staff both academic and non-academic for their brilliant ideas as well as the committee members for their ceaseless support and the distinguished invitees and attendees whose presence has made this occasion an outstanding success, and on behalf of the entire staff, I wish all our graduates the very best for their future.

**Prof. L. L. Ratnayake**  
Chancellor





## **Message from the Vice-Chancellor**

I am pleased to send this congratulatory message to the SLIIT International Conference in Advancements on Sciences and Humanities (SICASH), organized by the Faculty of Humanities and Sciences. This event bears great significance as the Inaugural Conference hosted by SLIIT's youngest Faculty, Humanities and Sciences since its establishment in 2019.

The Faculty continuously strives to create a research-rich environment and culture for our students. Active engagement in conferences of this nature will inculcate innovation, critical thinking and intellectual independence in our students which enable them to grow as responsible professionals of competence and integrity in various aspects of humanities and sciences.

The SICASH has been designed in such a way that it facilitates learning and networking in an engaging environment. It will provide an ideal platform for scholars to share their research findings and experiences in multiple areas such as Natural Sciences, Law, Education, Psychology, Nursing, English Language and Literature. The participants will also have the opportunity to immerse themselves in free exchange of ideas, to learn about the latest trends and common challenges in brainstorming sessions and to network with diverse minds.

I wish to commend the efforts of the Dean, Heads of Schools and the Academic Staff of the Faculty of Humanities and Sciences for their efforts in organizing the SICASH in order to foster research among the undergraduates and the entire SLIIT academic community.

I offer my best wishes for a productive conference.

**Professor Lalith Gamage**

Vice-Chancellor



## **Message from the Deputy Vice-Chancellor**

I am delighted to provide a congratulatory message to the organizers and participants of SICASH 2020. The Faculty of Humanities and Sciences at SLIIT is the organizer of this inaugural conference, and the Faculty is known for its high-quality academic programs and innovative research. SICASH 2020 is a multidisciplinary conference that caters to researchers from a broad range of subject areas. It is, therefore, an excellent forum for scholars from different disciplines to meet, identify and discuss research synergies and collaborate to solve the challenging problems faced by the world. In this regard, SICASH is happening during a very challenging period with the world struggling to overcome the Covid-19 pandemic. The pandemic has reminded us of the importance of basic and applied research and the need to advance the frontiers of knowledge through international collaborations.

I am pleased to note the significant interest from the local and international scholars in SICASH 2020. The organizers have taken considerable efforts to deliver an exciting conference program with prominent keynote speakers. I am confident that the SICASH conference series will become a pre-eminent international forum to present high-quality research and discuss the best approaches to tackle the problems of today and tomorrow.

I thank the organizers for their efforts and time and the participants for joining SICASH during a challenging time. I wish all participants of SICASH 2020 continued success with their scholarly endeavours.

**Dr. Nimal Rajapakse**  
Deputy Vice-Chancellor



## **Message from the General Chair**

I take great pleasure in writing this congratulatory message on the Inaugural Conference hosted by Faculty of Humanities and Sciences. We are heading to a new normal reshaped by the pandemic: remote working, virtual meetings and online learning which will constantly evolve. The objective of creating this conference is to provide a platform for our academics to showcase their research findings and to encourage dissemination of new knowledge within academia. Being the youngest faculty that offers the most diverse portfolio of programmes, SLIIT International Conference on Advancements in Sciences and Humanities (SICASH) embodies six research areas in both Social and Natural Sciences.

It is my vision to have a research journal published as a follow up activity of SICASH to provide further recognition to selected publications from the conference.

All papers in this conference have been double blind reviewed by a distinguished panel of reviewers in order to maintain high standards. This will result in gaining international recognition for the conference in the future.

I would like to thank the co-chairs, the organizing committee and the faculty members who worked tirelessly to make this conference a reality. I would also like to recognize the contribution made by the reviewers, session chairs and judges to maintain the academic rigor of the conference.

Finally, I extend my heartiest congratulations to all the authors who will be presenting their research work at SICASH 2020.

**Dr. Malitha Wijesundara**

Dean

Faculty of Humanities & Sciences



## Message from a Keynote Speaker

From the time when humans were hunter-gatherers, the practices of crop agriculture have passed through the phases of domestication of wild species and pastoral societies, selection of plants for improved properties, the discovery and application of Mendelian genetics, the discovery of the structure of DNA and the gene revolution, to New Breeding Technologies (NBTs) and gene editing.

In the broadest view, the term NBTs includes both genetically modified (GM) plants, in which genetic traits have been introduced from unrelated, closely related or from the same species, and the rapidly developing technologies of ‘genome’ or ‘gene’-editing. GM crops, which have been grown commercially since 1996, now provide more than 10% of the world’s food supply. Although the safest foods available, public acceptance of GM produce has been compromised by issues wholly unrelated to science, and this has reduced many potentially beneficial applications. The current status of GM crops will be presented.

Genome-, or preferably gene-editing, is a new set of technologies which can be used to modify plant properties. They are derived from bacterial systems for protection against viral infection. Gene editing technologies are based on making double-stranded (ds) break(s) in a target sequence of DNA, with the site of the ds break directed by an RNA sequence, developed as single or multiple guide RNAs (gRNAs). There are various forms of gene-editing based on the site-directed nuclease (SDN) system used – the best known is ‘CRISPR/Cas9’.

When ds breaks occur in DNA, plants (and other organisms) often make mistakes in repairing the DNA. For what is defined as ‘SDN-1’, there is no external genetic material incorporated at the join, but the mistakes take the form of deletion or insertion of bases at the breakage site (Non-Homologous End Joining). For SDN-2 and SDN-3, if an additional oligonucleotide with ends homologous to sequences at either side of the ds break are provided, then additional nucleotides may be incorporated at the repair site, from a single nucleotide up to a complete gene (Homology Dependent Repair).

The significance of this technology is that SDN-1 mutations are simply targeted mutations. Since plant breeding using chemical or irradiation mutagenesis generates random ds breaks in

DNA, and this is an accepted and widely used form of crop breeding, national and international regulations which had captured SDN-1 technology as GM, needed to be re-assessed. As a result, in many countries, including the USA, Canada, most countries in S. America, S. Africa, Japan and Australia, have reviewed GM regulations/policy, and have declared SDN-1 edited plants not to be GMOs.

This is a highly significant change, because it exempts SDN-1 gene-edited plants from being regulated as GMOs, and this has democratized this technology, so that the costs for generating new varieties using SDN-1 technology become essentially the same as for conventionally bred crops. An overview of the current regulatory landscape will be presented. Examples will also be provided for current applications of gene editing to crop improvement, and its future potential both for large scale and horticultural crops.

However, there is one caveat to be aware of, that gene-editing technologies are subject to patents, and a license is required from the patent holder(s) to commercialize new varieties generated using gene-editing technology.

Taking a broader perspective, Agriculture 4.0 involves more than NBTs and gene-editing (Agri-Bio). It includes rapid advances in Agri-Tech and Food-Tech: there is new excitement and investment in all these areas; which will all be needed to feed the world's peoples sustainably from 2050 and beyond.

**Michael G K Jones**

Professor of Agricultural Biotechnology,

Director of the Western Australian State Agricultural Biotechnology Centre, Food Futures Institute, Murdoch University, Australia.



## **Message from a Keynote Speaker**

Though democracy is a vital concept, there is no agreement as to its precise definition. Being an universally recognized ideal shared by peoples throughout the world, democracy is a basic right of citizenship to be exercised under conditions of freedom, equality, transparency and responsibility, with due respect for the plurality of views and in the interest of the polity.

Democracy aims to preserve and promote the dignity and fundamental rights of the individual, among others, to achieve social justice and to create a climate that is favourable for peace. Human rights which are inalienable and inherent rights of people require empathy and the rule of law. Democracy provides the natural environment for the protection and effective realization of human rights. However, the recognition, acceptance, and enthronement of the basic principles of democracy and of human rights in a country's constitution by itself are meaningless, unless they are enforceable at law in the hands of an independent judiciary.

Historical experience reveals that democracy cannot be attained without a system of government which divides power among the co-equal branches of power – the Executive, the Legislature, and the Judiciary. In such a system of governance, the role of the judiciary is paramount. It is the judiciary which channels power related conflicts through a legal process which uses agreed legal reasoning to interpret and apply pre-existing law. The judiciary is in the forefront of the rule of law, which is fundamental to democracy.

The 1st Republican Constitution did not provide for the separation of powers; but it could be recognized that the 2nd Republican Constitution accommodated it. It is vitally important in a democracy that the judiciary as a whole be impartial and independent to be able to realise the basic principles of democracy and to be the arbiter in power related conflicts between the state and the citizen. Role of an independent judiciary is therefore a central component of any democracy and is crucial for Rule of Law and human rights.

According to one of world's foremost judges and legal theorists - Aharon Barak - judicial independence is composed of two foundations: firstly, every judge should be free to decide the matters before him without any improper influences, inducements, or pressures, direct or indirect, from any quarter or for any reason, and, secondly, that the Judiciary is independent of the Executive, and the Legislature, and has jurisdiction, directly, or by way of review, over all issues of a judicial nature. These two foundations - the independence of the individual judge

and the independence of the judicial branch – are cumulative. Neither is sufficient by itself. Only together do the two guarantee the independence of the judiciary. Personal independence of a judge is a constitutional principle. It means that the judge is subject to no authority other than the law. Institutional independence is also a crucial condition because judge's personal independence is incomplete unless it is accompanied by the institutional independence of the Judicial branch, designed to ensure that the Judicial branch can fulfil its role in protecting the constitution and its values.

Personal independence and Institutional independence are protective walls which prevent the Legislature and Executive branches from influencing the way judges realise their role as protectors of democracy and its core values. Breaking these protective walls and the checks and balances mandated by the doctrine of separation of powers, will result in anarchy and the demise of the Rule of Law.

The impeachment motion to remove the 43rd Chief Justice underscored the importance of the role of the judiciary in upholding democracy. The 17th Amendment to the Constitution, 2001 establishing the independent institutions to conserve, secure and protect fundamental democratic values, was felled by the 18th Amendment to the Constitution, 2010. The introduction of the 19th Amendment to the Constitution, 2015 appeared to bring some sanitizing warmth of the early breezes of further democratization and the reinforcement of rule of law. But alas, the 20th Amendment, 2020 put paid to all aspirations! It rolled back the 19th amendment and gave a knockout blow to the rule of law! It gave the President expansive powers and greater immunity and granted him sole and unfettered discretion to appoint all the judges of the superior courts. A state which repressed or persecuted sections of its people could not be regarded as observing the rule of law. A core idea of the rule of law is that the government must be able to point to some basis for its action that is regarded as valid by the relevant legal system. The rule of law provides the foundation for the controls exercised by the judiciary over governmental action through judicial review and in this sense, it is expressive of how the state ought to behave towards its citizens.

Consequently, in a State governed by the rule of law governmental action conforms to precepts of good administration, this being an essential facet of accountable government in a democratic society. Political power can be capable of great and awful feats but it can also be incredibly insecure and fragile. Overreach can shatter an iron grasp. One cannot trade the rule of law for the rule of power.

The “Wellbeing” of the State and all its citizens depends on it.

**Dr. K. Kanag-Isvaran**

President's Counsel





## **Message from a Co-Chair**

Research makes our lives comfortable. From the time it started in Fertile Crescent; approximately 6000 years back, with the production of cheese, bread and wine, it has continued with more sophisticated inventions. Continuation of research is triggered by dissemination and recognition of new knowledge in fora which propagate research culture. Aligning with this environment, Faculty of Humanities and Sciences organized SLIIT International Conference on Advancements in Sciences and Humanities (SICASH) 2020.

The response we received for the call for papers was 77 manuscripts. All the submissions were meticulously selected after going through a double-blind peer review process by at least two subject experts who were mostly academic staff of state and non-state universities. As a result, 61 papers were selected and are ready to be presented as oral and poster presentations.

In this juncture, I would like to express my sincere appreciation to the paper and poster presenters as they are the foundation of this conference. Contribution from the Chairpersons, Judges and Paper Reviewers is enormously valued and appreciated. To organize a conference of this magnitude is not an ordinary task hence my heartfelt appreciation goes to the organizing committee for their untiring efforts to bring this conference into life today. Also, I would like to thank all the sponsoring organizations for providing their generous financial support. Lastly, I would like to thank all the conference participants for their contributions which provided the strength for SICASH.

With this message and on behalf of the Organizing Committee, I invite you to attend and actively participate in this important international gathering.

**Prof. Sriyani E. Peiris**

Head

School of Natural Sciences





## **Message from a Co-Chair**

I am glad to send this message to the first ever SLIIT International Conference on Advancements in Sciences and Humanities organized by the Faculty of Humanities and Sciences, Sri Lanka Institute of Information Technology.

Hosting of research conferences provides an occasion to share one's research findings with others and test their reliability, accuracy, dependability, and completeness in a congenial environment with eminent and experienced researchers and stakeholders providing constructive feedback. It further buttresses the manifold objectives of carrying out research, some of which are: engaging in research that helps the researchers gain valuable experience in scientific and reliable ways of searching for new knowledge and truth; it provides a unique opportunity to test and challenge the existing knowledge, build on it and come up with new knowledge; it finds solutions to problems faced by the living beings; it offers new vistas to life and lifestyles; it provides leads for further explorations and investigations; it affords the ground for testing, sharpening and honing one's own results and recommendations; it improves the standing of the researchers and the institution to which they belong.

I take this opportunity to congratulate all the Paper and Poster Presenters, the Dean and other members of the Organizing Committee of the Faculty of Humanities and Sciences on their dedicated guidance and commitment in organizing SICASH and convey my best wishes for a successful and fruitful engagement of great minds.

**Prof. N. Selvakkumaran**

Head

School of Law

## **SICASH 2020 - Programme**

**26<sup>th</sup> March 2021**

- 09.00 a.m. - National Anthem
- 09.05 a.m. - Traditional lighting of the Oil Lamp
- 09.10 a.m. - Welcome Address by General Chair - Dr. Malitha Wijesundara
- 09.15 a.m. - SICASH Video Presentation
- 09.20 a.m. - Address by Co-Chair - Prof. Sriyani E. Peiris
- 09.25 a.m. - Address by the Vice-Chancellor of SLIIT- Prof. Lalith Gamage
- 09.35 a.m. - Address by the Chief Guest  
Prof. Kapila Perera - Secretary Ministry of Education
- 09.45 a.m. - Keynote Speech 01  
Prof. Michael G K Jones, Murdoch University, Australia
- 10.05 a.m. - Keynote Speech 02  
Dr. K. Kanag-Isvaran, President's Counsel
- 10.30 a.m. - Parallel Technical Sessions
- 1.15 p.m. - Announcement of Awards
- 1.30 p.m. - Vote of thanks by Co-Chair - Prof. N. Selvakkumaran

## SICASH 2020 - Natural Sciences – Session I

#	Field	Title of the Paper	Name of the Author/s	Page Number
1	Natural Science	Effect of 1-Methylcyclopropene and Wrapping Material on Shelf-Life and Postharvest Qualities of Spine Gourd ( <i>Momordica Dioica</i> )	Wijesinghe, G.P.M, Kumara, G.D.K , Kumara, J.B.D.A.P	1
2	Natural Science	Impact of Spacing and Type of planting material on Dry Matter Percentage in Cinnamon Bark; at the stage of first Harvest	Aluthgamege, H. N., Fonseka, D. L. C. K., Benaragama, C. K., Kumarasinghe, H. K. M. S.	7
3	Natural Science	Newly Introduced Creeper Legume <i>Vigna Marina</i> as A Solution for Protection of Road Cuts In Sri Lanka	De Silva, M.H.S.C,Yapa, P.I. and Mahatantile,W.D.K.	13
4	Natural Science	Phenotypic Plasticity Index as A Tool to Assess the Suitability of Three <i>Coleus</i> ( <i>Plectranthus scutellarioides</i> (L.) R.Br.) Varieties in Low-Maintenance Landscaping	Kodithuwakkuge, V. N., Padmaperuma, O. A. D., Gunathilake, G. K. D. C. S., Liyanage, L. P. H., Krishnarajah S. A. and Beneragama, C. K.	19
5	Natural Science	Multilocal Evaluation of Growth and Antioxidant Content of Curly Kale ( <i>Brassica oleracea</i> L. var <i>acephala</i> ) and Chinese Kale ( <i>Brassica oleracea</i> var. <i>alboglabra</i> ) in Sri Lanka	Jayasooriya, R. Y, Chamara, R.M.S.R , Gunathilake, G.K.D.C.S., Liyanage, L.P.H. and Beneragama, C.K.	26
6	Natural Science	Electrochemical Evaluation of Delayed Release Behaviour of Diclofenac Sodium Tablets	Sewwandi, A.A.M., Soysa, H. Sasimali M.	34
7	Natural Science	Growth Parameters and Grain Yield of Rice ( <i>Oryza Sativa</i> L.) as Affected by Biofilm Biofertilizer Application	Ketippearachchi, K.G, ,Seneviratne, G., and D.L.C.K. Fonseka	40
8	Natural Science	Case Study on Safety Culture in Chemical Laboratories in Western Province, Sri Lanka	Samaranayake, A.D.A.I., Nishadya, S.M.S. and Jayasundara, U.K.	44
9	Natural Science	ZnO Nanoparticles Deposited on Gamboge ( <i>Garcinia Gummi-Gutta</i> L.) Based Activated Carbon for Removal of Phenol from Synthetic Wastewater	Nadeeshani, M.LN. and Edussuriya, M.	50
10	Natural Science	The Use of Colour Shade Material in Black Pepper ( <i>Piper Nigrum</i> L) Propagation	Jayasinghe, J.A.T.U., Wickramanayake, D.S.D.D.S. <sup>1</sup> , and Kirthisinghe, J.P.	56

## SICASH 2020 - Natural Sciences – Session II

#	Field	Title of the Paper	Name of the Author/s	Page Number
1	Natural Science	Identification of SNP-Allelic Polymorphism Based Changes in Two Salt Responsive Proteins, Na <sup>+</sup> H <sup>+</sup> ANTI PORTER 4 and GLUTAREDOXIN 24 Between Two Rice Varieties	Abhayawickrama, B.P., Hanchapola, C.R., Kottearachchi, N.S., and Gimhani, D.R.	61
2	Natural Science	Molecular Phylogeny of Rasboroides (Family Cyprinidae): An Endemic Freshwater Fish Species in Sri Lanka	Lankika, S.P.C. and Herath, V.	66
3	Natural Science	Review on Methods of Explant Surface Sterilization for Efficient Micropropagation	Hemathilake, H.M. and Peiris, S.E.	76
4	Natural Science	Effects of Silver Nitrate in In Vitro Establishment of <i>Cordyline Fruticosa</i> (L.) CV ‘Purple Compacta Tri Colour’ with CSUP Media Sterilization	Peiris, S.E., Hemathilaka, Heshika and Peiris, Colin N., Wijerathna, A.W.	83
5	Natural Science	In Vitro Root Induction and Acclimatization of <i>Cissampelos pareira</i> : An Important Medicinal Plant	De Silva, D.C.M and Fonseka,D.L.C.K.	89
6	Natural Science	Callus Induction Protocol for <i>Aegle Marmelos</i> (L.) Corr. (Beli) through Seeds Explants	Hansani, S.A.N.P. ,Fonseka, D.L.C. K.,	93
7	Natural Science	Improvement of the Survival Rate of In Vitro Propagated <i>Dendrobium</i> Intermediate CV ‘White’ during Acclimatization	Isaac, P.N. and Peiris, S.E.	98
8	Natural Science	Production of Disease Free <i>Rumohra Adiantiformis</i> (Leatherleaf Fern) Using In Vitro Propagation	Perera, D. and Peiris, S.E.	105
9	Natural Science	An Efficient Plant Regeneration using Leaf Explant for <i>Osbeckia Octandra</i> (L.) DC; A Valuable Medicinal and Ornamental Plant	Dilrukshi S. K. Nagahatenna and Sriyani E. Peiris	111

## SICASH 2020 – English Language, Literature & Education

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1	English & Literature	A Study on the Impact of Online Monolingual and Bilingual Dictionary Use on ESL Learners' Vocabulary Acquisition and Retention	Wijesuriya, Keshani, and Dissanayake, Sucheru, D.M.M.	118
2	English & Literature	Incorporating A Task-Based Approach to Motivate Speaking in The General English Classroom	Rathnasena, Upeksha	124
3	English & Literature	Effectiveness of L2 Grammar Videos: A Dialogue between Teachers and Learners	Kalinga, J.	129
4	English & Literature	Property, Sustainability and Well-Being: The Perspectives of the American Colonizers and the Natives in William Faulkner's Go Down, Moses	Jayasinghe, M.K.	140
5	English & Literature	Lessons Learnt: A Study of Student Feedback Regarding Online Proficiency Assessment	Rathnasena, U. and Kalinga, J.	146
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# Natural Sciences





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## Effect of 1-Methylcyclopropene and Wrapping Material on Shelf-Life and Postharvest Qualities of Spine Gourd (*Momordica dioica*)

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### ABSTRACT

Spine gourd (*Momordica dioica*) is a tropical under-utilized, climbing creeper vegetable (commonly known as kakrol, spiny gourd or teasle gourd) belonging to the family *cucurbitaceae*. It is native to Asia and now extensively distributed in Sri Lanka due to boosted commercial cultivation of hybrid varieties. Spine gourd has a growing demand both in the local and the export market for its distinct taste and promising health properties over thousands of years. However, vulnerability to postharvest damages due to large area/volume ratio and climacteric ripening behaviour result in short shelf-life for this commodity. Consequently, its market potential is significantly affected. The present study attempts to extend shelf-life while maintaining postharvest qualities in spine gourd by using 1-methylcyclopropene (1-MCP) and Low-Density Polyethylene (LDPE) wrapping at an ambient temperature ( $27 \pm 1$  °C). The experiment was conducted according to the Completely Randomized Design (CRD) using eight treatments: 0, 0.5, 1.0, 1.5  $\mu\text{L L}^{-1}$  1-MCP treated for 15 hours and stored with and without LDPE wrapping under ambient temperature ( $27 \pm 1$  °C). Physical parameters; fresh weight loss, firmness, peel colour changes, and chemical parameters; total soluble solids, titratable acidity, were evaluated daily. Fresh weight loss and peel colour changes significantly declined in wrapped Spine gourd fruits. The highest firmness was observed in chemically treated and LDPE wrapped fruits than the control during 5 days of the storage. Thus, it can be concluded that some postharvest qualities of Spine gourd are positively affected by 1-MCP treatment and LDPE wrapping.

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## INTRODUCTION

Postharvest management is the main quality dependent factor of any harvested commodity. Freshly harvested commodities are made to undergo postharvest treatments to minimize losses and increase their shelf-life. Worldwide postharvest losses are as high as 30 to 40 % in developing countries due to ineffective postharvest treatments (Jiang *et al.*, 1999).

Spine gourd is referred to as “King of Gourds” due to its higher nutrient content (Saha *et al.*, 1991). It contains a remarkable amount of carbohydrates, protein, fat, fiber, vitamins and minerals that increase their market demand, for both processed and fresh consumption.

Spine gourd shows some climacteric behavior which is more or similar to Bitter gourd (Payal, 2013). Ethylene ( $C_2H_4$ ) is a ripening hormone of climacteric fruits. At a certain maturation stage, ethylene is linked to its binding-site in the cell and promotes ripening and senescence of fruits (Lelievre *et al.*, 1997). Such Ethylene actions can be blocked by 1-Methylcyclopropene (1-MCP) (Sisler and Serek, 1997) that delay ripening and senescence.

Low density polyethylene wrapping is a common postharvest technique to increase the shelf life of different commodities. It creates a modified atmosphere around the fruits. Normally, edible Spine gourd fruits are rich with 84.1 % moisture (Singh *et al.*, 2009). Also, the spine like projections result in a large surface area/volume ratio. The high specific surface area of the fruit leads to increased moisture loss through fruit surface, resulting in fresh weight loss, wilting and ultimately short shelf life with low quality. Wrapping greatly reduces moisture loss and also reduces the respiration rate, chilling injuries, deformation, blemishes and the fruit decay (Mohammad and Wickham, 1993). Therefore, the present study was carried out to evaluate the shelf-life and postharvest qualities of the Spine gourd treated with 1-MCP and low-density polyethylene wrapping.

## OBJECTIVES OF THE STUDY

- To improve the shelf-life and postharvest qualities of Spine gourd by 1-MCP
- To improve the shelf-life and postharvest qualities of Spine gourd by LDPE wrapping

## METHODOLOGY

The experiment was conducted at the Sabaragamuwa University of Sri Lanka. Uniform Spine gourd fruits, harvested freshly at horticulture maturity were treated with Agrofresh™, in powder form, having 4% active ingredient 1-MCP. The following 1-MCP concentrations; 0  $\mu L L^{-1}$ , 0.5  $\mu L L^{-1}$ , 0.1  $\mu L L^{-1}$  and 1.5  $\mu L L^{-1}$  (1-MCP gas volume/chamber volume) with and without LDPE wrapping were used as treatments. There are eight treatments with three replicates.

Table 1: Treatments of the Experiment

T <sub>1</sub>	- Control 1 (Without Chemical and Wrapping)
T <sub>2</sub>	- 0.5 $\mu L L^{-1}$ 1-MCP
T <sub>3</sub>	- 1.0 $\mu L L^{-1}$ 1-MCP
T <sub>4</sub>	- 1.5 $\mu L L^{-1}$ 1-MCP
T <sub>5</sub>	- Control 2 (Only wrapping)
T <sub>6</sub>	- 0.5 $\mu L L^{-1}$ 1-MCP + wrapping
T <sub>7</sub>	- 1.0 $\mu L L^{-1}$ 1-MCP + wrapping
T <sub>8</sub>	- 1.5 $\mu L L^{-1}$ 1-MCP + wrapping

First, 400 ml, 10 %  $NaHCO_3$  solution was prepared. Next, randomly selected fruits and a beaker containing 10 %  $NaHCO_3$  were kept inside the sealable same size chambers. Relevant amount of weighted 1-MCP was put in to  $NaHCO_3$  and the chambers were sealed to avoid gas loss. Fruits were exposed to the gas released by the product for 15-hours at room temperature ( $27 \pm 1$  °C). After 15-hours, one set of Spine gourd fruits were wrapped individually with Low Density Polyethylene (LDPE). The experiment was arranged according to Completely Randomized Design (CRD) at room temperature ( $27 \pm 1$  °C). The observations were made daily.

Fresh Weight Loss of Fruits (FWLF) was calculated by using the following formula,

$$FWLF = \frac{\text{Initial weight of fruit (W1)}}{\text{Weight of fruits daily (W2)}}$$

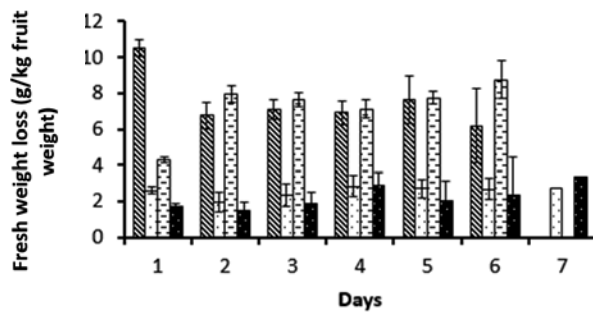


Figure 1: Fresh Weight Loss Changes During the Storage in 1-MCP Treated Unwrapped Fruits

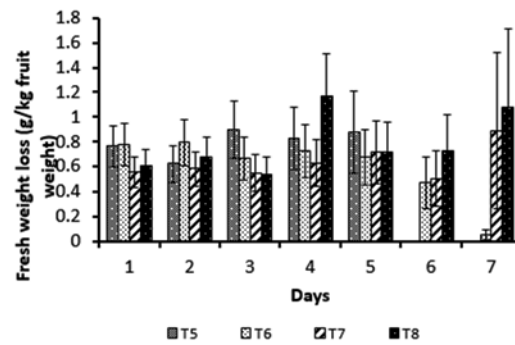


Figure 2: Fresh Weight Loss Changes During the Storage in Only Wrapping Treated Fruits

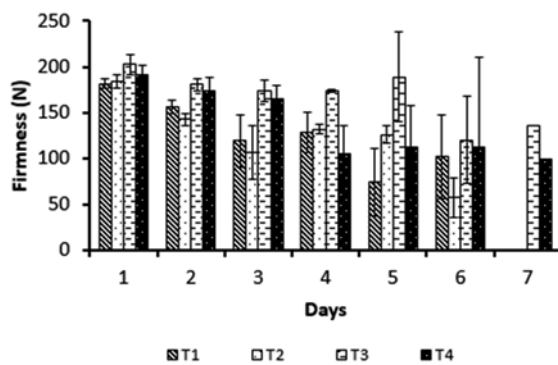


Figure 3: Firmness Value Changes During the Storage in 1-MCP Treated Unwrapped Fruits

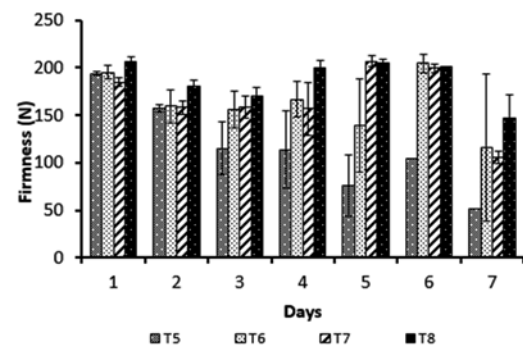


Figure 4: Firmness Value Changes During the Storage in Only Wrapped Fruits

Firmness was determined by using fruit firmness tester (FHP-803). The color of the fruit peel was determined as L\*, a\*, b\* values using a Colorimeter (CR-400). The Total Soluble Solids content of fruits was estimated using the Digital refractometer (ORD 85BM).

The Titratable Acidity (TA) was determined by the method described by Kumari *et al.* (2017). Two grams of fruit sample was weighed and crushed. The homogenate was diluted up to 100 ml with distilled water, then it was filtered, and two drops of 1 % phenolphthalein indicator was added to 10 ml of the filtered solution. Finally, it was titrated with 0.1 N NaOH solution till a pink color appeared. The TA was calculated using the following formula.

Data were subjected to statistical analysis using Analysis of variance (ANOVA) (Proc GLM) and Duncan's Multiple Range Test to compare mean values at the 5 % significance level.

## RESULTS AND DISCUSSION

### Fresh Weight Loss (g/kg Fruit Weight)

Fruit weight reduction was expressed in terms of grams per kg fruit weight during storage. There was no significant interaction ( $p \geq 0.05$ ) chemical wrapping on loss during the storage. The main effects of chemical and wrapping were significantly different ( $p < 0.05$ ). Chemical treated wrapped fruits showed the lowest fresh weight loss than the control.

The lowest fresh weight loss was revealed by wrapped fruits than the non-wrapped fruits throughout the storage period. Mean fresh weight loss values of 1-MCP treated fruits were lower than the control due to blocking the actions of the ethylene that greatly retarded the respiration rates (Benassi *et al.*, 2003). LDPE act as a gas barrier that greatly reduces gas exchange in the fruits and also modify the atmosphere around the fruit reducing the transpiration losses. Singh *et al.* (1979) reported that fruits packed in 400-gauge polyethylene at room temperature had 9 days more shelf-life than the control fruit.

### Flesh Firmness

Interaction (chemical\*wrapping) was not significantly observed on firmness during the

storage. Significant firmness ( $p < 0.05$ ) was observed among the treatments that progressively declined during the storage. Significant difference ( $p=0.0356$ ) was observed after the 2<sup>nd</sup> day of storage revealing that chemical treated fruits and wrapped fruits extend the highest firmness than the control fruits. Only chemical treated fruits had the best firmness quality during 3-5 days of the storage than the control fruits. After 5 days of the storage, significant firmness changes could not be observed in only chemically treated fruits. After 6 days of storage, a significant difference ( $p=0.0045$ ) was observed among treatments; wrapped fruits revealed the highest firmness value than the non-wrapped fruits. Major fruit softening enzymes are polygalacturonase (PG) and cellulase (endo-1.4,  $\beta$ -glucanase) which breakdown cell wall polysaccharides, resulting in soft fruit. This process can be delayed by the action of 1-MCP that blocks the ethylene receptors. That treatment showed the highest firmness quality during 3-5 days of the storage.

Mohammed and Wickham (1993), found that the firmness drop in wrapped fruits was lower than that of the non-wrapped fruits. At the beginning of the storage, there was no difference in firmness among the treatments, but with time, the wrapped fruits' firmness values were greater than the non-wrapped fruits due to the wrapping protecting the moisture level in the fruits that maintain the rigidity of the cells by turgidity.

### Peel Color Changes

L\*-value indicating the brightness (0 – Black, 100 – White), was progressively changed during the storage. After 5 days of the storage, there was a significant different ( $p=0.0113$ ). Lower brightness development was revealed by chemically treated fruits than the control. The highest brightness development was observed in non-wrapped fruits than the wrapped fruits after 6 days of the storage. The negative a\*-value indicates greenness and positive a\*-value indicates red color. There was no significant effect of chemical and wrapping on a\*-value changes in Spine gourd. The positive b\*-values indicate yellowness; that gradually increased with time due to degradation of the chlorophyll and production

of the carotenoids. After 3 days of the storage, a significant development that was yellow in color ( $p=0.0045$ ) was observed in non-wrapped fruits than in the wrapped fruits. The 1-MCP concentration had no significant effect to delay the pigment development in the Spine gourd. Similarly, there was no influence of 1-MCP on postharvest color changes in apricots (Dong *et al.*, 2002). Wrapped fruits greatly reduce the chlorophyll loss due to blocking the gas exchange, which results in a lower respiration rate and ethylene activity in the fruits.

### Total Soluble Solids (TSS)

There was no significant interaction (chemical\*wrapping) effect on TSS content during the storage. Wrapping and 1-MCP did not significantly affect TSS content during the 4 days of the storage. After 4 days of the storage, the wrapping significantly affected ( $p=0.0089$ ) TSS content in Spine gourd. Wrapped fruits showed the lowest TSS development than the non-wrapped fruits.

Pongener *et al.* (2011), found that the TSS content slowly increased in polyethylene wrapped Peach fruits than in the control under cold storage conditions. The delayed increase in TSS content in Spine gourd fruits might be due to retarded ripening and senescence processes which reduced the conversion of starch into sugars.

### Titrateable Acidity (TA)

There was no significant effect of 1-MCP and wrapping on titrateable acidity of Spine gourd.

### CONCLUSION

The fresh weight loss and peel color changes significantly declined in wrapped Spine gourd fruits and the highest firmness was observed in chemically treated and LDPE wrapped fruits than the control during the storage. Thus, it can be concluded that some postharvest qualities of Spine gourd are positively affected by 1-MCP treatment and LDPE wrapping.

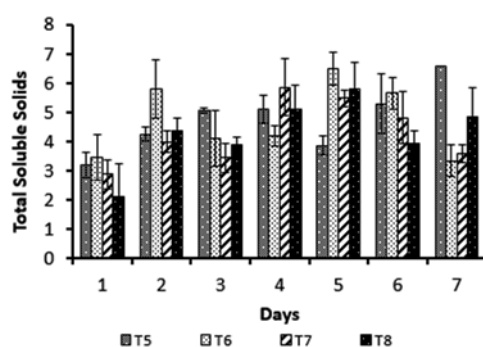


Figure 5: TSS changes during the storage in untreated wrapped fruits

Figure 5: TSS Changes During the Storage in Untreated Wrapped Fruits



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## Impact of Spacing and Type of Planting Material on Dry Matter Percentage in Cinnamon Bark: At the Stage of First Harvest

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### ABSTRACT

*Cinnamomum verum* J. Presl (cinnamon), is an evergreen aromatic plant with several uses and considered as a prominent spice throughout the world. Most familiar product of cinnamon is quills, produced by peeling and rolling the bark pieces in to a pipe like structure. Dry matter content in cinnamon bark is a determinant factor of income since weight of quills mainly depends on it. If the dry matter content in cinnamon bark can be increased, returns from cinnamon exports can be increased as well. Therefore, this study was aimed at identifying the effect of spacing and type of planting material on dry matter percentage in cinnamon bark at the stage of first harvest. Seedlings and vegetatively propagated plants of cinnamon variety Sri Gemunu were planted under three different spacings as 1.2×0.6 m with three plants per hill, 1.2×0.4 m with two plants per hill and 1.2×0.2 m with one plant per hill as two factor factorial RCBD at the Faculty of Agriculture, University of Ruhuna, Sri Lanka. First harvest was collected after two years from establishment and quills were produced with support of skilled cinnamon peelers. Weight of quills per plant was measured after air drying for three days and dry matter percentage in bark was determined by oven drying samples to a constant weight. The results revealed that the mean dry matter percentage in bark of cinnamon seedlings (37.84%) was significantly higher ( $P < 0.05$ ) than the mean dry matter percentage in bark of vegetatively propagated plants (31.69%). The mean quill weight per cinnamon seedling (45.93 g) was significantly higher ( $P < 0.05$ ) than the mean quill weight per vegetatively propagated plant (28.40 g). Interaction effect between spatial pattern and planting material was not significant for both bark dry matter percentage and weight of quills per plant. A moderate correlation between cinnamon bark dry matter percentage and quill weight was observed at the stage of first harvest ( $r = 0.429$ ,  $p = 0.036$ ) according to the Pearson's correlation test. Findings of the current study can be used for further studies.

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## INTRODUCTION

*Cinnamomum Verum* J. Presl, commonly known as cinnamon, is a world recognized spice crop belongs to the family Lauraceae. Sri Lanka contributes to about 60 – 70 % international cinnamon trade (Rajapakshe, 2011), hence the largest cinnamon exporter in the world. However, the economic returns are much lower than potential because of the low productivity of cinnamon cultivations (Samaraweera, 2011).

Unlike most of the crops, cinnamon has a unique harvestable part, the bark. The bark is peeled from the stem and produce a pipe like product by connecting several parts of those bark pieces to make a quill of standard length, which is the main primary product of cinnamon. Price of the quills is determined mainly by the weight and the quality. Therefore, factors influencing quill weight and quality should be optimized to fetch a considerably higher market price.

Dry matter percentage in the bark is a major factor affecting the quill weight because moisture content is reduced to about 10% during the process. (Dayananda *et al.*, 2003). Therefore, dry matter percentage in cinnamon bark should be enhanced in order to increase the quill weight. Hence, dry matter accumulation in the bark under different conditions should be studied to identify the optimum conditions for increasing dry matter percentage in cinnamon bark.

In perennial crops like cinnamon, dry matter accumulation in different plant parts vary with the age of the plant. To have an overall idea about the behavior of dry matter accumulation in bark throughout time, studies should be done from the stage of first harvest.

Therefore, current study was conducted to identify the influence of spacing and type of planting material on dry matter percentage in cinnamon bark at the stage of first harvest.

## MATERIALS AND METHODS

The study was conducted at the Faculty of Agriculture, University of Ruhuna, Sri Lanka. The area belongs to the low county wet zone (WL<sub>2</sub>) which receives more than 2,500 mm annual average rainfall. A flat land was selected and raised beds were prepared after initial land preparation.

Healthy seedlings and vegetatively propagated plants of cinnamon variety Sri Gemunu were established according to three special patterns as 1.2×0.6 m with three plants per hill, 1.2×0.4 m with two plants per hill and 1.2×0.2 m with one plant per hill. Four middle trees from the middle row from every treatment were used to take measurements.

All the plants were maintained according to the recommendations of the Department of Export Agriculture and after two years from the establishment, stems were harvested 10cm above ground level. The bark was peeled off with support of skilled cinnamon peelers and representative samples were taken from each harvested plant. Sample were sealed separately in polythene bags to prevent moisture loss and fresh weight was recorded as soon as possible. The samples were oven dried at 105 °C to a constant weight and dry weights were measured after cooling to room temperature in a desiccator. Following simple formula was used to calculate the dry matter percentage in bark samples.

Cinnamon quills were prepared separately for each plant by skilled peelers and weight of quills were measured after air drying for three days. Pearson's correlation test was used to determine the correlation between bark dry matter percentage and weight of quills at the stage of first harvest.

The experiment was conducted using two factor factorial (three spatial patterns and two planting material types) Randomized Complete Block Design (RCBD) with four replicates. Collected data were statistically analyzed using ANOVA and the means were separated by Duncan's Multiple Range Test (DMRT).

$$\text{Dry matter percentage in bark} = \frac{\text{Dry weight of the bark sample}}{\text{Fresh weight of the bark sample}} \times 100$$

## RESULTS AND DISCUSSION

Mutual shading is a major factor affecting the bark yield of cinnamon grown under full sunlight as a mono crop. Changes occurred in light quantity and quality due to mutual shading affect the dry matter production and distribution of the plant (Pathiratna, 2007). Hence, dry matter percentage in bark can be affected by the mutual shading. Though mutual shading can be easily changed by altering the plant density, it also can be changed by altering the pattern of plant distribution (spatial pattern) without changing the plant number.

Genetic potential can be identified as another factor affecting the dry matter percentage in cinnamon bark. Though cinnamon is largely

propagated by seeds, favorable characters can't be preserved due to the cross-pollinated nature of the plant. Hence, vegetative propagation has been introduced as a promising technique to protect the genetic potential of cinnamon plants.

The study was conducted to evaluate the impact of spatial pattern and planting material on dry matter percentage in cinnamon bark.

According to the results, the impact of interaction effect between spatial pattern and planting material was not significant ( $p < 0.05$ ) for the bark dry matter percentage of cinnamon while the type of planting material showed a significant impact ( $p < 0.05$ ) at the stage of first harvest (Figure 1).

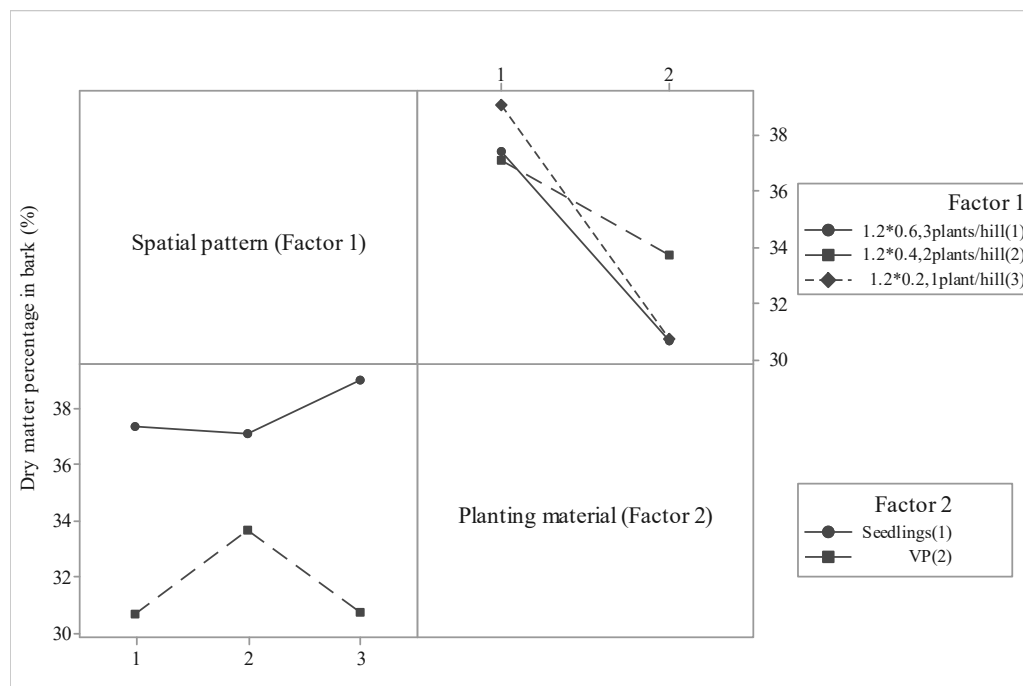


Figure 1: Interaction effect between spatial pattern and planning material for the dry matter percentage in Cinnamon Bark.

The results revealed that the mean dry matter percentage in bark of cinnamon seedlings (37.84%) was significantly higher ( $P < 0.05$ )

than the mean dry matter percentage in bark of vegetatively propagated plants (31.69%) (Figure 2).

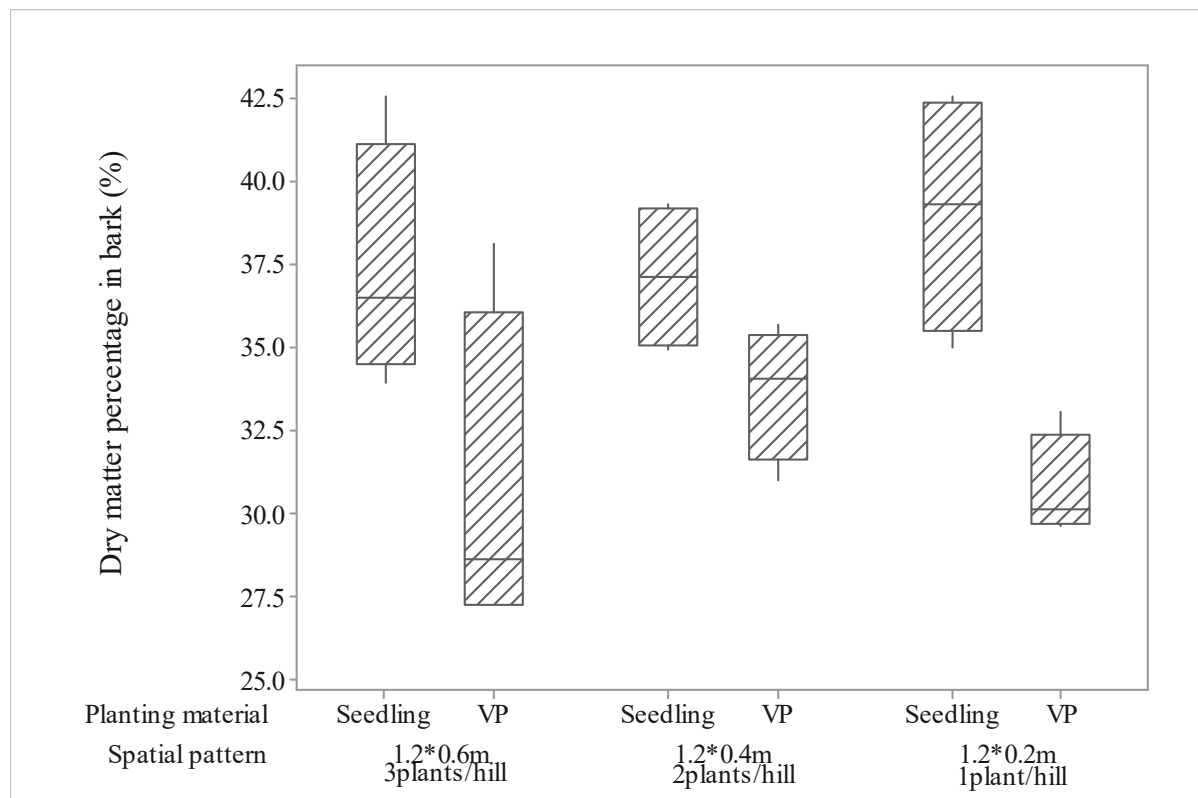


Figure 2: Dry Matter percentage of Cinnamon Bark according to Different Spatial Pattern and Planting Material Combinations.

When considering the results, though vegetatively propagated plants have a higher yield potential, seedlings tend to accumulate more dry matter content in the bark than vegetatively propagated plants at the stage of first harvest. Hence, it can be decided as vegetatively propagated plants require more time to reach the maximum potential yield than seedlings.

Dry matter percentage in bark directly influence the cinnamon yield as the main end product (cinnamon quills) been marketed after air drying which reduce the moisture level about to 10%. Therefore, the impact of spatial pattern and planting material on weight of quills produced per cinnamon plant was evaluated.

Same as the dry matter percentage, only the impact of planting material was significant for

weight of quills per plant ( $p < 0.05$ ). The mean quill weight per cinnamon seedling (45.93 g) was significantly higher than the mean quill weight per vegetatively propagated plant (28.40 g) according to the results (Figure 3).

Since both dry matter percentage and quill weight per plant were significantly higher in cinnamon seedlings while significantly lower in vegetatively propagated plants, the correlation between bark dry matter percentage and quill weight was evaluated (Figure 4). According to the Pearson's correlation test there was a moderate correlation between bark dry matter percentage and quill weight at the stage of first harvest ( $r = 0.429$ ,  $p = 0.036$ ).

Rate of dry matter accumulation in different plant parts vary with the age of the plant. Perennial crops allocate more dry matter

content to vegetative growth at early stages of life while focus on producing more reproductive organs at latter stages. When the dry matter percentage in bark vary with age, its influence

over quill weight also can be varied. Hence the correlation between bark dry matter percentage and quill weight can be varied with the time.

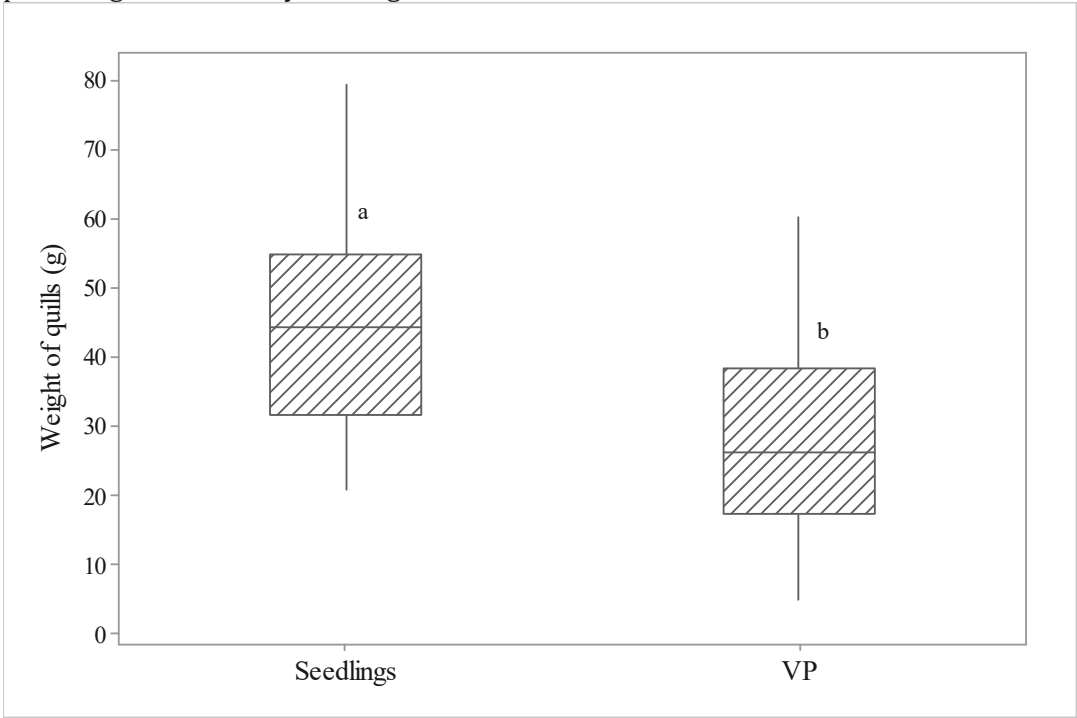


Figure 3: Impact of Planting Material on Weight of Quills per Cinnamon Plant.

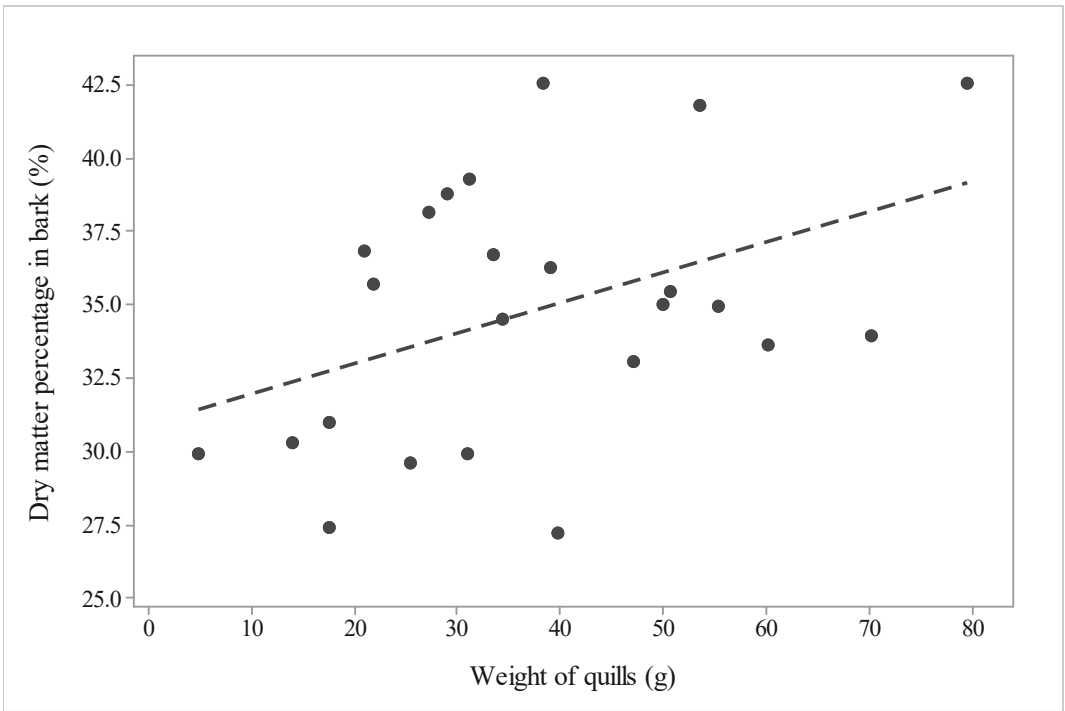


Figure 4: Correlation between Dry Matter percentage in Bark and Weight of Quills per Plant at the Stage of First Harvest.

## CONCLUSION

The results revealed that, the type of planting material has a significant impact over bark dry matter percentage of cinnamon and weight of quills per plant at the stage of first harvest. At the same time influence over quill weight from bark dry matter content at the stage of first harvest is moderate and

positive. Further studies should be conducted to find out the impact of spacing and type of planting material on dry matter percentage in cinnamon bark and influence over quill weight from bark dry matter content over time. Findings of the current study can be used for further productivity enhancement studies of cinnamon.

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## Newly Introduced Creeper Legume *Vigna marina* as a Solution for Protection of Road Cuts in Sri Lanka

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### ABSTRACT

Accelerated soil erosion and landslides are destructive degradation consequences in the central highlands, Sri Lanka. Therefore, cost-effective and sustainable slope stabilization techniques have become an urgent need to solve the problem. Properly designed vegetation covers play a significant role in erosion control. However, average plants cannot thrive on extremely degraded soils in the affected area. Therefore, the introduction of a low-demanding legume, *Vigna marina* (Burm.) Merr., as a vegetation cover was tested against soil erosion. Protection of bare road-cuts against soil erosion was the main focus of the study. The growth of *V. marina* was tested using five treatments - i.e. control (T1), subsoil (T2), decomposing parent material (T3), 20% Pinus wood biochar+subsoil (T4), and 20% Pinus wood biochar+decomposing parent material (T5). Control treatment was established as recommended by the Department of Agriculture for a similar plant (*Phaseolus vulgaris* L.). The highest growth was recorded in T1 followed by T4 and T5. The poorest growth was recorded in T2 and T3. Nitrogen (N) content of the soil has been significantly increased in T2, T3, T5 and T4 respectively whereas, a significant decline in soil N was recorded in T1. A significant decline in phosphorous (P) and potassium (K) content in the soil was common to all. The highest Nitrogen content of root nodules was in T5 and the lowest in T1. The largest number and the dry weight of root nodules were observed in T4 and T5 compared to the rest. The poorest nodule activity was recorded in T1. Therefore, *V. marina* appears to be a cost-effective sustainable slope stabilization technique for protection of road cuts.

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INTRODUCTION

Unprotected road cuts of Sri Lanka have become a serious threat to the land resource and safety of the population in those areas. One of the most important impacts of the acceleration of soil erosion is the loss of the surface soil layer which is rich in nutrients (Dharmasena, 2003). The surface soil layer has been eroded in most of the lands in the mountainous region of Sri Lanka and consequently, the subsoil layer or the decomposing parent material is exposed. These lands have been categorized under bellow class III of land suitability classification (Blanco-Canqui and Lal, 2008). Further, natural revegetation, if present, has a slow growth rate or is absent on these sites because of low soil fertility. Therefore, cost-effective remedial measures should be taken to cover the bare road cuts and steep slopes along the road network in these areas. Artificial layering with concrete and geotextile may be effective but not cost-effective and harms the natural beauty of the sensitive mountainous regions. Therefore, the introduction of natural vegetation in the form of a live mulch, using *V. marina* will be a cost-effective and sustainable solution.

*V. marina* is a densely growing perennial creeper legume. It grows well in the margin of sandy or gravelly beaches and it has a potential gene source for drought and saline soil tolerance (Lawn and Cottrell, 1988). Therefore, *V. marina* is used to stabilize coastal dunes to control sand erosion. It is a deep-rooted legume with a high rate of N fixation capacity in the sandy beaches. The ability of N fixation under such kind of stress environment is important for remediating degraded land in the world.

This study is the first attempt to test the potential of *V. marina* as a natural and cost-effective, sustainable solution for protection of road cuts in Sri Lanka.

Thus, objectives of this study were to assess the growth of *V. marina* in severely degraded lands, find out the impact of growing *V. marina* on the soil N, P and K, and find out the nitrogen fixation potential of *V. marina* root nodules in the different soil media.

MATERIALS AND METHODOLOGY

A greenhouse pot experiment was conducted by replicating (five times) five treatments (Table 1) arranged in a complete randomized design (CRD).

Table 1. Treatments of the Research

T1	Control (Department of Agriculture recommendation for the <i>Phaseolus vulgaris</i> L.) 1:1:1 ratio (top soil to sand to organic matter/cow dung) Basel dressing (Urea 5.55g, TSP 8.34g, MOP 4.39g) Top dressing (Urea 3.36g)
T2	Subsoil
T3	Decomposing Parent Material
T4	Subsoil + 20% Pinus Wood Biochar
T5	Decomposing Parent Material + 20% Pinus Wood Biochar

Preparation of *V. marina* Seeds for Planting

*V. marina* seeds were collected from the beach side of Kahawa, Sri Lanka. Scarification method was followed to stimulate the germination. Seeds were scarified using a sandpaper and they were

soaked in water overnight. Afterwards, the seeds were taken out and wrapped with moist tissue paper. A weight (700g wood plank) was kept (two days) on the wrapped seeds. A germinated seed was introduced to the prepared bags (bag size-8 inch x 10 inch).



The experimental duration of seeds was two months. N, P and K content and pH and EC of soil were recorded at the beginning and the end.

Total N content (N%) of soil samples and root nodules of *V. marina* (Dry basis) were analyzed by the Kjeldahl method. Dry weight of the above ground biomass, number of leaves, number of leaflets, number of shoots, dry weight of the root nodules, number of root nodules and N content of root nodules per plant were recorded at the end.

## RESULTS AND DISCUSSION

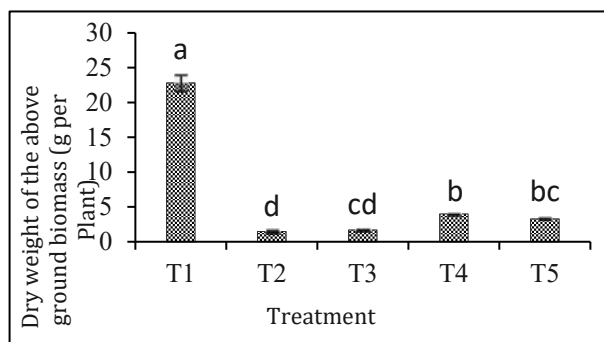


Figure 1. Dry Weight of the Above-Ground Biomass

Dry weight of the above ground bio mass (Figure 1), number of leaves, number leaflets and number of shoots per plant showed similar behavior in different treatments.

T1 was treated with the fertilizer recommendation of the Department of Agriculture for the common bean (*Phaseolus vulgaris* L.). It means, T1 was fed with the most demanding plant nutrients - i.e. N, P and K through Urea, Triple Super Phosphate (TSP) and Murate of Potash (MOP) respectively. Urea is the most common source of N. N is the most demanding major essential nutrient for crop growth. Therefore, urea significantly increases the yield/biomass by increasing the mean value of growth parameters.

The best performance of T1 was supported by an ample supply of plant nutrients by

Plant available P ( $P_2O_5\%$ ) of soil samples were analyzed using the Olsen method.

Exchangeable K ( $K_2O\%$ ) of soil samples were analyzed by the flame photometric method. Soil pH and soil EC were measured using pH and EC meter respectively.

All data were statistically analyzed using Statistical Analytical Software (SAS) 9.0 version. Duncan's Multiple Range Test (DMRT) was used to determine the significance of the treatment effects at  $p \leq 0.05$  level.

Dry weight of the above ground biomass was recorded at the end of the research (two months old creeper). The T1 (22.82g) has recorded the highest dry weight. The lower dry weights were recorded in T2 (1.47g) and T3 (1.70g) but they are not significantly different.

fertilizer application. *V. marina* has also performed well under extremely low fertility status - e.g. decomposing parent material (T3) with undetectable nitrogen content and subsoil (T2).

Subsoil treated with 20% Pinus wood biochar (T4) and decomposing parent material treated with 20% Pinus wood biochar (T5), the final pH values were recorded as 7.08 and 7.40 respectively. But the beginning pH values were recorded in T4 and T5 as 5.01 and 6.2 respectively. Therefore, neutral range pH values (finally recorded pH values) of T4 and T5 help to increase the availability of plant nutrients, create favorable conditions for the Rhizobium bacteria and increase nitrogen fixation by nodulation. Also, biochar increases the cation exchange capacity, moisture-holding capacity, and drainage by increasing the pore volume of the soil substrate. Finally, biochar increases soil fertility and increases the biomass of the plant.

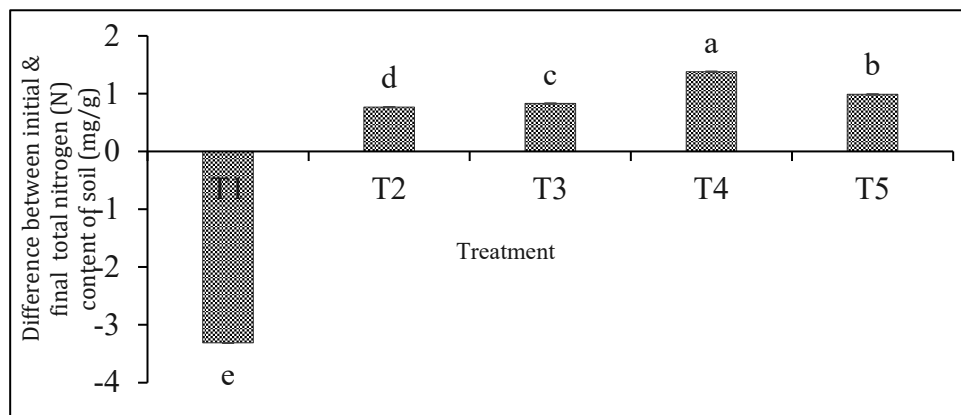


Figure 2. Difference between Final & Initial Total Nitrogen Content in Different Treatments

### Soil Nutrient Contents in Different Treatments

T1 (-3.314mg/g) has recorded a negative value and T1 shows decrement of total N content of soil. Other treatments have recorded positive values and they show increment of total N content of soil. The highest increment of the total N content of soil was recorded in T4 (1.38mg/g) whereas, the lowest increment of the total N content of the soil was recorded in T2 (0.768mg/g), and the second highest increment of the total N content of the soil was recorded in T5 (0.988mg/g).

T1 was fed with fertilizer recommendation by the Department of Agriculture. This could be the reason for comparatively lower total N content of the soil at the end when compared to the initial amount. Synthetic fertilizers could harm the microbial activities of the soil (Gunapala and Scow, 1998). Also, synthetic fertilizers are highly water- soluble and quickly leachable even within one watering after application. So, T1 has recorded a decline in total N content of the soil. High N levels in T4 and T5 treatments at the end of the growing period could be due to nitrogen fixation by symbiotic *Rhizobium* species. Further,

biochar provides a favorable environment for soil microbes.

Reduction of available P (figure 3) and K contents during the growing period showed similar behavior in different treatments.

Legumes need more P as it is required for energy transformation in root nodules (Kabir et al., 2013). K is required to maintain plant health, synthesis of protein and starch and enhancing photo synthesis. Potassium is especially important for maintaining nitrogenase activity per unit root weight and per unit nodule weight of legumes (Høgh-Jensen, 2003). Therefore, every treatment has used P and K for their needs and significantly reduced the initial P and K content at the end.

### Root Nodules Formation

The T4 (79.04mg) and T5 (71.1mg) have recorded the highest dry weights of root nodules. The lowest dry weight was recorded in the T1 (9.28mg). The T3 (46.22mg) has recorded the second-highest reading of the dry weight. The T2 (26.58mg) has recorded the third highest in the dry weight.

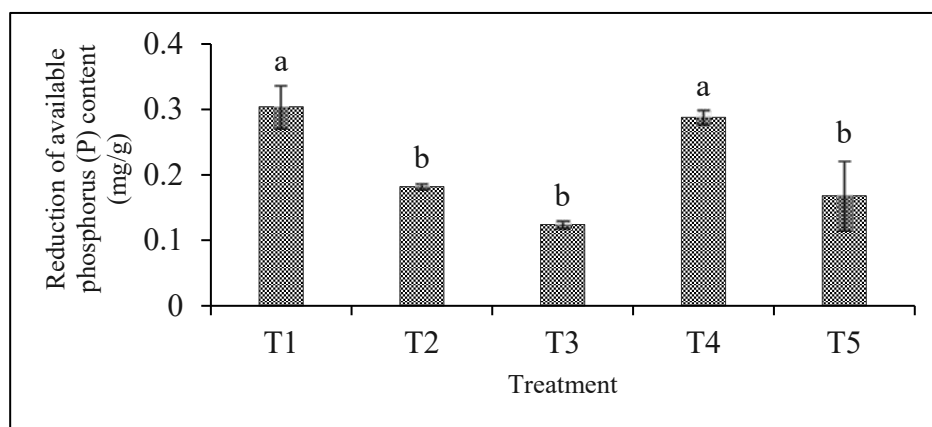


Figure 3. Difference between Initial and Final Available Phosphorous Content in Different Treatments

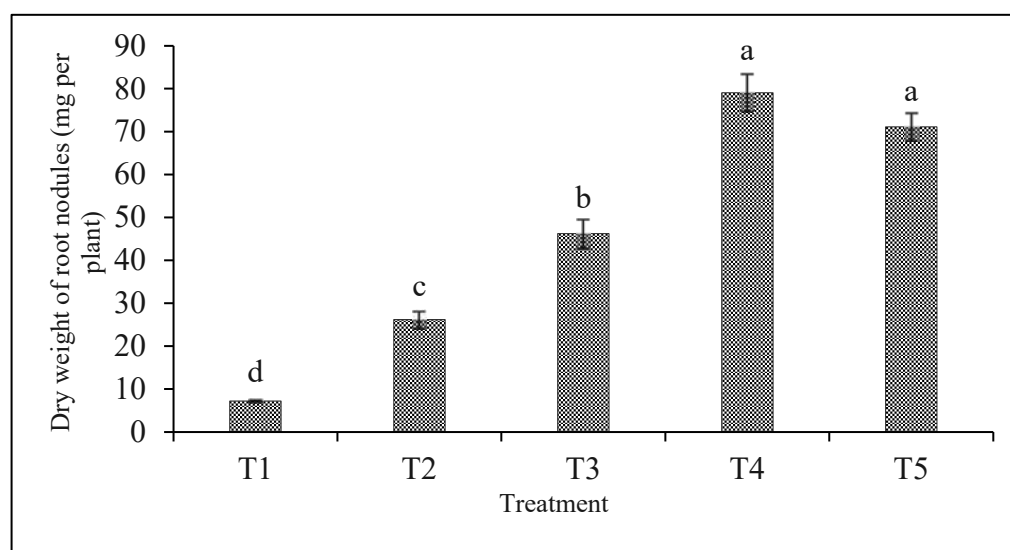


Figure 4. Dry Weight of Root Nodules in Different Treatment

Dry weight of root nodules (figure 4), number of root nodules and total nitrogen content of root nodules showed similar behavior in different treatments.

Root nodule production and nitrogen fixation of legumes mainly depend on symbiotic *Rhizobium* bacteria. But, soil acidity (low pH) adversely influence on *Rhizobium* growth, survival, abundance, and nodulation. Also, increasing  $H^+$  concentration and increasing the solubility of the toxic metal ions such as  $Al^{3+}$ ,  $Cu^{2+}$ , and  $Mn^{2+}$  retard nodulation. These are the

primary causes of inter-cellular pH instability leading to growth inhibition of *Rhizobium* bacteria in low pH soils. T2 has recorded initial pH as acidic pH (4.96) and after synthetic fertilizer (Urea, TSP, MOP) feeding, T1 has recorded acidic pH (5.12) by increasing  $H^+$  concentration of the soil. Not only acidic pH, synthetic fertilizer is toxic to most of the symbiotic bacteria (Ferguson et al., 2013). Therefore, T1 and T2 have recorded the lowest dry weight root nodules. T3 has recorded average values because it has recorded a neutral pH value (6.23).

The highest values of root nodule dry weight and the number of root nodules were recorded in T4 (20% Pinus biochar treated subsoil) and T5 (20% Pinus biochar treated decomposing parent material). After treating with 20% Pinus wood biochar, the final pH was recorded as 7.08 in T4 and 7.4 in T5. These pH values have been included under the neutral range (6.5-7.5), because biochar is a liming agent and increases the pH. Then it makes favorable conditions for the Rhizobium bacteria and helps to increase nodulation. Also, biochar provides houses for microbes and absorb toxic materials from a substrate (Schulz and Glaser, 2012). So, this miracle agent – i.e. Pinus wood biochar increases the nodulation. Therefore, T4 and T5 have recorded the highest dry weight and total nitrogen content of root nodules.

## CONCLUSION

*V. marina* has a potential to establish itself well under extremely degraded soil

conditions i.e.–subsoil and decomposing parent material. Biochar conditioning of severely degraded soil/substrate such as subsoil and decomposing parent material result in a significant increase in the growth of *V.marina* and soil nitrogen. Introduction of *V.marina* reduces soil phosphorus and potassium. Poor fertility status of the soil appears to favor the nitrogen fixation of *V.marina*. The *V.marina* appears to be highly effective as a cover crop in degraded soil and thus it can be used in controlling soil erosion on road cuts & any other exposed areas of land resource.

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## Phenotypic Plasticity Index as a Tool to Assess the Suitability of Three Coleus (*Plectranthusscutellarioides* (L.) R.Br.) Varieties in Low-Maintenance Landscaping

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### ABSTRACT

People often demand low-maintenance landscape designs. Ability of plants to survive and adapt to different ecological breadths while maintaining the aesthetic appeal is associated with the low-maintenance. Selecting plants for low-maintenance landscape designs is a difficult task. Without a proper objective tool to support decision making, selection is often made based on prior experience or trial-and-error basis, which involves a greater degree of subjectivity. Phenotypic Plasticity Index (PPI) is a relatively new tool to support in selecting plants to be grown under an environmental gradient continuum. In this study, PPI of 10 morphological and physiological traits of three varieties of *Plectranthusscutellarioides* (L.) R.Br. (Coleus), grown under a light gradient continuum, were calculated using minimum and maximum least square means of the trait. They were also grouped into three categories as high, moderate and low phenotypic plasticity, based on calculated PPI values. The highest plasticity was shown by the parameters related to photosynthesis such as chlorophyll and anthocyanin concentrations while the number of branches, plant height and number of leaves remained in moderate plastic category implying that the species did not try to alter its morphology drastically. These plasticity indexes indicate that all three varieties rely much on shade tolerance over shade avoidance. Furthermore, low plasticity of parameters which explains the plant architecture (height, branching, number of leaves) expresses that the effect of shade is minimum to the aesthetic qualities of three varieties of Coleus suggesting them as potential candidates for low-maintenance landscaping.

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## INTRODUCTION

Low maintenance landscaping is a popular but challenging concept in modern day landscaping. Plants employed in such projects must be capable of surviving under changing environmental conditions such as different moisture regimes, shade levels, and temperatures with no or minimum effect to their aesthetic appearance (Wickramaratne & Beneragama, 2011). Predictability of plants' suitability for a given environmental condition with a strong scientific justification will take landscaping one step ahead rather than selecting plants using the trial-and-error method. The Phenotypic Plasticity Index (PPI) is a relatively new tool to support in selecting plants to be grown under an environmental gradient continuum.

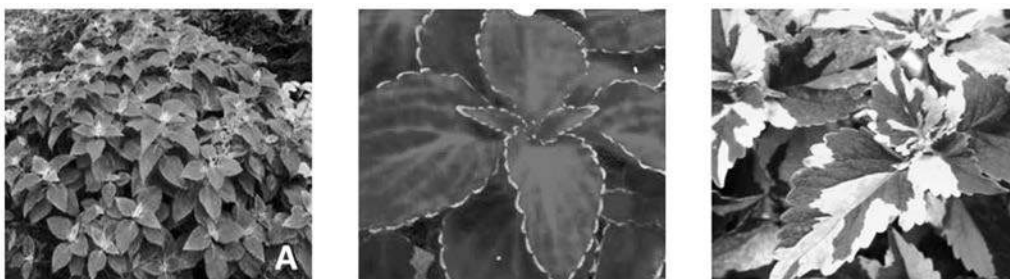
The Phenotypic Plasticity Index is defined as the ability of a given genotype to produce different phenotypes under varying environmental conditions (Fusco & Minelli, 2010). Unlike the genetic variations, PP permits the plant species to adapt to the rapid changes in the environment which is an important functional trait to have in a plant that is used in landscaping (Puglielli *et al.*, 2017). There are many methods to calculate PPI and each method possesses its own strength and weaknesses (Valladares *et al.*, 2006). However, correctly calculated PPI

can be used as an important tool to choose the right plants for a given purpose (Valladares *et al.*, 2007).

The present study was conducted to assess the PP of three *coleus* varieties in response to changing shade conditions. The assessment was done based on the PPI values of 10 different morphological and physiological traits.

## MATERIALS AND METHODS

The experiment was conducted at the Royal Botanical Garden, Peradeniya (WM<sub>3</sub>). Mean and maximum temperatures recorded at the location during the experiment were 23.3°C and 33°C respectively. Laboratory analysis was conducted in the Department of Crop Science, Faculty of Agriculture, and University of Peradeniya. Three varieties of *Plectranthusscutellarioides* (*Coleus*) that are commonly being used in landscaping, were selected for this experiment, namely, 'Alabama sunset', 'Velvet red' and 'Finger paint' (Plate 1). Uniformly rooted, two-weeks old cuttings were planted in black polybags. The bags were filled with a potting medium composed of loam soil, compost, cattle manure, and sand in the ratio of 4:2:1:1 (v/v). A light gradient continuum was simulated using black polypropylene shade nets to have 0, 40, 50 and 70% shade levels.



**Figure 1:** Three different *Plectranthusscutellarioides* varieties used in the study  
A) 'Alabama Sunset' B) 'Velvet Red' C) var. 'Finger paint'

## MEASUREMENTS

Direct morphological parameters related to growth and development such as leaf length, leaf width, leaf area (AM350 portable leaf area meter), and plant height were measured at 15, 30, 45 and 60 days after the exposure to different light levels. At the same points of measurement, the number of branches and number of leaves were counted. Leaf dry weight was obtained at the 45 and 60 days after the exposure to different treatments. Based on that, specific leaf area was calculated. Chlorophyll content and monomeric anthocyanin content in leaves were spectrophotometrically

determined according to Lichtenthaler (1987) and Silva *et al.* (2017) respectively. The experiment was carried out as a 2-factor factorial Completely Randomized Design. Each treatment was triplicated with 30 experimental units (plants) per each replicate.

### Calculation of Phenotypic Plastic Index (PPI<sub>LSM</sub>)

Phenotypic plasticity for each plant parameter was calculated using the Phenotypic Plasticity Index (PPI), based on the maximum and minimum least square means (Valladares *et al.*, 2007).

$$PPI = \frac{\text{Maximum least square mean} - \text{Minimum least square mean}}{\text{Maximum least square mean}}$$

Measured plant functional traits were categorized into three categories based on PPI value as highly plastic (1.00-0.60), moderately plastic (0.59-0.30), and least plastic (0.29-0.00).

## RESULTS AND DISCUSSION

Valladares *et al.*, (2006) comprehensively summarizes different PPI calculation methods together with their strengths, weaknesses and applications. In this study, the PPI was calculated using the least square mean values where this method of calculating the PPI can be used when some covariate is expected to influence the target variable or trait. Below mentioned are the accordingly calculated PPI values for 10 plant functional traits that were considered in this study.

In all three varieties of *Plectranthus scutellarioides* (L.) R.Br, both morphological and physiological traits related to the photosynthesis have shown high to moderate plasticity to the changing shade levels (Tables 1-3). The results indicate a direct influence of shade on

photosynthetic pigments. Anthocyanin content showed the highest PPI in all three Coleus varieties while chlorophyll content showed high PPI in the variety 'Finger paint' and moderate PPI in the other two coleus varieties. These observations can be explained using regulatory mechanisms of photosynthesis. In low shade conditions, the rate of photon interception could be greater than that of the photochemical reactions. This triggers photo inhibition mechanisms of the plant which generate reactive oxygen species (ROS). Long term exposure to high light intensities could be detrimental for plants due to the aforementioned reason. To prevent this from happening, plants synthesize anthocyanins which are capable of scavenging ROS under excess light conditions (Osakabe & Osakabe, 2012; Trojak & Skowron, 2017).

In contrast, when plants are grown in a shady condition, their main priority becomes capturing as much photons as possible, and directing that energy to chlorophylls which act as photochemical reaction centers (Garland *et al.*, 2010). This is the reason for plants to increase its green

colour and change the variegation pattern of leaf in shady conditions. Both these mechanisms can be considered as shade tolerance mechanisms against the stress caused by different light levels. (Singhal, 2017; Wang *et al.*, 2019). In the present study, leaf morphological characters such as leaf length, width and area also showed high to moderate plasticity in different shade levels. Plasticity of leaf morphological characters permits the plants to increase photosynthetic efficiency by changing the light intercepting area under different shade conditions. All these mechanisms lead the plants to maintain their photosynthetic rates without much of a change which is also

proven by the low PPI of specific leaf area and leaf dry mass.

Plant height, the number of branches and the number of leaves of a plant can be considered as functional traits which enable plants to avoid stress caused by extreme light intensities and also to determine the plant architecture and its aesthetic qualities. The PPI values of the aforesaid traits were recorded among the least values in all three varieties in the present study. Thus, it appears that the plant architecture of *Plectranthusscutellarioides* remains unchanged or maintains with minimum changes under different shade levels.

Table 1: Calculated Phenotypic Plasticity Index (PPI) for measured parameters of *Plectranthusscutellarioides* (L.) R.Br. var. 'Alabama Sunset' plants under 0% to 70% shade range

Measured Parameter	Maximum	Minimum	PPI	PP Category
Anthocyanin content (mg/g)	13.99	4.80	0.66	High
Chlorophyll content (mg/g)	3.72	1.34	0.64	High
Leaf area (cm <sup>2</sup> )	10.81	4.78	0.56	Moderate
Specific leaf area (cm <sup>2</sup> g <sup>-1</sup> )	121.00	62.00	0.49	Moderate
Leaf width (mm)	105.81	101.72	0.33	Moderate
Leaf length (mm)	147.48	101.72	0.31	Moderate
Number of branches	10.00	7.00	0.30	Moderate
Plant height (cm)	45.83	35.43	0.23	Low
Number of leaves	58.00	49.83	0.14	Low
Leaf dry weight (g)	0.10	0.09	0.09	Low

Table 2: Calculated Phenotypic Plasticity indices (PPI) for measured parameters of *Plectranthusscutellarioides* (L.) R.Br. var. 'Velvet red' plants under 0% to 70% shade range

Measured Parameter	Maximum	Minimum v	PPI	PP category
Anthocyanin content (mg/g)	40.28	14.40	0.64	High
Chlorophyll content (mg/g)	14.11	6.61	0.53	Moderate
Leaf area (cm <sup>2</sup> )	2.95	1.46	0.51	Moderate
Specific leaf area (cm <sup>2</sup> g <sup>-1</sup> )	120.00	72.00	0.40	Moderate
Leaf width (mm)	122.36	203.20	0.37	Moderate
Leaf length (mm)	7.00	5.00	0.29	Low
Number of branches	154.33	203.20	0.24	Low
Plant height (cm)	0.12	0.09	0.21	Low
Number of leaves	44.00	37.33	0.15	Low
Leaf dry weight (g)	46.83	40.16	0.14	Low



Table 3: Calculated Phenotypic Plasticity indices (PPI) for measured parameters of *Plectranthusscutellarioides* (L.) R.Br. var. 'Finger Paint' plants under 0% to 70% shade range

Measured Parameter	Maximum	Minimum	PPI	PP category
Anthocyanin content (mg/g)	12.11	2.30	0.81	High
Chlorophyll content (mg/g)	14.14	4.81	0.66	High
Leaf area (cm <sup>2</sup> )	3.89	1.62	0.58	Moderate
Specific leaf area (cm <sup>2</sup> g <sup>-1</sup> )	140	63.00	0.55	Moderate
Leaf width (mm)	119.34	110.62	0.37	Moderate
Leaf length (mm)	161.18	110.62	0.31	Moderate
Number of branches	0.10	0.08	0.25	Low
Plant height (cm)	9.00	7.00	0.22	Low
Number of leaves	51.00	39.83	0.22	Low
Leaf dry weight (g)	57.50	45.00	0.22	Low

Furthermore, it is apparent that all three coleus varieties do not rely on shade avoidance as an adaptive mechanism. Shade avoidance is considered as a primitive evolutionary mechanism comparative to shade tolerance mechanisms like changes in pigments (Touchette *et al.*, 2009).

Even though the leaf anthocyanin content changed drastically depending on the light environment, the external appearance of the leaf did not change considerably, maintaining the aesthetic appeal of the plant under all light levels tested in the present study. This was evident by the image analysis performed to investigate the leaf colouration (data not shown). Offering effective protection to leaves without significantly compromising photosynthesis

under full-sun conditions is well known (Neill & Gould, 2003). However, the ecological advantage of retaining the anthocyanins even under low light levels as low as 30% in these plants is not clear.

Of all, variety 'velvet red' showed the least plasticity in all the characters except for leaf width and dry weight (Table 4). Variety 'finger paint' resulted in the highest plasticity values for most of the traits while the rest of the parameters were dominated by 'Alabama sunset'. This implies that the varieties 'Finger paint' and 'Alabama sunset' can be recommended for low-maintenance landscaping with a wider ecological breadth in terms of light/shade. Although the variety 'Velvet red' displayed the least PPIs, it does not necessarily reflect its unsuitability for such landscapes.

Table 4: Comparison of highest and lowest PPI recorded for functional traits of 3 varieties

Measured Parameter	Least PPI in variety	Maximum PPI in Variety
Anthocyanin content	Velvet red	Finger paint
Leaf area	Velvet red	Finger paint
Chlorophyll content	Velvet red	Alabama sunset
Specific leaf area	Velvet red	Finger paint
Leaf width	Alabama sunset	Velvet red / Finger Paint
Leaf length	Velvet red	Alabama sunset/Finger paint
Leaf dry weight	Alabama sunset	Finger paint
Number of branches	Velvet red	Alabama sunset
Plant height	Velvet red	Alabama sunset
Number of leaves	Alabama sunset/Velvet red	Finger paint

## CONCLUSION

Based on the PPI of 10 plant characteristics, it is obvious that *Coleus*, in general, shows considerable plasticity under different shade conditions without causing much of a change in plant architecture. *Coleus* also shows the

capability to regulate photosynthesis under given shade making them suitable to be utilized in low maintenance landscaping. Furthermore, the var. 'Finger Paint' which resulted in the highest PPI values in most traits may perform better in different light levels compared to the other two varieties tested.

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## Multilocal Evaluation of Growth and Antioxidant Content of Curly Kale (*Brassica oleracea* L. var *acephala*) and Chinese Kale (*Brassica oleracea* var. *alboglabra*) in Sri Lanka

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### ABSTRACT

Curly Kale (*Brassica oleracea* var. *acephala*) and Chinese Kale (*Brassica oleracea* var. *alboglabra*) are cruciferous vegetables, which have recently gained great popularity in the world as a 'super-food'. Generally, Kale has the capacity to tolerate diverse climatic conditions while demanding fewer inputs, thus making it possible to cultivate with a minimum cost for crop management. However, Kale is still not popular in Sri Lanka as a vegetable. Therefore, it has not been a commercialized crop to date. This study was conducted to explore the potential of cultivating Kale in Sri Lanka. Two cultivars of curly Kale ('Dwarf green curled' and 'Winterbor F1') and Chinese kale were cultivated in three agro-climatic zones representing three main climatic zones in the country, namely the Mid-Country Wet Zone, Mid country Intermediate Zone and Low-Country Dry Zone, using three different media (M<sub>1</sub>: Existing soil in each location; M<sub>2</sub>: Sand and coir dust mixture – ratio 1:1; M<sub>3</sub>: Sand, coir dust, and soil - ratio 1:1:1) at each location. The experiment was carried out as a three-factor factorial with three replicates as a pot experiment. Based on the results of the present study, even though all the varieties displayed a significantly ( $p < 0.05$ ) higher growth in terms of dry matter accumulation in the Wet Zone, the growth in the other two locations were also found to be satisfactory. Within each location, dry matter accumulation was not significantly ( $p > 0.05$ ) different among the varieties. Different media did not have a significant influence on growth. Even though the antioxidant contents in all varieties varied among locations, the values were within the acceptable range. Therefore, both Curly kale and Chinese kale can be successfully grown in the tested locations in Sri Lanka and can be easily introduced to local consumers as a 'super-food'.

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## INTRODUCTION

Patterns of food intake play an essential role in the maintenance of the health and well-being of people. Half of the global requirement for protein and carbohydrates are provided primarily by three crops; rice, maize, and wheat (Jaenicke & Hoschle-Zeledon, 2006), resulting in diets that contain inadequate nutrients leading to obesity and malnutrition. However, the vegetable-rich diet is considered as a good source of nutrients for a healthy life reducing many health risks. Especially, vegetables play a remarkable role in human nutrition and health since they contain dietary fiber, phyto chemicals, vitamins, and minerals (Dias, 2013).

Curly Kale (*Brassica oleracea* var. *acephala*) and Chinese Kale (*Brassica oleracea* var. *alboglabra*) are leafy vegetables that belong to the family Brassica ceae. They are an excellent source of nutrients, and other health-promoting phyto-chemicals such as glucosinolates, polyphenols, and carotenoids, which are important for antioxidant activity (Samec, *et al*; 2019). In addition, they are easily grown vegetables, thus widely accepted as a 'super-food'. Kale is an annual or biannual plant with the continuous growth of stems and leaves, which is mostly propagated by seeds. Among many types of Kale in the world, Curly kale, and Chinese Kale are predominantly popular. Leaves can be harvested four to six weeks after transplanting under optimum conditions and they are normally consumed in a fresh form as salads and leaf juice, and also in cooked form as soup and added to other meals as components of the decoration (Hahn, *et al*, 2016).

Kale is one of the most demanding vegetables in some countries, and can be

easily grown in Sri Lanka. Nevertheless, it still lacks popularity among people in the country. It can be grown in a wide range of soils with a minimum cost for crop management. Further, it is tolerant to unfavorable climate conditions (Samec, *et al*; 2018). However, it has not been a commercialized crop in Sri Lanka to date. Fully grown immature leaves are suitable for consumption that makes several times harvesting possible. Especially, at the home garden level, few plants are good enough for family consumption. It is healthier to add this vegetable as a part of the diet at least 2-3 times a week because of its health benefits, and as a change for the common vegetables that we eat on a daily basis.

Despite its enormous values, still, it is a less-priority crop among the Sri Lankan farmers and it is grown as a mixed crop only in very limited extents in some areas belonging to the Up-Country Wet Zone. The reason could be scarce information about the growing conditions, management practices, and health benefits. Therefore, the present experiment was conducted to investigate the possibilities of growing Kale in multiple locations in Sri Lanka.

## MATERIALS AND METHODS

The study was carried out in three locations representing three main climatic zones in Sri Lanka as shown in Table 1. Three different varieties, V1- Chinese kale (*Brassica oleracea* var. *alboglabra*), V2- Dwarf green curled, and V3- Winterbor F1 (V2 and V3 are cultivars of curly kale) were tested in three different media (M1: Existing soil in each location; M2: Sand and coir dust mixture – ratio 1:1; M3: Sand, coir dust, and soil - ratio 1:1:1). The experiment was carried out as a three-factor factorial with three replicates.

Table 1: Site Characteristics of Experimental Locations During the Experimental Period

Experimental Location	Agroecological Zone	Temperature Range (C°)	Annual Rainfall (mm)	(RH) %	Soil Type of an Area
Dodangolla Experimental station	Intermediate zone (IZ) (Mid country) IM3	20.5 - 29	900 -1150	70-85	Reddish Brown Latasolic
Mahailuppallama sub campus*	Dry zone (DZ) (Low country) DL1	23 - 41	1000-1500	70-85	Reddish Brown Earth
Agricultural Bio Technology Center (Peradeniya)*	Wet zone (WZ) (Mid country) WM2	20 - 36	2132	55-90	Red Yellow Podzolic

\*Under semi-open greenhouse conditions

A nursery was established using the standard nursery medium (sand: coir dust - 1:1 ratio). After seedlings reached the three or four leaves stage, healthy, vigorous, uniform seedlings were transplanted in poly bags (35cm diameter, black). Recommended fungicides and insecticides were applied when necessary. All plants were watered based on moisture depletion, and fertilizer application was done according to the recommendation for cabbage (DOA, 2019). Harvesting of the plants in three locations was done after six weeks of transplanting.

Measurements were made from the third week after transplanting to harvesting at bi-weekly intervals. Plant dry weight was measured in shoots and roots separately (Model 18 and Gallenkamp OMT) at 72 °C for 48 hours. Chlorophyll content was spectrophotometrically determined according to Lichtenthaler (1987). Ascorbic acid content was determined with the specifictitrant 2, 6 Dichlorophenolindo-phenol according to Hahn, et al. (2016). Leaf antioxidant content, in the form of radical scavenging activity, was measured by DDPH assay according to Blois (1958) with minor modifications. In addition, a detailed soil analysis was conducted for each medium at each location before and after cultivation. The data were statistically analyzed with

SAS software (SAS Institute, Cary, NC) and Duncan's multiple range test at the  $p < 0.05$  level of significance.

## RESULTS AND DISCUSSION

The results of the soil analysis revealed that total Nitrogen, available Phosphorus, exchangeable Potassium, electrical conductivity (EC), soil pH, and Cation Exchange Capacity (CEC) of the media in three locations were within the levels favorable for crop cultivation (data not shown).

Although the zones were identified at agro-ecological region level as WM<sub>2</sub>, IM<sub>3</sub> and DL<sub>1</sub> (see Table 1), hereafter those regions will be referred to as WZ, IZ and DZ for clarity. As shown in Figure 1, the Wet Zone (WZ) and Intermediate Zone (IZ) recorded significantly higher growth than that of the Dry Zone (DZ). Considering the dry weight of shoots, there was no significant ( $p > 0.05$ ) difference between varieties in these two zones. However, plants grown in media 2 and 3 in the WZ have shown their maximum growth, whereas in the IZ, the best growth was observed in the medium 1. A significant ( $p < 0.05$ ) difference between varieties was noted in the DZ. Of all, variety 3 has recorded the highest growth in the media 2 and 3.



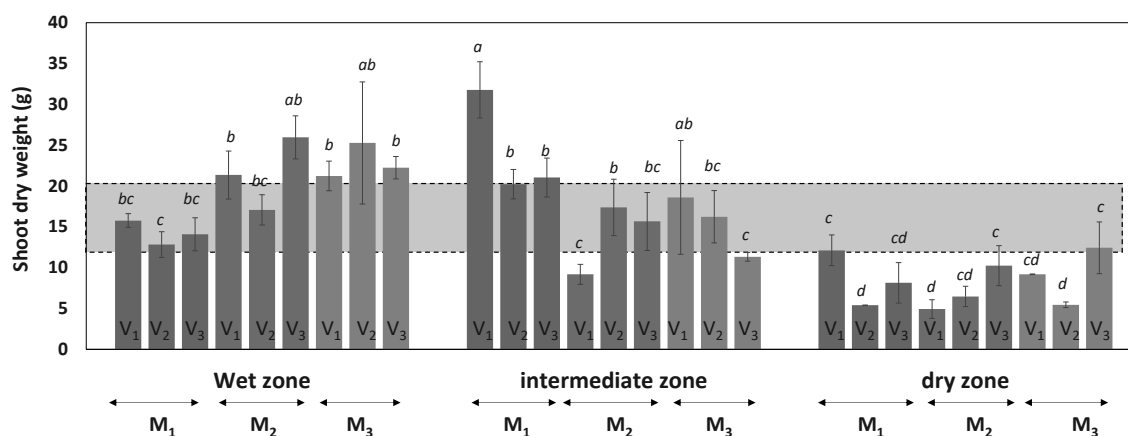


Figure 1: Shoot dry matter accumulation in Chinese Kale (V1), Dwarf green curled Kale (V2) and Winterbor F<sub>1</sub> curly Kale (V3) grown in existing soil in-site (M1), sand: coir dust (M2) and soil: sand: coir dust (M3) at all three locations (WM<sub>2</sub>, IM<sub>3</sub> and DL<sub>1</sub> as depicted by Wet zone, Intermediate zone and Dry zone respectively). Means±SEM are shown (n=5). Means with the same letter on the bars within the experiment are not significantly different ( $p < 0.05$ ). The gray horizontal box in the background represents the range of shoot dry weight reported in previous studies (author compilation).

Each plant species has an optimum temperature range for its maximum growth rate, and biomass accumulation in the shoot (fresh mass) is generally known to be influenced significantly by the temperature variance (Berry and Bjorkman, 1980). If the temperature increases beyond the optimum level, the crop yield losses also accelerate (Hatfield and Prueger 2015; Lefsrudet *al*; 2015). Results of the present study in the WZ and IZ are comparable to the results of previous studies. Comparatively, several degrees (C°) higher temperatures in the DZ may not be the optimum range for maximum growth of Kale.

The leaf chlorophyll content is an index of the photosynthetic potential and productivity of the plant. In addition, chlorophyll gives an indirect estimation of the health status of the plant (Filella *et al*, 1995). In the present study, leaf chlorophyll content (Figure 2) in the WZ and DZ was reported to be higher compared to that of the IZ ( $p < 0.05$ ). All three varieties grown in the DZ have performed well, having a higher amount of chlorophylls in all media. Further, the varieties grown in the IZ have significant differences among the three media ( $p < 0.05$ ). Within each location, Medium 1 (M1) resulted in the highest chlorophyll content. This may be because of the high amount of N, P, K levels present in the existing soil which has a direct relationship on the amount of chlorophyll in leaves as explained by Zhang *et al* (2017).

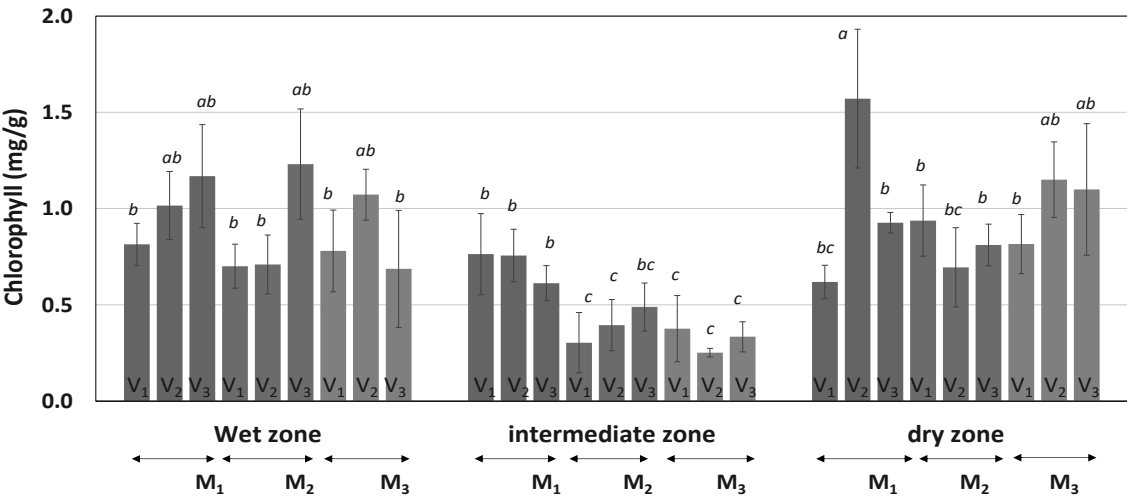


Figure 2: Changes of leaf Chlorophyll content in Kale in three locations (see Figure 1 for details). Means with the same letter on the bars within the experiment are not significantly different ( $p<0.05$ )

Ascorbic acid (AsA) level is an important quality parameter in Kale crop (Fiutak and Michalczyk, 2020). According to Sikora and Bodziarczyk (2012), average Ascorbic acid content in Kale is 62.3 mg/100 g. Results of the present experiment revealed that, AsA content in the WZ was significantly ( $p<0.05$ ) higher than that of the IZ and DZ (Figure 3). Within the IZ and DZ, media had a significant effect ( $p<0.05$ ) on the AsA content. The highest AsA content was recorded in variety 3, irrespective of the

location. According to Lee and Kader (2000), AsA content in horticultural crops can be influenced by many factors such as pre-harvest climatic factors, genotypic differences, and cultural practices. The reduction in the AsA content in the DZ could be because of the lower light intensities experienced during the experimental period due to the cloud cover. Fiutak and Michalczyk (2020) have demonstrated that a higher light intensity during the cropping period increases the content of AsA in plant tissues.

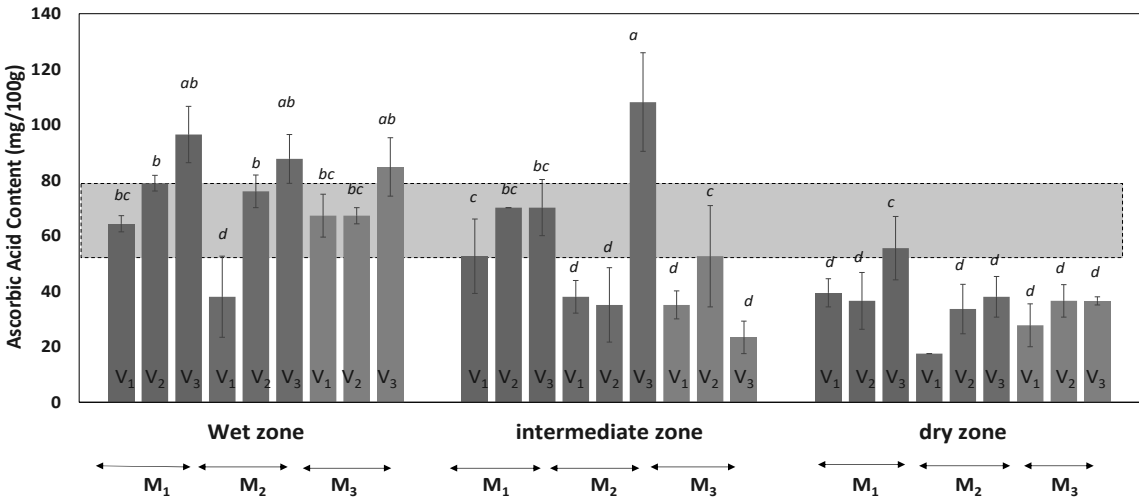


Figure 3: Changes of Ascorbic acid content in Kale in three locations (see Figure 1 for details). Means with the same letter on the bars within the experiment are not significantly different ( $p<0.05$ ).



Kale is rich in powerful antioxidants (Almughraby et al, 2018). Korus (2011) reported that the antioxidant capacity in Kale ranges between 40.7–65.5% RSA (14.7–23.7  $\mu$ M Trolox/g). Although the antioxidant content/activity of Kale in the present study was significantly ( $p < 0.05$ ) different among

locations, the levels are well-within the previously reported levels (Figure 4). The DZ resulted in the highest amount of antioxidant levels compared to those of the IZ and WZ. There was a media effect on the antioxidant content both in the WZ and DZ.

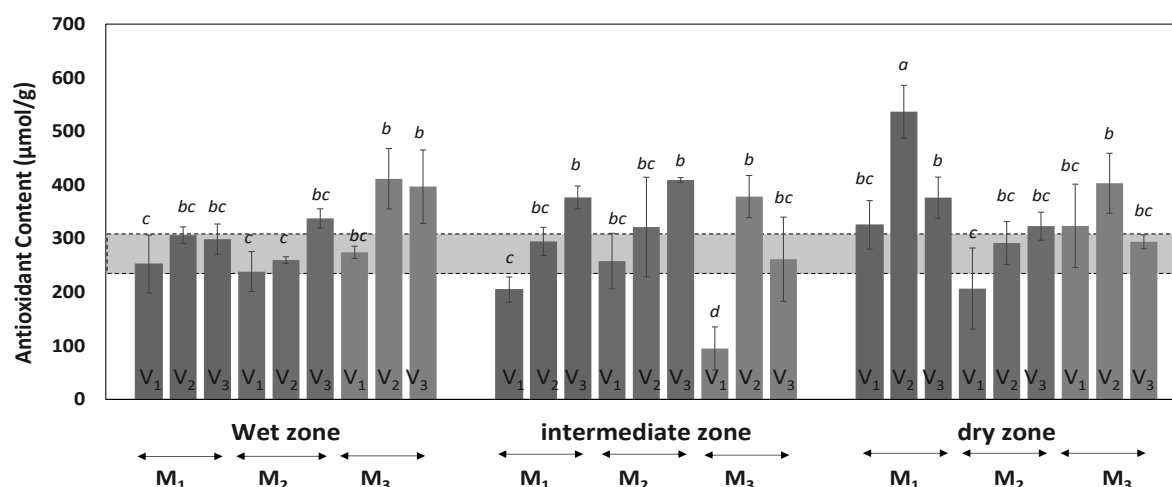


Figure 4: Changes of Antioxidants level in Kale in three locations (see Figure 1 for details). Means with the same letter on the bars within the experiment are not significantly different ( $p < 0.05$ ).

## CONCLUSION

It is apparent that both Chinese Kale and Curly Kale can be successfully grown in the WM<sub>2</sub>, IM<sub>3</sub> and DL<sub>1</sub> regions with the existing soil in-site, without any soil amendment. The leaf yields, ascorbic acid contents and the antioxidant activity in leaves are comparable to the values reported elsewhere. Although the yields are lower in the Low-Country Dry Zone, perhaps due to the high temperature and the low light intensities experienced during the experimental period, with possible manipulations of the environment

(Fiutak and Michalczyk, 2020), Kale can be a potential crop even in the Dry Zone (at least for DL<sub>1</sub>) of Sri Lanka.

According to the findings, both Chinese Kale and Curly Kale seem to be a potential crop to be cultivated in all three climatic zones in the country. However, in order to generalize to the whole country/climatic zones, further experiments are needed in the other agro-ecological regions as well.

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## Electrochemical Evaluation of Delayed Release Behaviour of Diclofenac Sodium Tablets

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### ABSTRACT

Diclofenac Sodium is a commonly used electro active anti-inflammatory drug. There are various analytical techniques to detect Diclofenac Sodium active ingredient including cyclic voltammetry. Cyclic voltammetry was used with different kinds of modified electrodes. In this project, drug release action of Diclofenac Sodium is detected by introducing bare Platinum electrode as the working electrode instead of the modified electrodes. Carbon and silver/silver chloride electrodes are counting and reference electrodes respectively. Platinum electrode is characterized by using 0.5 mM potassium ferrocyanide in a 0.1 M Potassium chloride solution at different scan rates. Diclofenac Sodium dissolution medium is a phosphate buffer solution. The optimum pH value of the phosphate buffer solution for the Diclofenac Sodium dissolution is identified as 6.8. From the resultant cyclic voltammograms of current density at bare platinum electrode Vs. applied potential, the variation of drug concentration with respect to the time is analyzed. The limit of detection (LOD) of Diclofenac Sodium and the limit on quantification (LOQ) on the bare platinum electrode are 0.21 mM and 0.63 mM respectively. The limit of detection is suitable to detect the delayed release behaviour of Diclofenac Sodium. All the three selected brands take around 12 hours to reach a constant concentration. Finally, the characteristic drug release curve of delayed release drugs can be obtained from the resultant graphs of drug concentration Vs. drug dissolution time for the three selected brands. Electrochemical sensors are therefore proposed as an alternative tool for delayed release analysis in medical sciences and pharmaceutical industries.

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## INTRODUCTION

Diclofenac is a chemically 2-[2-(2,6-dichloroanilino)phenyl] acetic acid. It is used as a drug commonly in the form of sodium salt. There are several methods for the detection and determination of Diclofenac Sodium. They include UV spectrophotometry (Alexander *et al.*, 2012) (Sultana *et al.*, 2017), capillary zone electrophoresis (CZE) (Jin & Zhang, 1998), thin-layer chromatography (Dighe, *et al.*, 2006), high-performance liquid chromatography (Yilmaz, *et al.*, 2011), mass spectrometry, polarographic analysis, and chemometric techniques (Thiagarajan *et al.*, 2012). These methods are expensive, difficult to perform, and time consuming compared with voltammetric methods. Diclofenac Sodium is an electro active drug. It can be oxidized and the reaction is reversible (Ensafi, *et al.*, 2013). It consists of two electrons gaining and releasing intermediates while undergoing the redox reaction, making it possible to apply electrochemical methods like voltammetry for estimation of Diclofenac in the form of sodium salt. The voltammetric methods are simple to handle, less expensive and less time consuming. Among the voltammetric techniques, cyclic voltammetry, differential pulse voltammetry and liner sweep voltammetry were used in the Diclofenac Sodium detection (Manea, *et al.*, 2010). Among them, cyclic voltammetry is the easiest technique to handle. Various types of bare and modified electrodes were used as Diclofenac Sodium sensors. Most of them were Nano technology based surface modifications. The major purpose of the developed sensors was the detection of the presence of Diclofenac Sodium in low concentrations in different matrixes.

Control on the rate of a drug released in human subjects is an important criterion in modern medical practices. Delayed released drugs are a specified drug category. As a result of the modified formulation of the drug structure, the releasing activity of the drug can be altered. Such modified drugs can be divided into two groups: Controlled release drugs and Sustained release drugs.

The controlled release drugs are designed to get controlled entry to the body according to the specified drug profile. These controlled release drugs can be further divided into three categories as delayed release, prolonged release, and extended release drugs. The rate and the duration of the drug release are designed to achieve the target drug concentration. The nano-based bi-layered coatings are applied to develop the drug release action. It is important for the pharmaceutical industry to apply an easy method to check the quality of their designed bi-layered coatings. But determination of the delayed release behavior of Diclofenac Sodium in-vitro studies by cyclic voltammetry is not commonly described in literature and industry. This study was focused on determining the delayed release behavior of the marketed solid forms of Diclofenac Sodium by using the cyclic voltammetry.

## METHODOLOGY

Three brands of marketed Diclofenac Sodium tablets were obtained from pharmacies in Sri Lanka. They were randomly coded, Brand A, Brand B and Brand C. The declared active ingredients in the labels were 50 mg Diclofenac Sodium. The dissolution medium, 0.1 M phosphate buffer at pH 6.8 stock solution was prepared with 0.1 M Potassium chloride and pH was adjusted using hydrochloric acid or sodium hydroxide. The platinum electrode was polished with alumina before each analysis. The samples were checked one by one with PGSTAT101 (Auto Lab) potentiostat instrument. The three-electrode system included bare Platinum electrode, Carbon electrode and Silver/silver chloride. 0.5 mM potassium ferricyanide and 0.5 mM potassium ferrocyanide in 0.1 M Potassium chloride solution at 10.00, 20.00, 50.00, 80.00, 100.00, 150.00 and 200.00 mVs<sup>-1</sup> scan rates were used to characterize the bare Platinum working electrode. The Carbon electrode and Silver/silver chloride (3.0 mol L<sup>-1</sup> Potassium Chloride) electrode were used as counting and reference electrodes respectively. Using the Randles-Sevcik equation, the surface area of the Pt electrode was calculated to compare with the



theoretical value. Pure Diclofenac Sodium active ingredient, (assay 99.6%) which is free from other additives and fillers, was purchased from the State Pharmaceutical Manufacturing Corporation (SPMC). The standard Diclofenac sodium sample series were prepared by using that active ingredient and from them, the calibration plot was obtained. The optimum pH value for the Diclofenac Sodium tablet dissolution was determined by using random seven tablets from each brand and adding them

into 50.00 ml of pH 4.0, 6.0, 6.8, 7.0, 7.2, 7.6 and 8.0 phosphate buffer solutions in 0.1 M Potassium chloride solutions. The voltammograms were obtained at 100 mVs<sup>-1</sup> scan rate, without disturbing the coat of the tablet. Drug dissolution of three brands was analyzed at the 37°C room temperature. The concentrations were checked from time to time for a period of 12 hours at 100 mVs<sup>-1</sup> scan rate using the same three electrode systems.

### Platinum Electrode Characterization

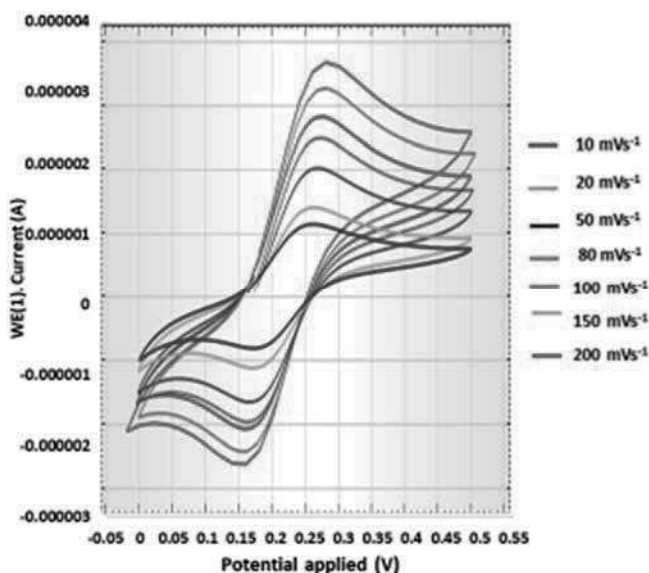


Figure 1: Cyclic voltammograms for 0.5 mM Potassium ferricyanide in 0.1 M Potassium chloride solution at different scan rates

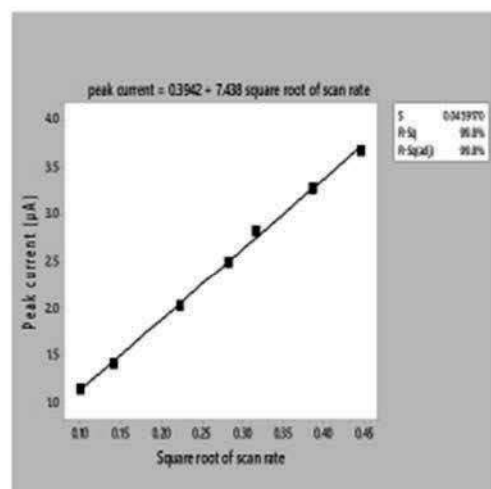


Figure 2: Cyclic voltammograms for 0.5 mM Potassium ferricyanide in 0.1 M Potassium chloride solution at different scan rates

### RESULTS AND DISCUSSION

Electrochemical characteristics of the Platinum electrode was accessed by cyclic voltammetry using  $[\text{Fe}(\text{CN})_6]^{3-/4-}$  redox pair. There was both an oxidation peak and reduction peak. Figure 1 shows the graph of working electrode current Vs. applied potential. The cyclic voltammograms performed in 0.5 mM Potassium ferricyanide

**Calibration Curve**

The all peak current values extracted from Figure 3 were converted to the current by

in 0.1 M Potassium chloride for bare Platinum electrode. It shows a reversible process, so the Randles-Sevcik equation can be applied to obtain the linear relationship between the peak current and the square root of scan rate (Figure 2). The calculated surface area of the used Platinum electrode according to the slope of the graph is  $2.1413 \times 10^{-6} \text{ m}^2$ .

using the regression equation of the calibration plot in the following figure 4. The limit of detection (LOD) was 65.61 mg/L (0.21 mM) and limit of quantification was

198.83 mg/L (0.63 mM) at bare platinum electrode with respect to seven standard solution of Diclofenac Sodium. This is too large LOD when comparing to the LOD of copper doped Zeolite-expanded Graphite-

Epoxy electrode ( $5.0 \times 10^{-5}$  mM) (Manea *et al.*, 2010). But LOD of bare platinum is a suitable value to determine the delayed release behavior of Diclofenac Sodium.

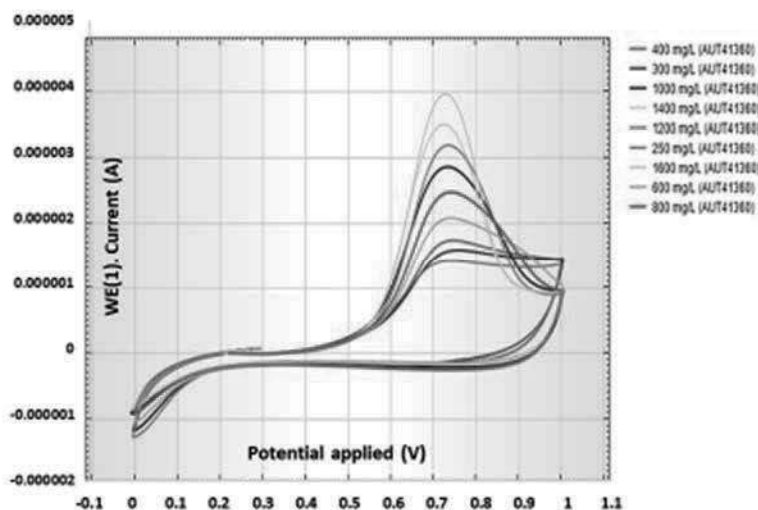


Figure 3: Cyclic voltammograms of working electrode current density ( $\mu\text{A}/\text{m}^2$ ) Vs applied potential (V) for Diclofenac Sodium standard solutions in pH 6.8. Phosphate buffer solution in 0.1 M Potassium chloride at  $100 \text{ mVs}^{-1}$  scan

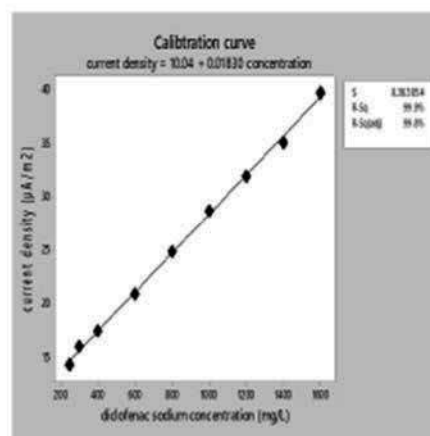


Figure 4: The graph of current density at working electrode ( $\mu\text{A}/\text{m}^2$ ) Vs. Concentration (mg/L) of Diclofenac Sodium standard solutions

### Determination of the Optimum pH Value of Phosphate Buffer Solution for the Tablet Dissolution

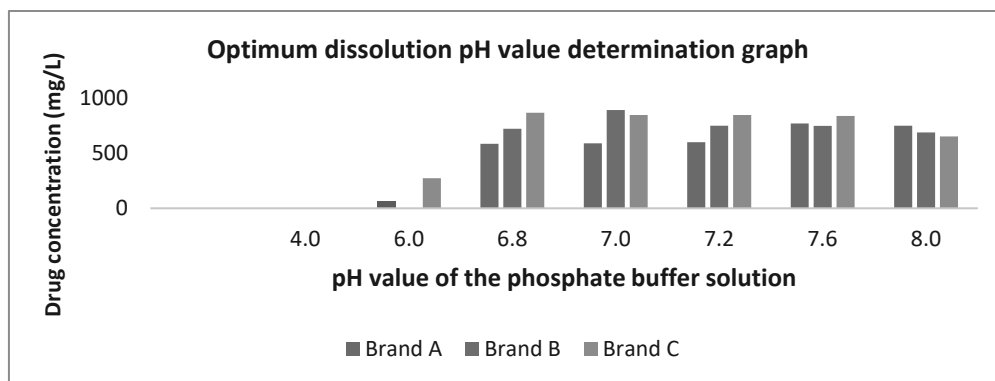


Figure 5: Comparison of optimum dissolution pH values of the test solutions of selected three brands

The target action site of Diclofenac Sodium is the small intestine in the human body. The main purpose of this section is the determination of the optimum pH where the maximum self-drug dissolution occurs. The maximum dissolutions were in pH 7.6, 7.0,

6.8 for brand A, brand B and brand C respectively (Figure 5). Due to the reason the pH value of the small intestine is near to 6.8, the delayed release activity of all three brands was further checked out in 6.8 pH value.

#### Determination of the Delayed Release Behavior:

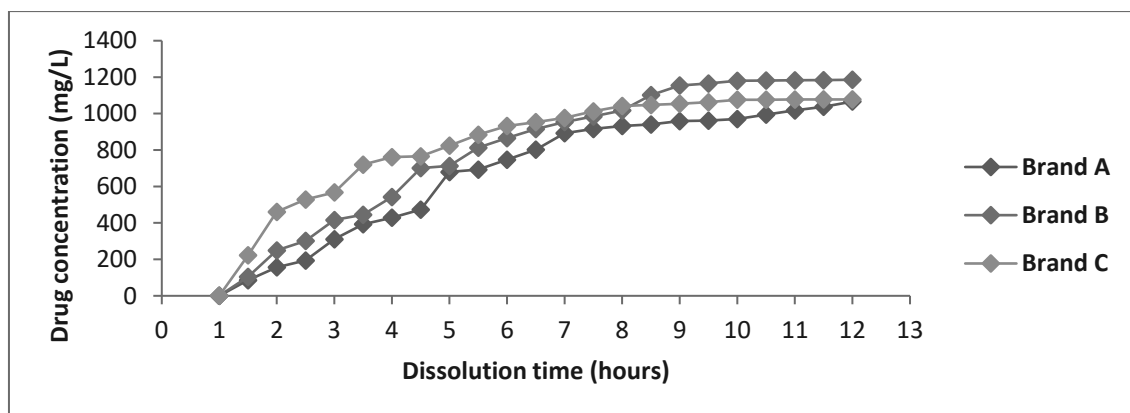


Figure 6: Comparison graph for the delayed release behavior of test solutions of three brands

The delayed release determination was time dependent and the readings were taken after every hour for 12 hours. However, from that time period it can be identified that all three brands have the delayed release behavior (Figure 6). All three brands showed the dissolution after one hour as reflected in detection sensitivity. There may be small concentrations available below minimum detection limit for the platinum electrode surface within the first hour. After 12 hours, brand A, brand B and brand C has showed 1075.96 mg/L (3.38 mM), 1066.23 mg/L

(3.35 mM) and 1185.85 mg/L (3.73 mM) respectively. Voltammograms which were obtained without polishing the electrode did not show the characteristic peak of the Diclofenac Sodium. It may be due to the accumulation of some oxidized products on the electrode surface. Finally, the characteristic nature of a drug release profile of a delayed release drug can be obtained from the all resultant graphs of drug concentration vs. dissolution time for the selected three brands.

#### CONCLUSIONS

It can be concluded that for the determination of the delayed release behavior of electro active Diclofenac Sodium, this method can be used successfully, because when the target drug can oxidize on the platinum electrode surface, the drug concentration can be determined using cyclic voltammetry.

Though the limit of the detection concentration is lower than that of the advanced modified electrodes which were used with Nano-scale modifications, for the determination of the delayed release activity, this Platinum electrode can be used very easily without any modifications.



## ACKNOWLEDGEMENT

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## Growth Parameters and Grain Yield of Rice (*Oryza sativa* L.) as Affected by Biofilm Biofertilizer Application

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### ABSTRACT

Overuse of synthetic fertilizer causes a number of detrimental impacts on both human and environmental health. Hence, beneficial microbial biofilm-based Biofilm biofertilizers (BFBFs) have been developed to make agro ecosystems more eco-friendly. Accordingly, it has been revealed that the BFBFs can reduce current application of chemical fertilizers (CF) in rice even up to 50% without hampering grain yield in field experiments in research stations. Thus, the aim of the present study was to evaluate growth parameters and grain yield of rice after application of BFBF in farmers' fields. The experiment was designed in block design for paired comparison with uniform, consecutive paddy fields in 12 farmer fields in the Polonnaruwa district. The farmers' CF practice (N: P: K; 155:20:20) and BFBF practice (1 L BFBF with N: P: K; 59:15:16) were applied as treatments with 12 location replicates per treatment in the Yala 2018 season. Means of shoot and root dry weights per plant, thousand grain weight and yield of the two practices were evaluated. T-test was used for mean comparison. Results indicated that there is a significant increase ( $P < 0.05$ ) in shoot (53%) and root (89%) dry weights per plant and thousand grain weight (18%) in BFBF practice compared to the farmers' CF practice. Further, the average grain yield of the BFBF practice was 5,112 kg/ha whereas that of farmers' CF practice was 4,238 kg/ha, a 21% increment in the grain yield. Hence, it can be concluded that the BFBF can enhance plant growth and grain yield while reducing farmers' use of CF in paddy fields.

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## INTRODUCTION

Rice is the main food and nutritional energy source of more than half of the world's population. The usage of chemical fertilizer to enhance agricultural production has increased over time. Excessive use of chemical fertilizer gives rise to soil, water and air pollution, and health hazards (Ajmal et al., 2018). Many alternatives like biofertilizers are available to replace chemical fertilizers. Biofertilizers are natural fertilizers which are live inoculants of bacteria, algae, fungi alone or mixtures, and they enhance the availability of nutrients to the plants (Al Abboud et al., 2014). As a novel improvement in biotechnology, useful microbial communities in biofilm mode have been developed *in vitro* to be applied as biofertilizer, which are called BFBF (Seneviratne et al., 2009). A biofilm is a gathering of microorganism adherent to each other and/or surfaces and embedded in a matrix of polymers (Seneviratne et al., 2008). The gathering leads to metabolic cooperation between them (Seneviratne et al., 2009). A biofilm contains microbial cells and tacky extracellular polymeric substances, which give arrangement and safety to the microbial community. Various types of biofilms have been produced by using rhizosphere fungi and  $N_2$  fixing bacteria from different genera, in order to be used as biofertilizers in agriculture (Buddhika et al., 2016). BFBFs have been tested for different types of crops in agricultural research centers at several districts in the country. Previous studies demonstrated that BFBFs in fields of research stations can cut down CF usage for rice without reducing grain yield (Buddhika et al., 2016). However, there has been no critical evaluation of the effects of BFBF application in farmers' fields for rice. Therefore, this study was carried out to evaluate the effect of BFBF application on growth parameters and grain yield of rice in farmers' fields and the potential of reducing CF requirement in rice.

## MATERIAL AND METHODS

### Experimental Location

A field experiment was carried out in 12 farmer fields in Polonnaruwa (DL), with an average annual temperature of 30°C and with an average annual precipitation of 1,800 mm. This study was conducted using a 3.5 months old rice variety, Bg 300. In each location, two consecutive (uniform) paddy fields with BFBF practice and farmers' CF practices were established and seed paddy was broadcasted. Each paddy field had an area of about 1 acre. Two treatments with 12 location replicates were applied to determine the most effective treatment; a) BFBF practice – 1 L BFBF with N:P:K; 59:15:16, and b) Farmers' CF practice – N:P:K; 155:20:20.

### Sample Collection

Four rice plant hills with rhizosphere soil were randomly uprooted at 50% flowering stage from each paddy field. Seed samples were collected from three 2 x 2 m crop cuts at physiological maturity stage and sundried.

### Data collection

At 50% flowering stage, root and shoot dry mass were determined and at the physiological maturity stage, thousand grain weight and yield were determined. First, soil and plant debris were removed carefully from roots and the plants were washed carefully without damaging the root system. The plant roots and shoots were separated and oven dried at 65°C until a constant weight was given. Then, the weights of the root and shoot were measured using a top loading balance. Thousand grains were counted and were oven-dried at 40°C until a constant weight was given. Then, thousand grain weight was measured using an analytical balance. The grain yield was obtained from the crop cuts, and it was calculated per hectare.

### Data Analysis

Means of all the variables of BFBF practice and farmers' CF practice were calculated. A

T-test was done to compare the data. Data were analyzed statistically using Minitab 17 version.

## RESULTS AND DISCUSSION

### Growth Parameters

BFBF application showed a significantly higher ( $P < 0.05$ ) shoot dry weight compared to the farmers' CF practice (Table 1). In BFBFs, enhanced microbial action produces plant growth promoters such as Indole acetic acid (IAA), thus helping plant growth and development (Bandara et al., 2006). Therefore, BFBF helps to increase plant growth during the vegetative phase (Seneviratne et al., 2008). BFBF application

showed a significantly higher ( $P < 0.05$ ) root dry weight compared to the farmers' CF practice. This is because of the better hormonal regulation for root growth with the increased soil microbial action of the BFBF (Seneviratne et al., 2008). Root growth is essential in improving nutrient uptake.

### Yield Parameters

BFBF application showed a significantly higher thousand grain weight (Table 2) compared to the farmers' CF practice. Application of BFBF improves seed filling, and hence thousand grain weight while reducing number and weight of unfilled grains per panicle compared to the CF (Wickramasinghe et al., 2018).

Table 1: Dry matter accumulation in shoot and root of BFBF practice and farmers' CF practice

Treatment	Shoot dry weight (g/plant)	Root dry weight (g/plant)
BFBF (n=12)	11.88a $\pm$ 1.45	4.25a $\pm$ 0.71
CF (n=12)	7.79b $\pm$ 0.83	2.25b $\pm$ 0.43

Mean  $\pm$  SE. Values in each column followed by the same letter are not significantly different at 0.05 probability level according to t-test.

Table 2: Thousand grain weight (g) and grain yield (kg/ha) of BFBF practice and farmers' CF practice

Treatment	Thousand GW (g)	Grain yield (kg/ha)
BFBF	20.93a $\pm$ 1.14	5,112a $\pm$ 129
CF	17.73b $\pm$ 1.17	4,238b $\pm$ 111

Mean  $\pm$  SE. Values in each column followed by the same letter are not significantly different at 0.05 probability level according to t-test (n = 12).

## CONCLUSION

Application of BFBF on rice improved the grain yield, thousand grain weight, shoot and root dry weights of the plant while reducing

the requirement of chemical fertilizers. Thus, it can be concluded that BFBF is an eco-friendly alternative to reduce chemical fertilizer usage, while increasing grain yield in large scale paddy cultivation.

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## Case Study on Safety Culture in Chemical Laboratories in Western Province, Sri Lanka

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### ABSTRACT

A laboratory where chemicals are handled can be considered as a hazardous environment and hence, prudential practices should be strictly enforced. In Sri Lanka and around the world, there are numerous reports of accidents involving injuries such as deaths from chemical laboratories due to lack of safety rules. The purpose of this case study was to analyse the safety culture and the level of safety regulations existing within the chemical laboratories in Sri Lanka. A survey was conducted with the supervisors of the final year students (academic year 2018/2019) who attended industrial training at laboratories in the Western Province of Sri Lanka, representing both the private and government sector. Even though 80 surveys were distributed among 80 laboratories, only 46 surveys were submitted. The majority of the individuals who participated in the survey were between the age of 30 – 35, and none were below 20 years. Regardless of the working experience among the participants, 80% of them continue in the same workplace with the intention of moderate self-perceived risks. However, the majority considers safety an important factor with improved safety inspections compared to previous years. About half of the surveyed individuals stated that monthly inspections were carried out while 54% of the respondents mentioned that it was attended to by the employees from the laboratory. An astounding number of participants were prepared to take action in case of an emergency as they were aware of the location of the safety equipment and how to handle it. This study shows that the participants have positive attitudes towards the laboratory safety rules and inspections. However, the safety culture should be improved further to minimize laboratory related accidents or injuries.

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## INTRODUCTION

Laboratories are naturally dangerous work environments and recent events in several chemical laboratories raise concerns about the acceptable levels of safety that should be followed by students, lab staff, and other stakeholders working in chemical laboratories (Schröder, 2016). Therefore, it is important to make laboratories a safer place to work without any potential harm to any individual. All laboratories should have well prepared safety regulations (also known as the Safety Policy). The safety culture of a particular organization is used to describe the state of its safety, which can be defined as the commitment of an organization to prioritize their safety over other processes that might be beneficial to the work environment (Nitsche, 2019; Gosavi, 2019). An organization that keeps an active safety culture can have a long lasting health in terms of the employees as well as the organization. Conversely, poor safety culture can impact the workplace and primarily the workers by leading to high risks such as loss of limbs or sometimes death (Cadwallader & Pawelko, 2019; Gibso et al., 2014). Even though such places keep safety standard and culture in a positive state, not much is known about how researchers in industries, academic and governmental laboratories apply safety in Sri Lanka (Miller & Tyler, 2019). Therefore, it is important to understand the level of safety practices regardless of the quantity handled, as chemicals can be hazardous and dangerous and sometimes, they can even be radioactive materials, sensitive explosives or harmful biological substances (Salazar-Escoboza et al., 2019).

Institutions such as research labs have their own ways to control the exposures to chemical hazards according to a hierarchy of controls. In every laboratory, employees should be under the regulation of occupational safety by either ISO 45001 or any other acceptable guidelines such as Occupational Health and Safety Administration (OSHA). Training the staff with proper instructions will be essential whenever a new person is recruited to a laboratory. The focus of this study is to understand the level of safety regulations and

methods established in laboratories at private and government organizations in Sri Lanka.

## METHODOLOGY

The study was conducted from January 2019 to July 2019. A hard copy of the survey questionnaire was distributed among the supervisors of the students registered for the final year Industrial Placement and Scientific Training Course at the College of Chemical Sciences for the academic year 2018/2019. The questions of the survey were adapted from a Canadian study on safety culture and safety compliance in academic laboratories in Canada (Ayi, 2018). The ethical approval was taken prior to conducting the study from the respective industries and participants. There were five parts in the survey questionnaire administered, namely part A, B, C, D, and E. Part A was mainly focused on the general information on the person filling the questionnaire. Part B consisted of questions which represented the relevance of laboratory safety as understood by each subject in the absence of specific guidelines. Part C was focused on collecting data related to satisfaction of the subject on laboratory safety with no criteria for assessment while part D was dedicated to information on whether risk assessment has been carried out. The last part of the survey represented the general impression of the subjects on the safety of the laboratory. The collected data were analysed statistically using Microsoft Excel 2013 and results were represented in frequency distribution tables.

## RESULTS

Even though 80 surveys were distributed, only 46 participants submitted the completed survey reports by the deadline. According to the demographic data, 31 participants were females while 15 were males. All the participants were between 30-35 years of age. Most of the participants were from Research and Development in the private or governmental laboratories while none of the participants were from the academic related laboratories. The majority of the participants had a working experience of more than 10 years and out of them 80 % have been working

in the same laboratory throughout that period. More than 50 % of participants spend 40 hours or more per week in handling chemicals. The majority of participants believe that the risk associated with the chemicals is moderate while 10.87 % of the participants think that the level of self-perceived risk is high.

According to data, a majority believes that safety is very important for their work while 6.52 % of the participants consider it is quite important. 86.96 % of participants supported the fact that the safety can be greatly improved just by inspections while a few participants believe that the safety is slightly improved by inspections. 19.57 % of the participants believe that safety is of equal importance to other lab priorities. Though 39.13 % of the participants think that the safety procedures in the laboratory are stringent, about 32.61 % of them claim that the safety procedures should be more stringent. According to the data, even though over 90 % of participants

agreed that safety was to be an important factor, only 80 % of participants agreed that appropriate safety measures have been taken to safeguard the employees from all possible risks in their respective laboratories. However, about 39.13 % of the participants believed that safety was paramount, and the employers had taken precedence over all other laboratory priorities. In general, 93.48 % reported that their safety culture has been developed compared to past years. Over 95.50 % of the participants reported that the employers had taken steps to avoid or minimize the injuries. All the participants had been given personal protective equipment (PPE) by the employers which is indeed a good sign. About 93.48 % are able to use the required PPE properly and securely. Figure 1 shows the usage of PPE when performing laboratory work and according to the chart, only about half of the participants use PPE all the time.

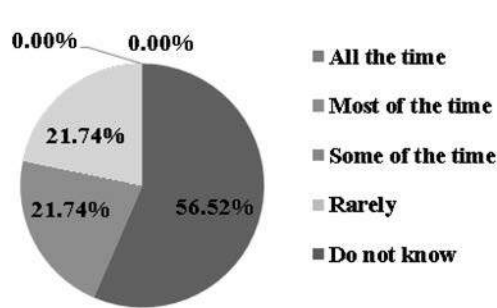


Figure 1: Usage of PPE

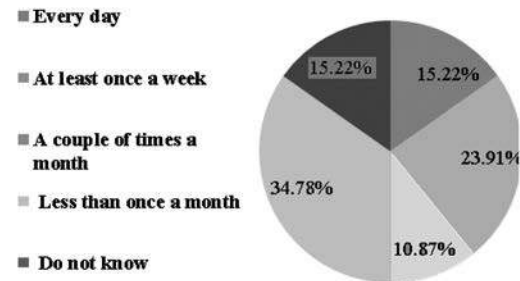


Figure2: Frequency of People Working without supervision

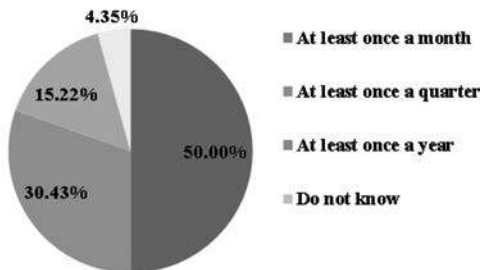


Figure 3: Frequency of Safety Inspections

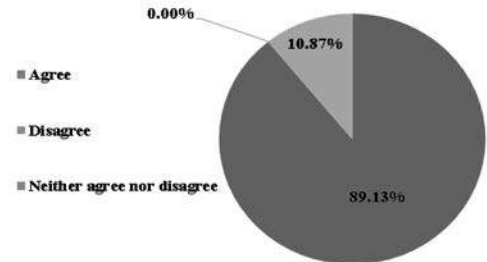


Figure 4: Laboratory is a Safe Place

According to Fig. 3, about 15.22% of the participants said their laboratories have safety

inspections once a year while the rest were uncertain about such inspections. It is clear that 95% laboratories do have some sort of



safety inspections. About 54.35% of the respondents stated that the safety inspections are carried out by the employees from the same laboratory and only 17.39% are conducted by a third party. Although 78.26% of the respondents have access to the data and records of the laboratory safety and compliance, 21.74% have neither agreed nor disagreed on the matter. As per the responses, most of the participants have received general safety training and laboratory safety training on specific agents/hazards they work with. About 10% of the participants have not received any safety training which is questionable. A staggering number of participants were aware of the actions to be taken in case of emergencies and were trained on how to handle safety equipment safely. The

majority of participants (86.96%) have reported that their supervisor or principal investigator frequently checks chemical handling and the safety equipment. About 93% responded that a risk assessment has been conducted in the laboratory either formally or informally. While 93.48% of participants answered that they feel comfortable talking to their supervisor about safety concerns, 78.26% of the participants have not reported any accidents/ incidents or near misses. Overall, a vast number of respondents claimed that their laboratory was a safe place to work (89.13%), and opposed the claim that safety rules had a negative impact on productivity (76.09%). This is demonstrated in Fig. 4.

Table 1: Comparison between participants from the Western Province of Sri Lanka and the Canadian study.

Questions	Options	Response frequency	
		Sri Lanka <sup>a</sup>	Canada <sup>b</sup>
My laboratory is a safe place to work	Agree	89.13%	91.00%
	Disagree	0.00%	0.00%
	Neither agree nor disagree	10.87%	9.00%
Safety is of utmost importance in my laboratory	Takes precedence over all other lab duties	54.35%	88.00%
	Is of equal importance to other lab priorities	45.65%	12.00%
	Less important than experiment/low priority	0.00%	0.00%
Safety rules negatively impact productivity	Strongly agree/agree	6.52%	4.00%
	Strongly disagree/disagree	76.09%	30.00%
	Neither agree nor disagree	17.39%	66.00%
The level of risk associated with laboratory work is	Low-very Low	28.26%	59.00%
	Moderate	56.52%	32.00%
	High-very high	15.22%	9.00%

<sup>a</sup> n = 46, <sup>b</sup> n = 56: n- number of participants

According to the literature, the safety culture in industrial laboratories in Sri Lanka has never been evaluated before and as far as the authors are aware, this might be the first of such. Our study mainly focused on chemical industries in the Western Province of Sri Lanka which represent both the private and government sectors. The majority of the respondents were aware of the laboratory setting and the safety culture and hence we believed that their responses were to be frank. Responding that their laboratories never had risk assessment indicated the prevailing lack of safety culture in Sri Lankan laboratories

which should be immediately addressed before any disaster occurs as in Beirut recently. Many accidents have been reported around the world due to hazardous chemicals and certain equipment. These were mainly due to the poor handling of chemicals and unsafe storage conditions. Further, the majority of safety inspections are not carried out by third party auditors which is alarming. This kind of perception can influence workers' behaviour and attitudes negatively towards laboratory safety rules and regulations. Moreover, they might tend to pay less attention to safety rules and regulations as

they believe that the risk is low, or that it is not going to affect them which is the greatest myth in laboratory safety. However, participants do have a positive attitude toward safety inspections as they believe that the safety can be greatly improved by inspections. The first party inspections may not be transparent and hence the falsified data could put the lives of employees at risk due to lack of constructive suggestions. This situation can be avoided by having third party inspections in addition to the first party to ensure the credibility and transparency. From the responses it is clear that an industry hardly carries out such inspections to keep the safety policy and safety culture active simply because it is an extra expense for the employer. However, they do not know that the accident or incident claims could be thousands or sometimes a million times the expense of an audit. Further, the lack of strong commitment and laws in the country could lead them to avoid such inspections. This is clear when some participants responded that safety rules negatively impact their lab productivity which is questionable and alarming. It is unbelievable that some of the laboratory personnel as well as their managers did not understand that important fact. Again, this fact might support their reluctance to have third party inspections. Regardless of that, a considerable number of participants feel that the safety should be more stringent, and that it could be further improved. Sometimes maintaining occupational safety and health standards would not be enough to maintain a proper safety culture for a chemical laboratory as the guidelines cover a wide range of industries. Hence the rules and regulations must be redefined without harming the original goals. More than 90.00 % of participants claimed that the appropriate safety measures have been taken to protect employees from injuries which is a satisfactory response. A considerable number of participants stated that accidents/injuries have happened to them while working in the laboratory which reflected that those particular industries do need stringent safety practices.

The majority said that they were comfortable speaking with their supervisor regarding safety, but still many participants have not reported accidents/ incidents to their

supervisor which was contradictory to their earlier response. Further, there is no proper practice to report any incident, near miss or an accident, regardless of its nature of, which is not acceptable. The authors believe that the government and the National Institute of Occupational Health and Safety (NIOSH) should take initiatives to implement such best practices in future.

According to Table 1, the majority of the participants from both studies agree to the statement that the laboratory is a safe place to work. However, there is a comparative difference between the response frequencies obtained for other questions. The table further demonstrates that the importance of safety over other lab duties has the highest percentage in both studies. The level of risk associated with laboratory work shows the lowest percentage in both studies with high to very high responses. More than 50.00% of the respondents from the Sri Lankan study state the level of risk associated with the lab is moderate while 60.00% participants from the Canadian study believe that the level of risk is low to very low.

## CONCLUSION

This study shows that the chemical laboratory workers have more positive attitudes toward laboratory safety rules and inspections and a satisfactory level of safety culture is maintained within the current laboratories in Sri Lanka. However, these safety cultures should be further improved to match the working environment and it would help to minimize injuries or accidents that can happen in future. Proper safety training should be provided by qualified and knowledgeable safety officers on the importance of control of hierarchy, and the use of PPE at all times when performing lab work. Finally, the authors would like to suggest that future studies of this nature should include a survey on the safety of the academic laboratories in Sri Lanka where the safety should be taught and practiced properly.

## ACKNOWLEDGEMENT

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study and to all the students who registered for the industrial placement and scientific training at the College of Chemical Sciences in the academic year 2018/2019.

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## ZnO Nanoparticles Deposited on Gamboge (*Garcinia gummi-gutta* L.) Based Activated Carbon for Removal of Phenol from Synthetic Wastewater

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### ABSTRACT

This study was performed to investigate the potential utilization of Gamboge in the green synthesis of ZnO nano particles (NPs) and production of activated carbon (AC) in order to explore both ZnO NPs and Gamboge based AC for the removal of phenol from synthetic wastewater. Aqueous extracts of dried fruits of *Garcinia gummi-gutta* L. were used for the synthesis of ZnO NPs and formation of NPs was confirmed by the characteristic absorption peak at 364 nm in the UV-Vis spectroscopic analysis. X-ray diffraction pattern confirmed a well crystallized hexagonal wurtzite structure of ZnO NPs. Gamboge based activated carbon (AC) samples were prepared using two activating agents: ZnCl<sub>2</sub> and H<sub>3</sub>PO<sub>4</sub>. Deposition of NPs on AC was confirmed by X-ray diffraction analysis. Photo catalytic degradation ability of synthesized NPs and NPs deposited AC was studied for the removal of phenol from synthetic phenol solution. The present study revealed that, incorporation of AC produced by activation with ZnCl<sub>2</sub> into ZnO NPs has enhanced the removal efficiency of phenol by 12%. The effect of experimental parameters such as pH, contact time, dosage and initial phenol concentration on degradation of phenol was studied. It was revealed that NPs loaded onto ZnCl<sub>2</sub>/AC have higher degradation ability (94.23%) for phenol when compared with NPs loaded onto H<sub>3</sub>PO<sub>4</sub>/AC (81.72%) at optimized experimental conditions. The highest phenol degradation efficiency was observed under optimum conditions of pH 6.9, dosage of 3.0 g L<sup>-1</sup> and initial phenol concentration of 100 mg L<sup>-1</sup> in natural sunlight for 6.00 h. It is evident that the intensity of sunlight which was measured using the Lux meter plays a major role in photo catalytic degradation of phenol. This research opens a new path to enhance photo catalytic degradation of phenol in which both NPs and ACs are used.

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## INTRODUCTION

Nanotechnology has provided a reliable alternative to many challenging problems in various fields such as drug delivery, catalysis, solar energy harvesting, hydrogen generation, and wastewater treatment<sup>1</sup>. ZnO NPs can be synthesized by hydrothermal process, sol gel method, co-precipitation, simple combustion, pyrolysis, solvothermal, pulsed laser deposition sputtering, etc <sup>2</sup>. However, the synthesis of ZnO NPs using natural substances has become the most preferred method because it is a green, cost-effective, clean, safe, and single-step method. In the green synthesis of NPs, natural compounds contribute to growth terminating, stabilizing, reducing, and capping the precursor. Green synthesized ZnO NPs have recently attracted significant interest as a photocatalyst, which can be effectively used for the removal of organic pollutants from wastewater. Phenol, which is a raw material in several industries is also a major aquatic pollutant in the environment. Many treatment processes for purifying wastewater contaminated with phenol are not effective due to high operational costs and mainly because of the formation of new degraded products<sup>3</sup>. Photo catalytic degradation is one of the eco-friendly techniques used for the treatment of wastewater containing toxic organic compounds in which phenol can be completely degraded into carbon dioxide and water. Activated carbon is a commonly used adsorbent due to its extremely high surface area, large adsorption capacities, micro pore volumes, and relative ease of regeneration ability. Due to these unique properties, incorporation of AC in the reaction media can enhance the effective surface area where catalytic reactions take place.

The present study reports the synthesis of ZnO NPs using an aqueous extract of *Garcinia gummi-gutta* L. and zinc acetate as precursors. Activated carbon was prepared using  $\text{ZnCl}_2$  and  $\text{H}_3\text{PO}_4$  as activating agents. The precursor material (dried fruits of Gamboge) was activated and carbonized with activating agents. In the chemical activation process, the liquid chemical is intercalated into the matrix formed by carbon which produces pores at

high temperatures. ZnO NPs were loaded onto two different types of activated carbon. The effect of several parameters such as pH of the medium, the irradiation time of natural sunlight, adsorbent dosage, and initial concentration of phenol in the degradation of phenol was studied.

## MATERIALS AND METHODS

### Materials

Zinc acetate dihydrate ( $\text{Zn}(\text{CH}_3\text{CO}_2)_2 \cdot 2\text{H}_2\text{O}$ ) was used as the precursor material for the synthesis of ZnO NPs. Zinc chloride, phosphoric acid (85% acid), and sodium hydroxide (NaOH) were obtained from Merck and phenol from BRECKLAND (99% purity). All the chemical reagents used were of analytical grade.

### Synthesis of ZnO Nanoparticles

An aliquot of 50.0 mL of 0.50 mol  $\text{dm}^{-3}$  zinc acetate solution was added to 20.0 mL of aqueous fruit extract of *Garcinia Gummi-gutta* L. and were mixed homogeneously for 10 min at room temperature. 2 M NaOH was added drop wise until pH reaches 12 and stirred for 2 h at 60 °C. The obtained pale white precipitate was washed with distilled water and ethanol and kept in the oven at 60 °C for 24 h.

### Synthesis of Activated Carbon (AC)

Dried, grounded, and sieved (0.251-0.152 mm) fruits were stirred separately with zinc chloride and phosphoric acid solutions at 85 °C for 7 h. Impregnated mixtures were carbonized in a muffle furnace at 450 °C and washed with hot distilled water until the pH of the filtrate reached the neutral value <sup>4</sup>.

### Impregnation of ZnO nanoparticles with AC

An amount of 0.05 g of synthesized ZnO NPs was added to 200 mL of distilled water. An amount of 5.00 g of sieved activated carbon (0.251 mm- 0.152 mm) was added and stirred for 10 h. The solution was filtered and washed with distilled water. The sample was allowed to dry in the oven at 95 °C for 10 h<sup>5</sup>.



Table 1: Experimental Conditions for the Synthesis of AC

Impregnating agent	Impregnated ratio (w/w)	Activation temperature (°C)	Holding time in a muffle furnace (h)
ZnCl <sub>2</sub>	1:2	450	1
H <sub>3</sub> PO <sub>4</sub>	2:1	450	3

**Photocatalytic Activity**

A stock phenol solution of 1000 ppm was prepared to set subsequent diluted solutions. The pH of the solutions was adjusted using 0.1 M HCl and 0.1 M NaOH. The phenol content was determined at its maximum wavelength (270 nm) using a UV-Vis spectrophotometer. The degradation

percentage of phenol was calculated using the equation (6),

$$\text{Degradation \%} = \frac{C_0 - C}{C_0} \times 100\%, \quad (6)$$

where  $C_0$  and  $C$  are the initial and final phenol concentrations

**Characterization of Synthesized Nanoparticles**

The structural characteristics of ZnO NPs and AC were investigated by an X-ray diffractometer (Rigaku Ultima IV) equipped

with Copper-K $\alpha$  radiation (wavelength  $\lambda = 1.5406 \text{ \AA}$ ) at 40 kV and 30 mA. The X-ray diffractogram was recorded in the  $2\theta$  range over  $5 - 80^\circ$  at scanning steps of

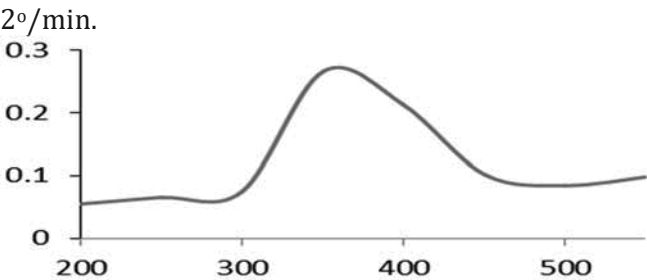


Figure 1: UV-Vis Spectrum of ZnO NPs Synthesized using Zinc Acetate and Aqueous Extract of Gamboge Dry Fruit as Precursors

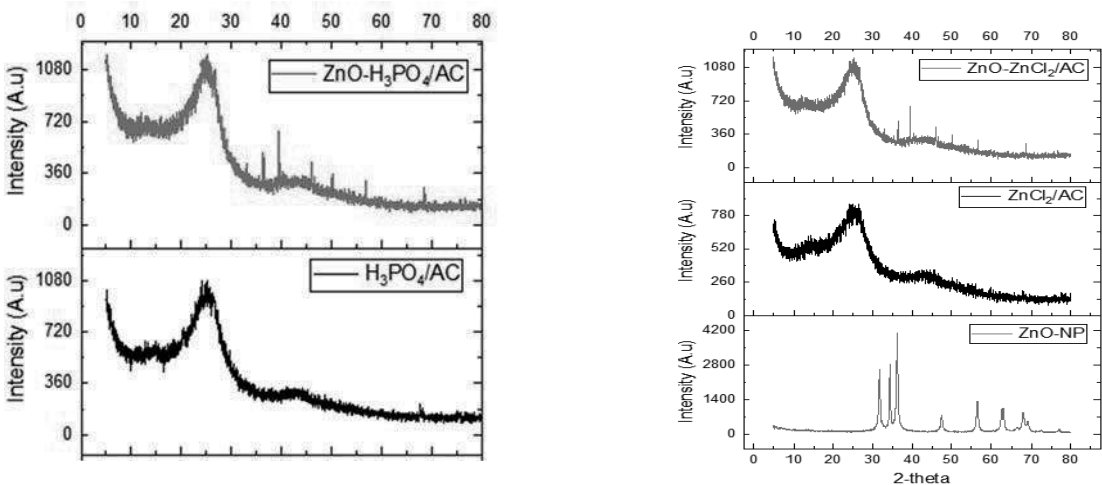


Figure 2: XRD Results of Synthesized ZnO NPs, AC and NPs Loaded onto AC.

## RESULTS AND DISCUSSION

UV- Vis spectrum of ZnO NPs displayed the maximum absorption peak at 364 nm corresponding to the characteristic band of ZnO NPs. X-ray diffraction patterns of ZnO NPs showed sharp peaks at  $31.718^\circ$ ,  $34.385^\circ$ ,  $36.203^\circ$ ,  $47.458^\circ$ ,  $56.556^\circ$ ,  $62.781^\circ$ ,  $66.258^\circ$ ,  $67.807^\circ$ , and  $68.941^\circ$  corresponding to the diffraction planes of (100), (002), (101), (102), (110), (103), (200), (112) and (201), confirming well-crystallized hexagonal wurtzite structure of ZnO-NPs<sup>7</sup>.

The crystalline size of synthesized ZnO-NPs is 25.94 nm.

There exist two broad diffraction peaks around  $26.49^\circ$  and  $43.3^\circ$  corresponding to diffraction planes (002) and (100) in  $H_3PO_4/AC$  (Figure 2(A)) and broad peaks around  $26.68^\circ$  and  $42.10^\circ$  corresponding to diffraction planes (002) and (100) in  $ZnCl_2/AC$  (Figure 2(B)), which confirms the formation of AC. XRD analysis is clear proof to show that NPs have loaded onto AC which is evident by broad peaks of AC and sharp peaks of ZnO NPs<sup>8</sup> (Figure 2, ZnO/  $ZnCl_2/AC$  and ZnO/  $H_3PO_4/AC$ ).

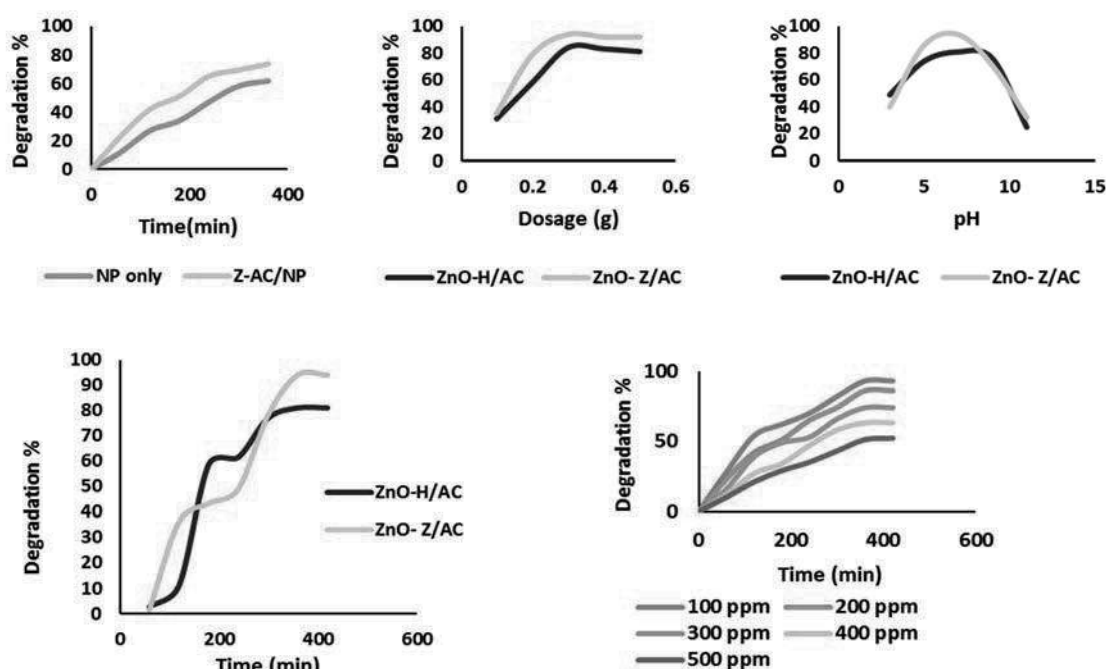


Figure 3: Photocatalytic Degradation % of Phenol under Sunlight, (a) Effect of Incorporation of AC (b) Effect of Photocatalyst Dosage (c) Effect of Initial pH Value of Aqueous Phenol Solution (d) Effect of Irradiation Time (e) Effect of Initial Phenol Concentration, When Other Parameters at Optimized Condition. (ZnO NPs loaded onto  $ZnCl_2/AC$  - ZnO-/ZAC, ZnO NPs with  $H_3PO_4/AC$  - ZnO-H/AC)

### Effect of Incorporation of Ac on Degradation of Phenol

Photocatalytic degradation of phenol was investigated with and without AC in the reaction medium. The mean intensity of sunlight was  $2990 \pm 720$  Lux. It was observed that the presence of AC has enhanced the degradation of phenol by 12% compared with only ZnO NPs (Figure 3(a)). This might be

attributed to the enhanced dispersion of NPs in the presence of AC. Also, it was found that NPs loaded onto  $ZnCl_2/AC$  are more effective than NPs loaded onto  $H_3PO_4/AC$ .

### Effect of Time on Degradation of Phenol

It was evident that the percentage of phenol degradation has increased with time evidently because the amount of hydroxyl radicals



produced increases with time. ZnO- Z/AC and ZnO- H/AC has 94.23% and 81.72% phenol degradation respectively within 6 h and the mean intensity of sunlight was  $3600 \pm 358$  Lux.

### Effect of Photocatalyst Dosage on Degradation of Phenol

The dosage of catalysts was varied from 0.1 to 0.5 g when the mean intensity of sunlight was  $3600 \pm 237$  Lux. It is shown in Figure 3(b) that the increase of dosage above  $3.0 \text{ g L}^{-1}$  has decreased the degradation % of phenol. This may be ascribed to the screening effect caused by the high amount of catalyst in which the particles tend to agglomerate. The scattering of light decreases making the less amount of radiation reaching to adsorbing molecules<sup>9</sup>.

### Effect of pH on Degradation of Phenol

Photocatalytic degradation of phenol in the presence of NPs loaded onto ACs was investigated over the pH range from 3 to 11 when the mean intensity of sunlight was  $3700 \pm 346$  Lux (Figure 3(c)). It was observed that the Photocatalytic degradation % of phenol increased with the rise of pH from 3 to 7, because when the pH value is lower than pHzpc of ZnO, (pHzpc, 8.5 that was established in a separate experiment), the surface is positively charged. In acidic pH values of the surface, the strength between ZnO surface and phenol is higher and most of the phenol molecules remain undissociated. Thus, maximum numbers of phenol molecules can absorb on ZnO photocatalyst and consequently increase the photodegradation of phenol. At higher pH phenol exists as

phenolate ions which decreases the adsorption of phenol to photocatalyst surfaces due to electrostatic repulsion<sup>10</sup>.

### Effect of Concentration of Phenol on Degradation Process

The maximum degradation of phenol resulted at an initial phenol concentration of  $100 \text{ mg L}^{-1}$  for ZnO-H/AC with optimized conditions and the mean intensity of sunlight was  $3600 \pm 283$  Lux (Figure 3(e)). Inefficient removal of phenol at higher concentrations may be due to the insufficient amount of catalyst and hence available sites to degrade all phenol molecules.

### CONCLUSION

In this study, zinc oxide nanoparticles were successfully synthesized, by using aqueous fruit extract of Gamboge (*Garcinia gummi-gutta L.*) as the stabilizing agent. Activated carbon samples were produced using the same fruit with activating agents  $\text{ZnCl}_2$  and  $\text{H}_3\text{PO}_4$ . The crystallinity of synthesized nanoparticles was observed using X-ray diffraction spectroscopy that revealed their crystalline nature. The results indicated that the presence of AC has enhanced the degradation ability of phenol by 12%. The highest phenol degradation efficiency, 94.23% was observed with ZnO NPs loaded onto AC prepared using  $\text{ZnCl}_2$  as the activating agent, under optimum conditions of pH 6.9, photocatalyst dosage of  $3.0 \text{ g L}^{-1}$ , and initial concentration of  $100 \text{ mg L}^{-1}$  in natural sunlight for 6 h. Results of this study revealed that the ZnO nanoparticles loaded onto AC can be efficiently utilized for the removal of phenol from wastewater.

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## The Use of Colour Shade Material in Black Pepper (*Piper nigrum* L) Propagation

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### ABSTRACT

Black pepper (*Piper nigrum* L.), is the second most important spice crop grown in Sri Lanka, having the potential of generating substantial foreign exchange earnings. Black pepper is grown as an intercrop with tea and coconut. Black pepper is commercially propagated through stem cuttings. In the traditional propagation method, coir netting is used as the shading material and it takes 5 months to plant in the field. Therefore, an experiment was conducted to find the correct shading to reduce the nursery period and to improve the quality of planting material by using coloured high-quality flame retardant, heavy-duty lock stitch knit, black, green and blue coloured shade fabric specifically for shade covers of 50 and 75% shade. The longest shoot length of 8.1 cm, highest fresh weight of 121 mg, highest dry weights of 18.1 mg, highest number of roots of 21 per plant, total root length of 13 cm per plant and highest root dry weight of 2.5 mg at 90 days were recorded in the treatment 50% blue shade. Therefore, the use of 50% blue shading material in pepper commercial nurseries provides better growth of pepper nursery plants.

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## INTRODUCTION

Black pepper (*Piper nigrum* L.), known as the king of spices, is an important Export Agriculture Crop in Sri Lanka. Black pepper is cultivated in home gardens, and as an intercrop with tea and coconut. The demand for black pepper is getting increased yearly in the world market. In Sri Lanka, the extent under pepper is estimated as 42,989 ha (DEA, 2018) and mostly grown in low and mid-country wet and intermediate agro-climatic zones.

Black pepper requires 2000-3000 mm of annual rainfall. It does not tolerate excessive heat and dryness. The optimum soil temperature for root growth is 28°C (Wahid and Sitepu, 1987). According to Vijayakumar and Mammen (1990), black pepper vines are day-neutral plants and remained green and healthy under a shade (7% incident light) whereas those exposed to sunlight turned yellow and developed necrotic patches during summer. Senanayake and Kirthisinghe (1983) reported that 50% shade boosted the growth of black pepper cuttings in the nursery. Illumination above 50,000 lux ( $900 \mu\text{mol m}^{-2} \text{s}^{-1}$ ) decreased carbon fixation in a few varieties of black pepper (Mathai, 1983). Shade regulation is an important cultural practice during cloudy or rainy weather to allow sufficient light for crop growth (Ramadasan, 1987).

Researchers described various methods of vegetative propagating black pepper for initial multiplication as well as for large-scale planting. Cuttings from orthotropic (vertical) branches or ground runners consisting of 3 nodes are the most common and traditional method used in Sri Lanka. Cuttings with 2 to 3 nodes have to be raised in the nursery initially and transplanted to the field after attaining sufficient growth (Sasikumar and Johnson, 1992). In the traditional nursery propagation method, mature orthotropic or runner shoot are selected from vines and three-node cuttings are planted in 250 gauge poly bags of 20x12.5cm filled with potting mixture and should be kept in a propagator for 4 weeks (DEA, 2018). After 14 days polythene should be removed gradually and plants should be

kept in the shade house and hardening should be practised. 50% and 70% shade cloth reduced leaf temperatures and coir netting could be used as the shading material (Seneviratne *et al.*, 1985).

The nursery period for the traditional propagation method takes 5-6 months. When the shoots have attained sufficient growth of 35 cm, plants can be transplanted to the main field.

Therefore, an experiment was conducted to reduce the nursery period using coloured high-quality flame retardant, heavy-duty lock stitch knit black, green and blue coloured shade fabric with two shade levels of 50 and 75% shade.

## MATERIAL AND METHODS

The experiment was conducted at the University farm, Dodangolla (IM3a), Sri Lanka. Matured three nodal fresh pepper (var. Kuching) was used for the study. Uniform cuttings were taken from orthotropic branches and inserted into fumigated, moist rooting medium prepared with equal parts of topsoil, sand, cow manure and coir dust. The leaf of the bottom node was completely removed and half of the leaf at the second node was cut off to reduce transpiration losses by the plant. The commercial rooting hormone (Rootone® - 0.3 % w/w indole butric acid) was used for root development of orthotropic cuttings and were treated with a Captan fungicide (N-trichloromethylthio-4cyclohexene-1) solution to prevent possible fungal infestations. 250 gauge poly bags of 45 x 12.5cm, filled 15 cm with the potting mixture were used to cover up to the lower node and watered well after planting of 3 nodal cutting. The top of the 45 cm sleeve was closed as a propagator for 21 days to induce root initiation. High-quality flame retardant, heavy-duty lock stitch knit black, green and blue coloured shade fabric specifically for 50 and 75% shade covers were used as overhead shade, one meter above the top closed poly bags for 90 days. Coir nettings of

50 and 75% shade levels were used as the control treatments.

Photosynthetic Photon Flux Density (PPFD) of direct sunlight, at the experimental site in Dodangolla and the shade levels of 50 and 75% were measured using MQ-500 professional PAR/PPFD meter during the experimental period from May to August. Randomised complete block design for 8 treatments with four replicates was used for the experiment. Each treatment consisted of 12 potted plants.

45 cm sleeve propagators were opened after 21 days. The survival rate was calculated for each treatment and the weeds were removed. Nursery plants were watered once in two days using a watering can by removing the coloured overhead shade. Randomly selected two plants from each replicate were used to measure the following at 30, 60 and 90 days after planting of cuttings. Shoot height from axillary base to tip of the plant was measured by using a measuring tape. The number of new leaves of the plant was counted and leaf area was measured. The number of roots was counted which have arisen from the cutting surface and the length of the roots was also measured using a measuring tape. Root volume was measured using a 100 ml gravimetric bottle. Shoot and root fresh weights were measured by using an electronic balance, after washing off all the soil particles. Shoots and roots were separately placed in an oven and dried at 70°C temperature until the weights come to a constant. Leaf temperature was measured randomly using an infrared thermometer.

Collected data were analysed statistically by the analysis of variance (ANOVA) technique using the SAS Windows Version 9.3. Means were separated using the least significant difference (LSD) at the 5% level of significance (Gomez and Gomez, 1984). Where there were significant effects, post hoc analysis was made with Duncan's Multiple Range Test (DMRT) at  $P \leq 0.05$  (Duncan, 1955).

## RESULTS AND DISCUSSION

Direct sunlight, at the experimental site, Dodangolla was between 600-1000  $\mu\text{mol m}^{-2} \text{s}^{-1}$  (32,000-54,000 lux) during the experimental period from May to August. All treatments showed approximately 18% mortality, causing foliar yellowing, defoliation and die back. The longest shoot length of 8.1 cm at 90 days was recorded in the treatment of 50% blue shade (Table 1).

Table 1. The shoot length (mm) after 30, 60, and 90 days of planting at 50 and 75% shade

Treatments	Shoot length (mm)		
	30 days	60 days	90 days
50% coir	5.2 <sup>a</sup>	25 <sup>a</sup>	70 <sup>b</sup>
50% green	2.1 <sup>d</sup>	18 <sup>b</sup>	55 <sup>c</sup>
50% black	3.5 <sup>c</sup>	23 <sup>a</sup>	70 <sup>b</sup>
50% blue	5.0 <sup>a</sup>	25 <sup>a</sup>	81 <sup>a</sup>
75% coir	4.2 <sup>b</sup>	25 <sup>a</sup>	65 <sup>bc</sup>
75% green	3.2 <sup>c</sup>	19 <sup>b</sup>	54 <sup>c</sup>
75% black	4.4 <sup>b</sup>	20 <sup>b</sup>	63 <sup>bc</sup>
75% blue	5.0 <sup>a</sup>	25 <sup>a</sup>	75 <sup>ab</sup>
The same letter/s in a column shows that there is no significant difference by DMRT at 5%			



The highest fresh weight of 121 mg and a dry weight of 18.1 mg at 90 days were recorded

in the treatment of 50% blue shade (Table 2).

Table 2. The shoot fresh and dry weights after 30, 60, and 90 days of planting at 50 and 75% shade

Treatments	30 days		60 days		90 days	
	Shoot wt (mg)	Shoot dry wt (mg)	Shoot wt (mg)	Shoot dry wt (mg)	Shoot wt (mg)	Shoot dry wt (mg)
50% coir net	4.9 <sup>a</sup>	0.7 <sup>a</sup>	30 <sup>a</sup>	4.5 <sup>a</sup>	105 <sup>b</sup>	15.2 <sup>c</sup>
50% green net	1.9 <sup>d</sup>	0.2 <sup>d</sup>	21 <sup>d</sup>	3.2 <sup>b</sup>	82 <sup>d</sup>	12.5 <sup>d</sup>
50% black net	3.3 <sup>c</sup>	0.4 <sup>c</sup>	27 <sup>b</sup>	4.1 <sup>ab</sup>	105 <sup>b</sup>	15.2 <sup>c</sup>
50% blue net	4.7 <sup>a</sup>	0.7 <sup>a</sup>	30 <sup>a</sup>	4.5 <sup>a</sup>	121 <sup>a</sup>	18.1 <sup>a</sup>
75% coir net	3.9 <sup>b</sup>	0.5 <sup>bc</sup>	30 <sup>a</sup>	4.5 <sup>a</sup>	97 <sup>c</sup>	14.3 <sup>c</sup>
75% green net	3.0 <sup>c</sup>	0.4 <sup>c</sup>	22 <sup>d</sup>	3.4 <sup>b</sup>	81 <sup>d</sup>	12.2 <sup>d</sup>
75% black net	4.2 <sup>b</sup>	0.6 <sup>b</sup>	24 <sup>c</sup>	3.6 <sup>b</sup>	94 <sup>c</sup>	14.4 <sup>c</sup>
75% blue net	4.7 <sup>a</sup>	0.7 <sup>a</sup>	30 <sup>a</sup>	4.5 <sup>a</sup>	112 <sup>ab</sup>	16.1 <sup>b</sup>
The same letter/s in a column shows that there is no significant difference by DMRT at 5%						

The number of new leaves per plant, leaf area, leaf temperature and Root volume was not significantly different among the treatments.

When comparing the shoot lengths of black pepper at 30, 60 and 90 days after planting 50% blue shade gave the best results among the 8 treatments. This may be the quality effect of blue light on plants, directly related to chlorophyll production. Plants that receive plenty of blue light will have strong, healthy stems and leaves. Besides, blue light regulates the opening of stomata, and control both transpiration and the uptake of carbon dioxide. Generally, only a low intensity of blue is needed in a light

spectrum for fully functional photosynthesis (Vijayakumar and Mammen, 1990). When cuttings are transplanted to the field, the quick establishment would assure whether they have long shoot lengths. When cuttings are planted in the field quick establishment would assure whether they have a good root system. The highest number of roots of 21 per plant, the highest total root length of 13 cm of and the highest dry weight of 2.5 mg per plant at 90 days were observed in treatment with 50% blue shade (Table 3). Leaf thrips and aphid attacks were found after 30 days of planting. A homemade neem-based insecticide was sprayed to control the insects.

Table 3. The number of roots, root length and dry weights at 90 days at 50 and 75% shade

Treatments	No. Roots	Root length (cm)	Root dry wt (mg)
50% coir	18 <sup>b</sup>	12.5 <sup>ab</sup>	2.5 <sup>a</sup>
50% green	14 <sup>c</sup>	9.5 <sup>c</sup>	1.2 <sup>b</sup>
50% black	18 <sup>b</sup>	12.7 <sup>a</sup>	2.4 <sup>a</sup>
50% blue	21 <sup>a</sup>	13.0 <sup>a</sup>	2.5 <sup>a</sup>
75% coir	17 <sup>b</sup>	12.9 <sup>a</sup>	2.4 <sup>a</sup>
75% green	12 <sup>c</sup>	10.2 <sup>c</sup>	2.3 <sup>a</sup>
75% black	18 <sup>b</sup>	12.4 <sup>ab</sup>	2.4 <sup>a</sup>
75% blue	20 <sup>a</sup>	12.5 <sup>ab</sup>	2.4 <sup>a</sup>
The same letter/s in a column shows that there is no significant difference by DMRT at 5%			

## CONCLUSION

The results of the study concluded that 50% of blue shade is better for Black pepper propagation using three nodal cuttings by the traditional method. Therefore, it is important to use 50% blue shading material in pepper

commercial nurseries for the better growth of cuttings and it can reduce the mortality rate in the field. Further research is needed to develop timing strategies in Black pepper nursery operations.

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## Identification of SNP-Allelic Polymorphism Based Changes in Two Salt Responsive Proteins, Na<sup>+</sup> H<sup>+</sup> ANTIPORTER 4 and GLUTAREDOXIN 24 Between Two Rice Varieties

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### ABSTRACT

Rice is identified as a salinity vulnerable crop. To avoid the salinity stress problem, advanced steps have been taken, including developing novel plant sources with genetic variation associated with stress tolerance. Therefore, developing salt-tolerant varieties by combining different salt-tolerant mechanisms is a long-term solution to withstand salinity stress. Subsequently, single nucleotide polymorphisms (SNPs) are largely utilized in crop improvement including rice. This study was focused on analyzing the SNP variations discovered in two key salt responsive genes: Na<sup>+</sup> H<sup>+</sup> antiporter 4 (*OsNHX4*) and Glutaredoxin 24 (*OsGRX24*). The *OsNHX4* and *OsGRX24* gene sequences of At354 and Bg352 were retrieved from the Next Generation Sequencing derived whole genomes of two rice varieties. The gene sequences were aligned along with the Nipponbare reference gene sequences and the SNP variants present in the coding regions were identified. The amino acid sequences of each gene were obtained and their physiochemical parameters and protein structures were predicted. Results showed that *OsNHX4* had 4 and 9 SNPs in At354 and Bg352 while *OsGRX24* had 3 and 5 SNPs in At354 and Bg352 respectively. The secondary protein structure of *OsNHX4* in Bg352 was modified due to an amino acid residue substitution, causing an alpha-helix to beta-sheet transition. In *OsGRX24* of Bg352, two different alpha-helix regions were affected due to amino acid substitutions. Consequently, it could be speculated that these amino acid differences between the two varieties might be one of the causal factors for their phenotypic differences in salinity responsiveness.

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## INTRODUCTION

Rice is an important cereal crop as it is the staple food for more than half of the world population, especially in Asia. Soil salinity is a major abiotic constraint for rice that results in severe agricultural losses by decreasing crop productivity and quality. Generally, the soil is defined as saline when the soil electrical conductivity (EC) of the saturation extract in the root area exceeds 4 dSm<sup>-1</sup> (40 mM NaCl) at 25 °C. Most of the crop plants exhibit slower growth rates, reduced reproductive development and lower yield under high salinity conditions (Shrivastava et al., 2015). The response of rice to salinity varies with different growth stages. Usually, rice is more tolerant to salinity at the germination stage while more susceptible at seedling and reproductive stages (Zeng and Shannon, 1998).

Phenotyping and genotyping of rice cultivars with differential tolerance to salinity is a common practice deployed to identify the tolerance mechanisms and underlying genes. Single nucleotide polymorphism (SNPs) found in salt-tolerant and sensitive cultivars indicates different genetic variations in genes.

Plants occupy several mechanisms to overcome and thrive in high salinity stress conditions. One of the common mechanisms is maintaining a low Na<sup>+</sup>/K<sup>+</sup> ratio in the cytosol. The Na<sup>+</sup> H<sup>+</sup> exchanger (NHX) genes in tonoplast are capable of sequestering Na<sup>+</sup> ions into the vacuole. The sequestering of Na<sup>+</sup> ions reduces the cytoplasmic Na<sup>+</sup> concentration and helps to maintain the osmotic balance. There are five antiporter genes *OsNHX1*, *OsNHX2*, *OsNHX3*, *OsNHX4*, and *OsNHX5* have been identified in rice (Zhang et al., 2018).

Glutaredoxins (*GRX*) are oxidoreductase enzymes that involve in maintaining and regulating redox states in cells and different redox-dependent signalling pathways. There are several *GRX* genes reported in rice and expression studies have indicated that *GRXs* participate in responding to various environmental stimuli including salinity stress (Garg et al., 2010).

Our previous study revealed whole genomic sequences of At354 and Bg352 which are salt-tolerant and susceptible rice cultivars respectively, where 2,478,369 and 2,477,244 number of SNP variants were found respectively (Abhayawickrama et al., 2020). By filtering abiotic stress-responsive genes, it was identified that two salt responsive genes, *OsNHX4* and *OsGRX24* contained polymorphic SNPs between At354 and Bg352, indicating a possible association with salinity responsiveness. Therefore, the present study was undertaken to further characterize the SNP based allelic differences of *Os06g0318500*(*OsNHX4*) and *Os11g0656000*(*OsGRX24*) genes and their corresponding *OsNHX4* and *OsGRX24* proteins.

## METHOD

### Identification of SNP Variants

Whole-genome re-sequencing of At354 and Bg352 was done in our previous study using Illumina's paired-end sequencing technology on the Hiseq 2500 platform. The *Oryza sativa japonica* group cultivar Nipponbare IRGSP-1.0 (GenBank Assembly Accession: GCA\_001433935.1) which is categorized as a moderately salinity tolerant variety (Quan et al., 2018) was used as the reference genome (Abhayawickrama et al., 2020). The abiotic stress tolerance related genes were identified using NCBI GenBank Database and Gramene Database. Two known salinity stress tolerance related genes with polymorphic SNPs, *OsNHX4* and *OsGRX24* were selected for further analysis.

### Comparative Analysis of SNPs in *OsNHX4* and *OsGRX24*

Gene Ontology (GO) analysis was conducted to obtain the molecular, biological and cellular components of *OsNHX4* and *OsGRX24*. The corresponding gene sequences of At354 and Bg352 retrieved from whole genomes, were aligned with the respective Nipponbare reference gene sequences using Unipro Ugene software (Okonechnikov et al., 2012). The exon regions of the coding sequences of each gene

were examined to identify the SNP variants polymorphic between At354 and Bg352. The coding sequences of *OsNHX4* and *OsGRX24* were translated into the amino acid sequences by the NCBI ORF Finder (<https://www.ncbi.nlm.nih.gov/orffinder/>). The physiochemical characteristics such as sequence length, molecular weight, the iso-electric point were retrieved for corresponding haplotypes using the Ugene software. Besides, the secondary protein structures were predicted by the GORIV method.

## RESULTS AND DISCUSSION

Analysis of the variants showed that *Os06g0318500*(*OsNHX4*) had 4 SNPs and 9 SNPs in At 354 and Bg 352 while *Os11g0656000*(*OsGRX24*) had 3 and 5 SNPs in At354 and Bg352 respectively.

GO analysis showed that *Os06g0318500* is involved in Na<sup>+</sup> K<sup>+</sup> antiporter activity (GO:0015385, GO:0015386). Also, the gene participates in biological processes such as responding to salt stress (GO:0009651), regulation of intracellular pH (GO:0051453) and promoting Na<sup>+</sup> K<sup>+</sup> homeostasis (GO:0055075, GO:0071805, GO:1902600).

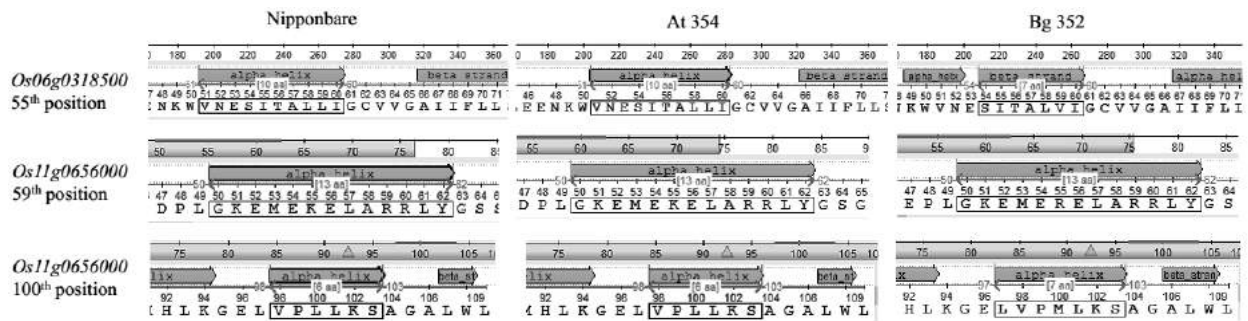
According to the secondary structures of *OsNHX4*, the amino acid residue at 59<sup>th</sup> position in Bg352 has been changed to Valine (V) from Leucine (L), affecting an alpha-helix and converting it into a beta-sheet (Figure 1) which appears less stable than alpha-helix structure.

According to the GO analysis, the gene *Os11g0656000* namely, Glutaredoxin 24 (*GRX24*) is associated with electron transfer activity (GO:0009055) and protein disulfide oxidoreductase activity (GO:0015035). Also, *GRXs* are involved in several metabolic pathways and protect plants over salinity and oxidative stress (Meyer et al. 2012). Analysis of the secondary structure of the *OsGRX24* showed that two amino acid variations were present in alpha-helix regions in the protein structure on 55<sup>th</sup> and 100<sup>th</sup> positions in the amino acid sequences of Bg352. The 55<sup>th</sup> amino acid residue has been changed into an Arginine (R) from Lysine (K) while the 100<sup>th</sup> amino acid has been changed into a Methionine (M) from Leucine (L) (Figure 1). The slight increase in the iso-electric point of At354 may be due to the substitution of polar amino acids (Table 1).

**Table 1.** Physiochemical Properties of *Os06g0318500* and *Os11g0656000*

Variable	Os06g0318500			Os11g0656000		
	At	Bg	Nip	At	Bg	Nip
Length of Protein	541	541	541	109	109	109
Molecular Weight	59564	59572	59621	11326	11361	11331
Isoelectric Point	7.1	7.1	7.1	8.77	8.36	8.36
Hydrophobicity %	54	55	54	36.8	40.4	42.3

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**Figure 1.** Analysis of Secondary Structures Showing the Affected Alpha-Helices or Beta-Sheets in *Os06g0318500* and *Os11g0656000*

## CONCLUSION

The results showed that SNP variations that occurred in the coding regions of the gene sequences have altered the physiochemical parameters of *OsNHX4* and *OsGRX24* amino acid sequences. The substitutions of amino acid residues in the *OsNHX4* and *OsGRX24* of Bg352 may have changed the stability of the proteins and affected the salinity tolerance adversely. Further studies on gene expression profiles are necessary for the confirmation of results.

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## Molecular Phylogeny of Rasboroides (Family Cyprinidae): An Endemic Freshwater Fish Species in Sri Lanka

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### ABSTRACT

Fish are considered as a highly diverse paraphyletic group in the animal kingdom. Freshwater fish show a significant diversity. The family Cyprinidae consists of the largest freshwater fish group, including nearly 210 genera and 2,100 species which exhibit a vast distribution throughout the world. Among the freshwater fishes, *Rasbora* is considered as the most species rich genus within the subfamily Rasborinae. Rasboroides is endemic to Sri Lanka and represents four species, including *Rasboroides vaterifloris*, *Rasboroides nigromarginatus*, *Rasboroides pallidus* and *Rasboroides rohani*. According to morphological studies, these species are grouped into one genus, but molecular identification has not been carried out except for *Rasboroides vaterifloris*. This study was designed to understand the position of *Rasboroides vaterifloris* within the family Cyprinidae. The mitochondrial cytochrome oxidase C gene (Cox1) sequences of 40 taxa were extracted from the National Center for Biotechnology Information (NCBI). A phylogenetic analysis carried out using the parsimony method in Seaview 4.6.1 with 1000 bootstrapped. The resulting phylogeny comprised of six main clades. *Horadandia atukorali*, and *Rasboroides vaterifloris* in the current study showed the sister group relationship with *Rasbora trilineata* and showed a monophyletic relationship with clade B. The sister group of *Rasboroides vaterifloris* and *Horadandia atukorali* showed a monophyletic relationship with *Rasbora trilineata* with a low bootstrap (46%). These results support the findings of the recent studies of Genus *Rasboroides*. It is essential to study more species in order to identify the taxonomical location of *Rasboroides vaterifloris* in the Family Cypiriniidae.

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## INTRODUCTION

Sri Lanka is enriched with high diversity of fauna and flora and freshwater fish diversity is incredibly significant. According to the recent studies, there are 119 freshwater fish species found in the inland freshwater bodies and among them 55 species are endemic and 27 species are exotic (Ministry of Environment, 2012). There are 45 species which have been identified as threatened, including one critically endangered or extinct species. Another 20 species are critically endangered (CR), 19 species are endangered (EN) and six species are vulnerable (VU). However, the 40-threatened species considered as endemic species. The freshwater fish considered as vulnerable taxonomic group as most of the threatened or endemic species found in streams outside the protected areas of Sri Lanka (Goonatilake, 2012). Senanayake & Moyale, 1982 have identified four major Ichthyological zones (Southwestern, Mahaweli, Dry and transition) according to the distribution pattern of the freshwater fish in Sri Lanka. The Southwestern and Mahaweli zones comprise of high freshwater fish diversity (Goonatilake, 2012).

*Rasboroides* represent four species, including *Rasboroides vaterifloris*, *Rasboroides nigromarginatus*, *Rasboroides pallidus* and *Rasboroides rohani* belong to family Cyprinidae, subfamily Rasborinae. All these four species of *Rasboroides* are endemic to Sri Lanka (Deraniyagala, 1930); (Meinken, 1957); (Deraniyagala, 1957) and (Batuwita, et al., 2013). Deraniyagala, 1930 distinguished *Rasboroides vaterifloris* as a distinct species from all known Indian and Ceylon (Sri Lanka) species of *Rasbora* in possessing an incomplete lateral line. (Brittan, 1954) created the monotypic subgenus *Rasbora* (*Rasboroides*) for *Rasboroides vaterifloris*, however, this subgenus was omitted from the study conducted by (Pethiyagoda, 1991). Later Kottelat & Vidthayanon (1993) validated it and elevated it to a generic rank. Meinken (1957) distinguished *Rasbora nigromarginatus* from the *Rasbora vaterifloris* according to their different morphology with a black lined golden color body with a moderate convex dorso-ventral profile. Deraniyagala (1957) reclassified this species into

*Rasboroides vaterifloris* identifying it as a color variant. Pethiyagoda (1991) further stated that these species cannot be differentiated, unless a careful comparative examination of morphometric differences, distribution and ecology. Therefore, *Rasboroides nigromarginatus* retained in the taxa *Rasboroides vaterifloris*. In a 2010 survey carried out by the Wildlife Conservation Society, Galle discovered the same population and re-described as a valid species (Batuwita, et al., 2013). They have split the color morph of *Rasboroides vaterifloris* as *Rasboroides pallidus* (Deraniyagala, 1957) from Kombala Kottawa forest and described another new species *Rasboroides rohani* from Suriyakanda, Singharaja forest (Batuwita, et al., 2013). According to the previous studies, *Rasboroides* species complex (earlier known as *Rasboroides vaterifloris*) has wider distribution from the Kelani basin to Nilvala basin in the low country wet zone clear streams. Figure 1 shows thirty four locations as distribution areas of *Rasboroides* spp. According to the (IUCN) fish database 2012 and (Batuwita et al., 2013). Batuwita, et al., 2013 identified the different pattern of distribution of four species. This distribution slightly differs from the Pethiyagoda (1991) distribution description. The purple colored circles in the figure 1 indicates the old distribution of the *Rasboroides*. In the meantime, the population with similar color patterns which belongs to the above four species can be found throughout the area of distribution. *Rasboroides vaterifloris*, *Rasboroides nigromarginatus*, *Rasboroides pallidus* and *Rasboroides rohani* are endemic to Sri Lanka (Deraniyagala 1930; Meinken 1975; Deraniyagala, 1957 and Batuwita, et al., 2013). Deraniyagala (1930) distinguished *Rasboroides vaterifloris* as a distinct species from all known Indian and Ceylon species of *Rasbora* in possessing an incomplete lateral line. (Brittan, 1954) created the monotypic subgenus *Rasbora* (*Rasboroides*) for *Rasboroides vaterifloris*, however, this subgenus was omitted from the study of (Pethiyagoda, 1991). Later Kottelat & Vidthayanon (1993) validated it and elevated to a generic rank.

These species differentiated only by examining morphological features and a few molecular phylogenetic studies have been carried out in Sri



Lanka. However, a morphological and molecular phylogenetic analysis was done for *Horadandiya atukorali*, *Horadandia atukorali* and *Rasboroides vaterifloris* to be sister taxa and called to re-examine (Liao et al., 2010; Tang, et al., 2010). *Rasboroides vaterifloris* represents the clade C of phylogenetic tree constructed by (Liao et al, 2010). *Horadandia atukorali*, *Rasbora gracilis*, *Boraras species*, *Rasbora bankanensis*, *Trigonostigma heteromorpha*, *Rasbora argyrotaenia*, *Rasbora Sumatra*, *Danio species*, *Microrasbora rubescens* are some of the Rasborinae species which studied in this study. According to their results, *Horadandia atukorali* was placed in clade which *Rasbora gracilis* and *Boraras* represent. The distribution given in the paper (Batuwita et al., 2013) is limited and the external morphological characters are much not easy to identify in the field. However, distribution of these four species is very debatable and need to be clarified. Due to the above reasons, there is an urgent need of clear

species identification and identification of species-wise distribution throughout the wet zone for its gene pool conservation. Therefore, this study has been designed to identify each species with respect to their genetic basis using molecular genetics studies and morphological studies. In the aspect of conservation, several sites of these species are now in vulnerable and selected as sites for mini hydro projects (eg. Atweltota site- only known site for *Rasbora nigromarginatus*). In addition, as shown in the figure 1, about 13 locations which distribute these four species have been recorded outside the protected area network. These results will be helpful to ecologists and conservationists to study and conserve the existing *Rasboroides* species. Therefore, this study has been designed as a preliminary study to predict the phylogenetic position of endemic *Rasboroides* species in Sri Lanka by using the available literature.

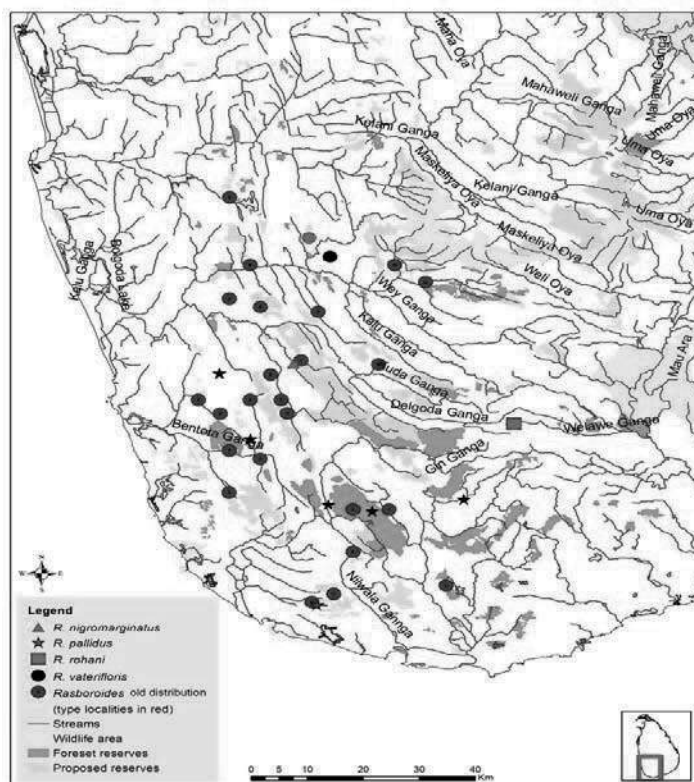


Figure: 1 Distribution of *Rasboroides* in Southwestern Sri Lanka. Batuwita, De Silva, & Edirisinghe, 2013 and Ministry of Environment, 2012.

## METHODOLOGY

Mitochondrial DNA sequences extracted from 40 species which represented in Annex table 1 were selected to develop a phylogeny according to a study done by Liao et al., 2010. The DNA sequence data were extracted from the National Center for Biotechnology Information (NCBI), USA. Mitochondrial *cytochrome oxidase c subunit 1 (cox1)* gene sequences were used to construct the phylogeny.

Nucleotide sequences were input into the Seaview 4.6.1 software and multiple alignment was performed by using Clustal Omega. Sequences were trimmed within 113 – 519. The phylogeny was bootstrapped with 1000 replicates. Parsimony phylogeny was constructed with 12 best consensus trees.

## RESULTS

The constructed molecular phylogenetic tree contains five clades labeled as A, B, C, D, E and F as shown in the figure 2. *Rasboroides vaterifloris* placed in the clade C. This is a small clade only include four species which show the monophyletic relationship with the clade B but with a low bootstrap support. *Rasboroides vaterifloris*: *Horadandia atukorali* represent the sister group and *Rasbora trilineata* and *Rasbora cephalotaenia* branched out individually. However, they show the monophyletic relationship with *Rasboroides vaterifloris*: *Horadandia atukorali*. The bootstrap value is 46% where it shows less support of branch nodes.

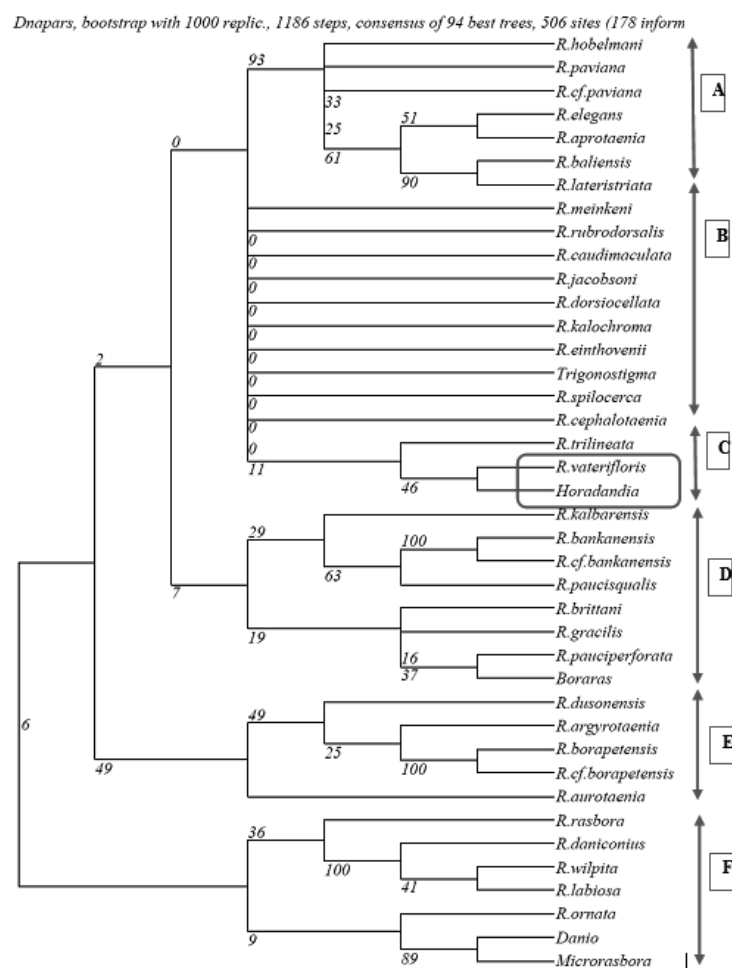


Figure 2: Molecular Phylogeny – Maximum Parsimony Tree bootstrap with 1000 replicates and consensus of 12 best trees.

## DISCUSSION

The clade C is the important clade for this study where it represents *Rasboroides vaterifloris* a species which is an endemic to Sri Lanka. This study shows that *Rasbora trilineata* branched out from the same ancestor but represent as monophyly with sister group of *Rasboroides vaterifloris* and *Horadandia atukorali*. However, there was a less bootstrap value which is about 46%. *Rasboroides vaterifloris* and *Horadandia atukorali* represent the sister group relationship in here as Tang et al., 2010. The same relationship showed in morphological phylogeny constructed by Liao et al., 2010. In that study, *Trigonostigma heteromorpha* showed a close relationship with *Rasboroides vaterifloris* and *Horadandia atukorali* where that was not displayed in the molecular study of Tang, et al., 2010 and the current study. They may have showed some morphological similar characters but can be genetically dissimilar. *Rasbora spilocerca* placed as the monophyly which was branched out from the major group of *Boraras*: *Trigonostigma* and *Rasboroides vaterifloris* and *Horadandia atukorali* were placed in (Liao et al., 2010) morphological phylogeny. *Horadandia atukorali* was grouped in the clade which *Boraras* species included in the molecular study done by Mayden, et al., 2008. *Horadandia atukorali* was grouped with *Rasbora gracilis* and *Boraras* in Conway et al., 2008 study. Mayden, et al., 2008 have been constructed phylogeny using *RAG1* gene sequence analysis. However, according to Tang, et al., (2010) *Rasbora spilocerca* and *Rasbora trilineata* showed a sister group relationship, but no close relationship was shown with *Rasboroides vaterifloris* and *Horadandia atukorali*. However, they recovered *Rasboroides vaterifloris* and *Horadandia atukorali* as sister to all other members of tribe Rasborini (Tang, et al., 2010). Kottelat and Vidthayanon were recognized *Rasboroides* as distinct genus and separated from *Horadandia atukorali* but stated that there are similarities between two species. All these studies show different relationships of the same species because the number of taxa they analysed were

limited. Mayden, et al., 2008 study was highly informative which analysed many species from different families of the order Cypriniformes. *RAG1* gene sequence was used to construct the tree and the results were different than the Tang, et al., 2010 which have done with *Cytochrome Oxidase C Subunit 1 (COI)* and *Cox1* gene sequences. The study conducted by Tang et al., 2010 have analysed more species in tribe Rasborini. The current phylogenetic tree shows more similarities to phylogenetic tree constructed by Tang et al., 2010 because most of the nucleotide sequences were extracted from that study. In Tang et al., 2010 study, *Rasboroides vaterifloris* and *Horadandia atukorali* showed a sister group relationship with the rest of the Rasborinae family, whereas *Horadandia atukorali* was placed with *Rasbora gracilis* and *Boraras* in the study conducted by Conway et al., 2008. Similarly both *Rasbora gracilis* and *Boraras* were placed in the same clade in the current study. Both studies were analyzed *RAG1* gene sequence. *Horadandia atukorali*, and *Rasboroides vaterifloris* in the current study shows sister group relationship with *Rasbora trilineata* and shows the monophyletic relationship with the clade B as Tang, et al., 2010 study this study also used *Cox1* and *COI* gene sequence. The results were little different in morphological phylogeny which Liao et al., 2010 *Horadandia atukorali* was placed with *Trigonostigma heteromorpha*. According to results obtained from molecular studies and morphological studies the position of the species can be changed due to molecular level differences. Species may show remarkably similar characters morphologically, but the genetic basis of those species can be distinct. Kottelat & Vidthayanon, 1993 recognized *Horadandia atukorali* and *Rasboroides vaterifloris* as a distinct genus. *Rasboroides* have elevated to generic rank and noticed similarities between *Horadandia atukorali* and *Rasboroides vaterifloris* but *Rasboroides vaterifloris* was not treated as a synonym of *Horadandia atukorali* (Tang, et al., 2010). The sister group relationship in the phylogenetic map was recognized and the related results were reported in previous

studies such as Conway et al., 2008, Tang et al., 2010 and Liao, et al., 2010.

## CONCLUSION

In this study *Rasboroides vaterifloris* and *Horadandia atukorali* showed the sister group and a monophyletic relationship with *Rasbora trilineata* but have a less bootstrap support which is about 46%. All the other endemic *Rasboroides* species, *Rasboroides nigromarginatus*, *Rasboroides pallidus* and *Rasboroides rohani* were not sequenced and

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a phylogenetic position was not decided. To make better conclusions on the phylogenetic position of these species needs to be analysed more taxa in the family. Since this study had considered 40 taxa in genus *Rasbora*, the phylogenetic position of *Rasboroides vaterifloris* has been repositioned.

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Annexure Table 1: Taxa Used to Construct Phylogenetic Tree with Gene Bank Accession Numbers.

Taxon	Gene Bank Accession Number	Source
Rasbora aprotaenia	KT960800.1	Dahrudin et al. (2016).
Rasbora argyrotaenia	EF452880.1	Mayden et al. (2007)
Rasbora gracilis	JF915665.1	Collins et al. (2011).
Rasbora baliensis	KT960811.1	Dahrudin et al. (2016).
Rasbora brittani	JF915657.1	Collins et al. (2011).
Rasbora caudimaculata	KC456377.1	Collins et al. (2011).
Rasbora daniconius	KJ476780.1	Lal et al. (2014).
Rasbora ornata	KX245114.1	Singh et al. (2016).
Rasbora paucisqualis	JF915671.1	Collins et al. (2011).
Rasbora paviana	JF781227.1	Song et al. (2013).
Danio dangila	KT199752.1	Kullander et al. (2015).
Microrasbora rubescens	LC189908.1	Kano et al. (2016).
Boraras brigittae	JF915557.1	Collins et al. (2011).
Rasbora dorsiocellata	HM224224.1	Tang et al. (2010).
Horadandia atukorali	FJ753505.1	Britz et al. (2009).
Rasboroides vaterifloris	EF452876.1	Mayden et al. (2007).
Rasbora spilocerca	HM224240.1	Tang et al. (2010).
Rasbora pauciperforata	HM224236.1	Tang et al. (2010).
Trigonostigma heteromorpha	JF915697.1	Collins et al. (2011).
Rasbora cephalotaenia	EF452881.1	Mayden et al. (2007)
Rasbora einthovenii	HM224226.1	Tang et al. (2010).
Rasbora elegans	HM224227.1	Tang et al. (2010).
Rasbora rasbora	HM224238.1	Tang et al. (2010).
Rasbora labiosa	JX887606.1	Kalyankar et al. (2012).
Rasbora lateristriata	KT960818.1	Dahrudin et al. (2016).
Rasbora cf.paviana	HM224223.1	Tang et al. (2010).
Rasbora cf.borapetensis	HM224222.1	Tang et al. (2010).
Rasbora cf. bankanensis	EF452871.1	Mayden et al. (2007)
Rasbora rubrodorsalis	HM224239.1	Tang et al. (2010).
Rasbora trilineata	KC456379.1	Panprommin (2013).
Rasbora wilpita	JX260962.1	Kalyankar et al. (2012).
Rasbora meinkeni	HM224233.1	Tang et al. (2010).
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## Review on Methods of Explant Surface Sterilization for Efficient Micropropagation

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### ABSTRACT

Surface sterilization of plant parts which are introduced to commence *in vitro* establishment is a crucial activity in micropropagation. To begin the elimination of microbial contaminations, selected plant parts should come from healthy mother plants which are grown in a protected environment with minimal biotic and a biotic stress. However, other than epiphytic microorganisms, plants also harbour microorganisms in the intercellular spaces which are referred to as endophytes. Thus elimination of contaminants to obtain axenic cultures is a challenge especially since endophytes can be carried over to the multiplication stage. Bacteria, fungi and viruses are popular among *in vitro* culture contaminants; hence sterilizing agents which can destroy epiphytic as well as endophytic microorganisms should be used with different concentrations and exposure time according to the explant type and plant variety. In this respect, disinfectants such as Sodium Hypochlorite, Benzalkonium Chloride, antibiotics (tetracycline + vancomycin + streptomycin + gentamycin + rifampicin), fungicides (Daconil™, Benomyl,) are used in plant culture to control or destroy pathogens. Efficacy, handling and storage must be carried out in aseptic conditions. This article has filtered all the surface sterilization methods and obtained the easiest and effective methods of sterilization of commonly used explants such as leaves, buds, nodes and seeds.

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## INTRODUCTION

Micropropagation is carried out by strictly adhering to aseptic procedures to prevent microbial contaminations. However, endophytes and epiphytes can be reintroduced from even slight negligence in aseptic handling (Daud et al, 2012). These microorganisms include bacteria, rickettsia, fungi, yeast, viruses (Kandel et al, 2017).

Once microorganisms get introduced in the culture from various avenues, they grow faster than the plant cells and the number overrides and competes further for nutrients and deteriorates the growing plant tissue. The results are the death of the whole tissue, tissue necrosis, reduced rooting and shoot proliferation (Webster et al, 2003). In most cases, contamination percentage increases when explant material is sourced directly from field-grown plants (Aarifa et al, 2013). To overcome detrimental effects generated from the microorganisms, attention should be paid to all five stages of micropropagation to prevent its introduction.

Mother plants should be grown in a protected house under optimum growth requirements so as not to create any biotic or abiotic stresses. Woody mother plants should be pruned, and newly developed shoots should be harvested as explants (Dissanayake et al, 2019). Plants that have been treated with fungicides and antibiotics before explant removal has produced a higher percentage of uncontaminated and vigorously growing shoots (Webster et al, 2003). In most cases, nodal explants show more contaminations than other types of explants such as leaves and stems due to the presence of endophytes in the extra cellular matrix (Quambusch et al, 2016).

Contaminations sometimes surpass the culture establishment stage. Some internal contaminants become exposed at later subcultures and it will be difficult to eliminate (Reed et al, 1998). Even though the explants are isolated and rinsed with Clorox™/ bleach or antibiotics, after several days they will become de-contaminated. In this case, detection at an early stage can aid

in selecting bacteria-free cultures (Reed et al, 2004). Bacterial contaminations can be identified as a yellowish/cloudy zone in the agar medium around the explant base within 10-15 days invariably in all the cultures (Harleen et al, 2012). Fungal contaminations can be identified as fluffy/ powdery/ mucus colonies with white, black or green in colour (Varghese and Joy, 2016) to the naked eye. Viral and chemical contaminants can also have considerable consequences for plant cultures. Daily microscopic observation of suspected cultures will also ensure early detection of microbial contamination and carry out appropriate action to be taken as soon as the first signs become visible. The other most threatening micro-organism type is mycoplasma, a genus of bacteria that do not possess a cell wall. Its contaminations are not easily detectable and do not get affected by antibiotics. Hence, it is very challenging for plant tissue culture. The objective of this paper is to introduce efficient sterilization methods that significantly reduce epiphytic as well as endophytic contaminants in *In-vitro* cultures.

## SURFACE STERILIZATION OF DIFFERENT TYPES OF EXPLANTS

### Leaves and Buds

Leaf explant is one of the popularly used materials for *In vitro* establishment. Plant species such as anthurium (Atak and Çelik, 2009), African Violet (Mukund et al, 2013), Begonia (Mendi et al, 2009), Streptocarpus (Read and Preece, 2007) are micropropagated commercially using leaf explants. In general, freshly collected leaves and buds are washed with liquid soap as a detergent with 2-3 drops of disinfectant by rubbing all the parts of the leaf gently and keeping it under slow running tap water for about 5 minutes. Then, the leaves are shaken gently for 10 minutes in 50µl of fungicide in 100 ml of distilled water. These explants are surface sterilized by adding 10% NaOCl (Clorox™) with one drop of Tween 20™ or liquid soap and are shaken for 10 minutes. The second wash is also employed again with 10% freshly prepared NaOCl by shaking it for another 10 minutes and

washed once with sterile distilled water by adding 2-3 drops of absolute alcohol (Oyebanji et al, 2009). Leaf explants are washed 2 times with sterile distilled water and added a few drops of antibiotic solution. Explants will be Cut into 1 x1 cm pieces and cultured in the nutrient culture medium.

### Nodes

The nodal explant is the most used material to establish shoot proliferation in micropropagation. Almost all plants can be successfully established *In Vitro* and once new shoots are produced, they can be multiplied for a required number. Being aerial parts shoots are expected to have less epiphytic microorganisms than the tissues underground (Biswas et al, 2009). The nodes are isolated as single nodes of about 2 cm having 1 cm from the node. Isolated nodes are rinsed by gently rubbing with liquid soap with 3-4 drops of liquid soap. Then they are shaken in 100µl of fungicide in 100ml of distilled water or about 1 hour. These explants are then washed with 10% bleach added 1ml/L liquid soap and shaken for 15-20 minutes. Before culturing, all the nodes are dipped in 70% alcohol for 3-4 seconds, rinse with sterile distilled water and rinse with 0.002% silver nitrate solution. Rinse twice with sterile distilled water and add few drops of antibiotic solution. Cut off the burnt edges of nodes and proceed with the culturing of nodes in the nutrient media (Daud et al, 2012).

### Seeds

Seeds are not popularly used to establish micropropagation as they do not produce true to type plants. Orchid seeds are minute and consist of little to no food reserves. Hence orchid seeds are germinated only in a nutrient medium or otherwise with the symbiotic relationship with mycorrhiza naturally. It takes about 3 to 4 months for an orchid pod to be ready for harvest. The mature unsplit orchid pod can be sterilized by dipping in 99% absolute alcohol and burning it in the flame 2-3 time. Then the pod is open, seeds are scraped out and carefully lay over the surface of the culture medium (O.S.T.M.R. guide, 2011).

Other than orchids other seeds can be sterilized using 90% ethanol or with sodium hypochlorite. First seeds must be rinsed with liquid soap while rubbing to remove any substance on the outermost coat to get rid of seed dormancy as it inhibits seed germination (Utami and Hariyanto, 2019). Then the seeds are kept under running tap water for 30 minutes. If sodium hypochlorite is used, 15% with 2-3 drops of liquid soap is used for 5- 10 minutes. The second wash also carried out with 10% freshly prepared sodium hypochlorite only by shaking it for 5-10 minutes, rinse 3 times with sterile distilled water and culture in an appropriate culture media (Utami and Hariyanto, 2019). Seeds of many species can be cultured in a water agar medium for better germination as MS or other media contain high salt content which can interfere with seed germination due to the high electrical conductivity value of the medium which hampers water absorption (Eren, 2017). However, *In Vitro* application of gibberellic acid has been given promising results for germination of seeds undergoing dormancy (Ribeiro et al, 2009).

## EFFECTS OF STERILIZATION AGENTS

### Disinfectants

Various disinfectants are used to decontaminate explants for *In Vitro* culture. Alcohol and NaOCl (Sodium Hypochlorite/ bleach) are the most commonly used disinfectants for surface sterilization of different type of explants. Sodium hypochlorite is very popular in the field of tissue culture because it is used for both explant surface sterilization and sterilization of media by sterilizing glassware (Peiris et al, 2011). The concentration of sodium hypochlorite will vary from explant to explant. For an instance, the concentration used for surface sterilization of nodes is higher than the concentration used for surface sterilization of leaves. Dissolving of NaOCl and water will give rise to two substances, hypochlorous acid (HOCl); which play a role in disinfection and hypochlorite ion

(OCl<sup>-</sup>); which play a role in the oxidation process (Namoos, 2010).

Seed surface sterilization is also possible with ethanol and isopropyl alcohol, which are the two most widely used alcohols for disinfectant activity. The optimum bactericidal concentration for ethanol and isopropyl alcohol is in the range of 60% - 70% by volume (WHO, 2014). Ethanol is used from the preparation room up to the laminar flow hood to kill pathogens and spores.

### **Fungicide**

Fungicides are often used to reduce endophytic fungal contaminations. Tebuconazole™ and Daconil™ can be used relatively safely and also have a broad-spectrum antifungal activity. The potency of fungicides depends on several factors: Type of fungal contaminations (exogenous/ endogenous), exposure time, the concentration of the fungicide, type of explant (mature/ immature shoots) or active ingredient. Generally, the exposure time is inversely proportional to the concentration of fungicide used (Simon et al, 2012). The use of fungicides on the mother plant in the field before harvesting the explants also have a promising effect (Dissanayake et al, 2019).

### **Antibiotics**

The use of fungicides alone will lead to the proliferation of other *In Vitro* pathogens such as bacteria, protozoa, mycoplasma and other microorganisms. To avoid this and control many contaminants, broad-spectrum antibiotics can be used in plant culture (Simon et al, 2012). Antibiotics generally must be stored at 4<sup>o</sup> C. Instead of using one antibiotic, a combination of two or more antibiotics helps to eliminate most contaminants (Reed et al., 1998) such as Streptomycin plus Gentamycin (SG),

Tetracycline plus Rifampicin (TR) and a combination of five antibiotics [tetracycline + vancomycin + streptomycin + gentamycin + rifampicin (TVSGR)] have given promising results in inhibition of bacterial growth in *In Vitro* micropropagation (Mbah and Wakil, 2012). Antibiotics used in plant tissue culture should be broadly active, soluble, unaffected by pH of the medium, non-resistance and minor side effects (Falkiner, 1997).

### **Silver Nitrate**

Silver is not considered a toxic heavy metal. Hence, silver nitrate can replace mercuric chloride which is used popularly for *In Vitro* establishment of explants. The most effective methods of explant treatment with silver nitrate are dipping them in 1% silver nitrate for 15-20 minutes (Ines et al, 2013). However, this method is mostly applied to buds and nodes. Silver-based antimicrobials are effective in the treatment of infections on the account of non-toxicity of active Ag<sup>+</sup> to plant cells (Andian et al, 2010).

### **Benzalkonium Chloride (BAC)**

Benzalkonium Chloride is a cost-effective disinfectant with antimicrobial properties against fungi, bacteria and viruses (Pereira and Tagkopoulos, 2019). A recent experiment has been conducted by using Benzalkonium Chloride containing commercial bleach (Lizol) and it has shown a cost-effective sterilization potential in *In Vitro* micropropagation. The explants (recalcitrant seeds of some medicinal, horticultural and other sensitive plants) are sterilized with 0.1% Benzalkonium Chloride in a combination with 70% alcohol for 5 minutes (Bhadane and Patil, 2016) and subjected to the next steps of sterilization.

### **CONCLUSION**

In the field of tissue culture, to obtain microorganism free *In Vitro* cultures,



sources of contamination need to be considered. Surface contaminants (epiphytes) can be killed by disinfectants such as sodium hypochlorite, benzalkonium chloride, ethanol, isopropyl alcohol, liquid soap. Endophytes can be destroyed by fungicides such as Daconil™, Tebuconazole™, Captain, Benomyl, Antibiotics combinations Tetracycline + Vancomycin + Streptomycin + Gentamycin + Rifampicin (TVSGR) or Tetracycline + Rifampicin (TR), Silver Nitrate (AgNO<sub>3</sub>) and toxic but efficient disinfectant; Mercuric Chloride (HgCl<sub>2</sub>). The

elimination of surface contaminants in mother plants by growing them in a protected house supplying the requirements at an optimal level can be an effective start. Contaminations are also minimized by keeping the laboratory under strict aseptic conditions and having properly trained operators. Sodium hypochlorite produced the largest reduction of bacterial and fungal contaminations and it is the most common cost-effective sterilizing agent for explant sterilization.

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## Effects of Silver Nitrate in *In Vitro* Establishment of *Cordyline fruticosa* (L.) cv 'Purple Compacta Tri Colour' with CSUP Media Sterilization

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### ABSTRACT

*Cordyline* Varieties have gained high interest in the export markets for the *in vitro* ex agar plant material. Though *in vitro* plants have many advantages in export markets required quantities cannot be produced in a given period of time due to the high contamination rates in establishment of explants. Hence, this study was carried out to investigate silver nitrate (AgNO<sub>3</sub>) in three concentrations, on *Cordyline fruticosa* cv 'Purple Compacta Tri Colour' as an efficient chemical which can overcome contaminations occurring during introduction of explants to the *in vitro* environment. Actively growing shoot tips and nodal explants from 6 cm below from the shoot tip of *C. fruticosa* were selected as explants. Surface sterilization of these explants was carried out with silver nitrate in three concentrations, 0.025%, 0.05% and 0.1%. Clorox™ in 10% was used as the control. The explants were cultured in Murashige and Skoog (MS) medium, with 0.5mg/L benzyl amino purine (BAP), which was sterilized with CSUP media sterilization. Data of non-contaminated cultures was collected after three weeks and shoot growth from explants was recorded after two months. According to the results obtained the explants treated with 10% Clorox™, 0.025%, 0.05% and 0.01 % of AgNO<sub>3</sub> had 13, 17, 22 and 40% uncontaminated cultures, respectively. These survived explants produced shoots in 50, 50, 60 and 66 % of uncontaminated explants, respectively after 2 months in the same medium. The production of uncontaminated cultures was significantly (P=0.001) different from the other two concentrations used and the control. The shoot production was not significantly affected by the AgNO<sub>3</sub> levels and when compared with the control. Hence, it can be concluded that 0.1 % of Silver Nitrate is an efficient chemical to obtain high amount of axenic cultures and shoots, in CSUP sterilized medium, which can be used for multiplication *in vitro*.

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## INTRODUCTION

*Cordyline fruticosa* cv 'Purple Compacta Tri Colour' belongs to family Asparagaceae and one of the most economically important indoor plants for its colorful foliage. Also Cordyline Varieties have a high demand in the export markets as a cut foliage (Weerahewa and Somaratne, 2011). Export performance of floriculture products from Sri Lanka was around USD 14,718,966 from decorative foliage plants in the year of 2019 and cordyline is one of the most popular foliage plants under the list of key products of Sri Lankan floriculture sector (EDB, 2019). By exporting such popular varieties as in vitro materials, the income from exports can be increased dramatically. *In Vitro* Micropropagation provides the possibility of producing a rapid growth of healthy plants in a small unit area within a short time and it helps to produce a large scale of plants (Ray et al., 2013). Mostly, Cordyline is propagated *in vitro* by using actively growing shoot tips or stem explants and it results in multiple shoot formation with the addition of benzyl amino purine (BAP) as a growth regulator (Kunisaki, 1975). Different factors such as plant growth regulators are being used to enhance the growth of micropropagated plants (Cardoso, 2019). Also it is shown that *in vitro* multiplication of cordyline Clones can be grown successfully in the solid medium (Khan et al, 2004; Evaldsson & Welander, 1985). Rooted Cordyline plants which are subjected to acclimatization show a 100% survival in the greenhouse and can be transferred into the nursery for sale (Khan et al, 2004).

Successful *in vitro* micropropagation of any plant depends on the health and vigorous growth of plant material during the time of collection of the explant and exogenous and endogenous contaminating microorganism-free explants (Safavi et al., 2011). In order to get favorable *in vitro* micropropagation of cordyline or any plant variety, a close attention must be paid at growth of the mother plant. Stages of micropropagation such as establishment, multiplication and rooting are performed under strict sterile conditions. Out of these stages, the most challenging is the establishment stage and it should be carried

out under high sterile conditions (Aghaye and Yadollahi, 2012). In order to destroy surface adhered microorganisms as well as endophytes, sterilization of explants is carried out using different procedures with sterilants such as sodium hypochlorite, mercuric chloride, silver nitrate, hydrogen peroxide, benzalkonium chloride, ethanol, fungicides and antibiotics.

Our study was conducted with an objective of finding the most effective concentration for explant sterilization by using silver nitrate ( $\text{AgNO}_3$ ) at 0%, 0.025%, 0.05% and 0.1% to reduce contaminations and produce viable, healthy shoots.

## MATERIALS AND METHODS

The actively growing shoot tips and nodes from 6 cm below from the shoot tip were collected as explants from the mother plants of *Cordyline fruticosa* cv 'Purple Compacta Tri Colour' growing in the plant house of Sri Lanka Institute of Information Technology, Malabe, Sri Lanka.

The terminal portions of the stem were cut into about 6 cm length from the mother plant. Leaves were removed by gentle peeling, without disturbing buds around the stem and thoroughly washing under running tap water. These explants were trimmed to about 1.5 cm for the surface sterilization and placed in four blue cap bottles each bottle containing 45 explants mix of shoot tips and nodes. A solution with a few drops of liquid soap and 30  $\mu\text{L/L}$  fungicide (Daconil™) were added and kept on the orbital shaker with a speed at 60 rpm for 30 minutes. The solution was decanted and 200 ml of 10% Clorox™ (Sodium hypochlorite -NaOCl ) were added to each bottle and kept on the shaker at 170 rpm for 15 minutes. Then this solution was decanted and fresh 10% Clorox™ was added and kept shaking for 10 minutes at the same speed. Explants were then washed thrice with sterile distilled water in the laminar air flow cabinet. The explants in one bottle (control) were cultured in the MS (Murashige and Skoog, 1962) agar medium with 0.5 mg/L BAP which was sterilized using CSUP techniques (Peiris et.al., 2011). Silver nitrate at 0.025%, 0.05%

and 0.1% concentrations was added to explants in the remaining three bottles and kept 10 minutes shaking occasionally. They were washed with sterilized water twice and cultured in the agar medium with the same composition. All the samples in the treatment and the control were arranged in complete randomized design in the culture growing room at 25°C and light level of 2000 lux for 16 hours. Data of uncontaminated cultures was collected after three weeks from the establishment and the shoot initiation was recorded after two months from initiation. Data was analyzed using linear logistic model (Thattil, 1998) for dose response on contamination and shoot initiation separately.

Table 1: Percentage of Uncontaminated Cultures of *C. fruticosa* CV 'Purple Compacta Tri Colour'

Treatment No.	Treatment (Ag NO <sub>3</sub> ) Concentration %	% of Uncontaminated Explants
1	0.025	18
2	0.05	22
3	0.1	40
4	0 - control	13

n= 45 - number of samples used to generate the percentages and analysis

The results of shoot initiation from the survived, uncontaminated explants were, 50, 60 and 67 and 50% from 0.025, 0.05 0.1% AgNO<sub>3</sub> treated explants and the control, respectively (Table 2, Figure 1). According to

The effect of the treatments was compared with the control in both analyses.

## RESULTS AND DISCUSSION

The best performance, after three weeks of *in vitro* establishment, was the 40% uncontaminated explants which were treated with 0.1 % AgNO<sub>3</sub>. The other concentrations, 0.05 and 0.025% had 22 and 18 %, respectively. The explants, surface sterilized with Clorox™ only, the control, survived 13% (Table1, Figure 1). According to the results of the contamination free cultures, the fitted logistic model for the control is -1.87 which is significant at 0.0001.

the results, the fitted logistic model is not significant which indicates that there is no statistical evidence to believe that different treatments would have different results on the shoot initiation.

Table 2: Percentage of shoot initiated explants from uncomminted cultures of *C. fruticosa* cv 'Purple Compacta Tri Colour'

Treatment No.	Treatment (Ag NO <sub>3</sub> ) Concentration %	Number of Uncontaminated Explants (n)	No. of Shoot Produced Explants	% of Shoots Produced from Uncontaminated Explants
1	0.025	8	4	50
2	0.05	10	6	60
3	0.1	18	12	67
4	0 - control	6	3	50

n= number of samples used to generate percentages and for the analysis.

It showed that 50 to 33% explants which were uncontaminated did not produce shoots. These explants are from the nodes of 5-6 cm away from the shoot tip. Though the explants were free from microbial contaminations after surface sterilization, it may not produce shoots due to various reasons such as explant maturity, internal damage to explants, endophytes and dormant

nature of mature nodes (Mihaljević, et.al, 2013). However, higher the survival percentage, higher the possibility of obtaining shoots which are suitable to enter the multiplication stage.



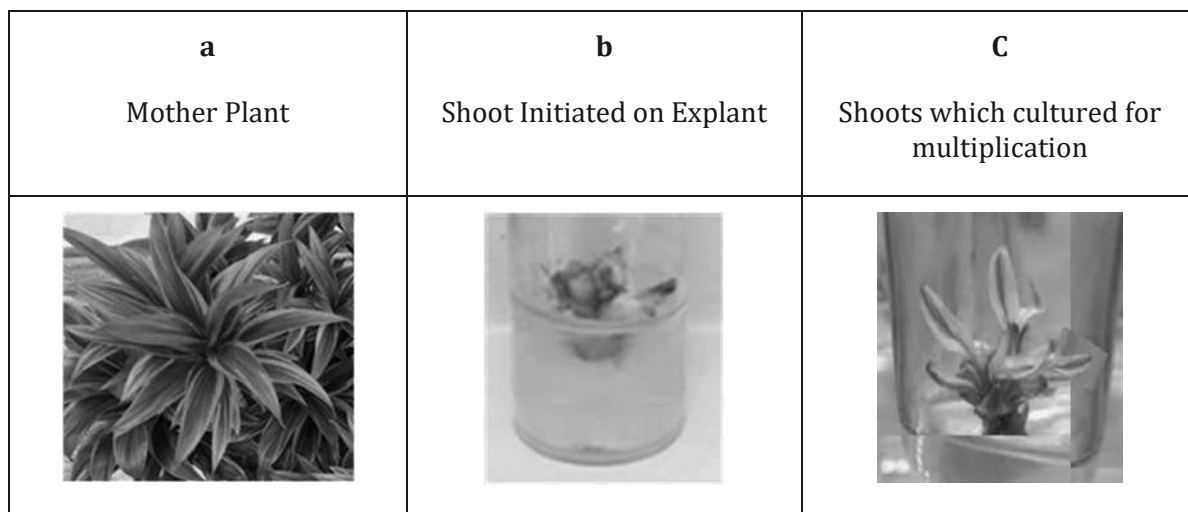


Figure 1: Various Stages of *C. fruticosa*- cv 'Purple Compacta':

The results revealed from this study showed that silver nitrate has an ability to destroy surface microorganisms effectively. Our findings are in agreement with the observations made by Nacheva and Ivanova (2017) who reported that explant sterilized with 2%  $\text{AgNO}_3$  produced 88% contamination free cultures which is the highest number of uncontaminated cultures of *Ginko biloba* tested in their study. In another study, Mihaljević et.al (2013) reported, 'Oblačinska' sour cherry, produced 96.67% healthy microbial contamination free explants when surface sterilized with silver nitrate ( $\text{AgNO}_3$ ) at concentration of 1% for 20 minutes. Also Atroschenko et al., (1990) reported that the explants of blackcurrants treated with 0.1% Silver Nitrate had a high percentage of explant survival.

Mechanisms of bactericidal action on killing them by silver ions are known to inhibit proteins by binding to their thiol groups and denaturing them. Also, silver ions prevent replication of DNA by its condensation. Silver also induces apoptosis in microbial cells (Pandian et.al, 2010). The investigations carried out in *in vitro* in a culture media by Melaiye & Youngs (2005) showed that the bioactive form of silver is the  $\text{Ag}^+$  ion. It ionizes into silver ions in the presence of aqueous media. In the presence of  $\text{Cl}^-$ , it produces anionic silver complex  $\text{AgCl}_2^-$ . This complex increases toxicity on sensitive as well as resistant bacteria strains and destroys the

cell wall, impairs essential enzymes, obstructs metabolic activity and/or causes RNA and DNA alteration.

*In vitro* establishment of plant parts is the major challenge in micropropagation. Having mother plants raised under stress free conditions makes this task a success up to some extent. However, explant living in *in vivo* environment is always in contact with microorganisms on their surfaces as well as inside the tissues between cells. Most of the surface sterilization methods address to destroy surface adhered microorganisms. In this activity, various chemicals are being used. However, the most important achievement is to produce a higher percentage of microbial contamination free explants which produce shoots to start the multiplication stage.

Contaminated explants can reduce the amount of shoots produced for the *in vitro* multiplication which will affect the final production. In order to overcome these problems, excessive cycles of multiplication are carried out with a less number of starting shoots in the multiplication stage. This leads to many problems such as hyperhydricity, poor rooting and poor performances of plants *ex vitro*. Hence, the production of a higher number of plants at the establishment is the most important aspect of micropropagation. In that perspective, this study revealed that having 0.1% silver nitrate as a sterilant for the



explant higher number of shoots can be produced to start in vitro multiplication.

## CONCLUSION

Silver nitrate in 0.1% concentration can be used to produce a higher number of uncontaminated cultures and shoots. According to the materials and concentrations used in this study, there is no significant difference in shoot production from the axenic explants of nodes and shoot tips of *Cordyline*

*fruticosa* cv 'Purple compacta tri colour' cultured using media sterilized with the CSUP technique.

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**SICASH**

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## ***In Vitro* Root Induction and Acclimatization of *Cissampelos pareira*: An Important Medicinal Plant**

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### ABSTRACT

*Cissampelos pareira*, known in Sinhala as *Diyamiththa*, is a climbing herb with numerous medicinal properties and belongs to the family Menispermaceae. The plant has a number of phytochemicals which have the potential to produce drugs for various diseases. An *in vitro* establishment and multiplication method were developed previously for this important medicinal herb in order to extract phytochemicals. Establishment of field plantations is another option to harvest large quantities of this plant. Therefore, the current study was aimed at developing a suitable *in vitro* root induction and acclimatization method for *in vitro* generated shoot tips of this plant. For root induction, micro-shoots were transferred to half strength MS medium with various combinations and concentrations of Indole-3-acetic acid (IAA) (0.5 and 1.0 mg/L) and Indole-3-butyric acid (IBA) (0.5, 1.0 and 1.5 mg/L). The study was carried out in Completely Randomized Design (CRD) with 20 replicates. The highest percentage of root formation, the highest number of roots and the highest length of roots were recorded in half strength MS medium with 0.5 mgL<sup>-1</sup> IAA and 1.0 mgL<sup>-1</sup> IBA. Above values were significantly higher than all other treatments ( $p \leq 0.05$ ). Five different potting media were tested for acclimatization and a significantly high rate of survival was recorded from plantlets established in coco pellets (95%) ( $p \leq 0.05$ ). The findings of this study can be used for commercial cultivation and further studies of *Cissampelos pareira*.

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## INTRODUCTION

*Cissampelos pareira* commonly known as *Diyamiththa* is an important medicinal herb belonging to the family menispermaceae with extensive medicinal uses in ayurvedic, Unani and traditional Chinese medicines. It is a climbing herb which is found throughout tropical and subtropical India from Sind and Panjab to South India and Sri Lanka (Lokhande and Biradar, 2016).

Leaves, stems and roots of this plant have a very high medicinal value because it contains numerous secondary metabolites as berberine (Kiritikar and Basu, 1999), hayatine, cissampeline, hyatinine, sepeerine, isochondodendrine (Jayaweera, 1982), pareirubrine A and B (Alves, 2017). Due to these medicinal properties, roots and leaves of *Cissampelos pareira* are used in preparation of herbal concoctions. The plant is used as an antioxidant, anti-inflammatory, diuretic, antihistamine, muscle relaxant, analgesic, cardio tonic, uterine relaxant, anti-diarrheal herb, and it also has tonic activities (Manu *et al.*, 2012). It is commonly used to treat indigestion, abdominal pain, diarrhea, blood disorders, bladder stones, cough, asthma, burns and wounds (Raveesha & Uthpala, 2018).

Though *Cissampelos pareira* is conventionally propagated by seeds and stem cuttings, efficiency of those methods is not sufficient to address the demand for commercial drug production. Hence, an *in vitro* establishment and multiple shoot induction protocol for this plant was developed in a previous study (Fonseka *et al.*, 2020).

Establishment of field plantations is another option to harvest large quantities of this plant for the secondary metabolite extraction. Hence, a large number of plantlets should be produced. *In vitro* generation of plantlets are the most efficient way of obtaining healthy planting materials.

Therefore, the current study was aimed at developing a suitable *in vitro* root induction

and acclimatization method for *in vitro* generated shoot tips of this plant.

## METHODOLOGY

Micro-shoots induced from a previous study was used for the root induction process (Fonseka *et al.*, 2020). About 2–3 cm long shoot tips with two to three leaves, harvested from the multiplication medium, were used for rooting. Micro-shoots were excised and inoculated on half strength MS medium with different concentrations and combinations of IAA (0.5 and 1.0 mgL<sup>-1</sup>) and IBA (0.5, 1.0 and 1.5 mgL<sup>-1</sup>). Cultures were maintained at 25 ± 2°C and 65–70 % relative humidity under photoperiod 16h light and 8h dark with 3000 lux light intensity by florescent tubes. Percentage of root formation, number of roots and length of roots were observed for the selection of best plant growth regulator combination for the root induction.

Plantlets of *in vitro* grown *Cissampelos pareira* with healthy, well-developed roots and shoots were removed from culture tubes and washed with lukewarm water to remove remaining agar in roots. Then, the plantlets were dipped in a fungicide solution for 10 minutes and transferred to five different acclimatization media (coco pellets, soil + sand (1:1), soil + coir dust (1:1), soil + sand + compost (1:1:1), soil + coir dust + compost (1:1:1)). Survival percentage of plantlets were observed after 8 weeks to select the best medium for acclimatization.

Data were statistically analyzed and mean separation was done with DMRT (Duncan's Multiple Range Test).

## RESULTS AND DISCUSSION

When planting tissues, it is clear that the endogenous hormones and nutrients from parent plants no longer exist since they are separated from their parent plants. Therefore, hormone sources are replaced by plant growth regulators in addition to tissue culture media. Manipulation of plant growth

regulators are essential to optimize root induction.

Auxins proved to be responsible for root induction of shoots and hence adding of auxins singly or in combinations to the rooting medium has been practiced for many plant species (Gopi *et al.*, 2006). According to the literature, IBA proved to be more successful in root induction of various medicinal plants (Chandra *et al.*, 2006).

In this study, the effects of IBA and IAA on root induction from *in vitro* generated shoots were investigated. Shoots were introduced to half strength MS medium supplemented with different growth hormone combinations.

Root induction was different according to the tested hormonal combinations. A significantly high root induction rate was observed in the medium supplemented with 0.5 mg/L IAA and 1mg/L IBA while a significantly low root induction rate was observed in the medium supplemented with 0.5 mg/L IAA and 1.5 mg/L IBA ( $p \leq 0.05$ ). The optimum root induction rate (95%) was observed on half strength MS with IAA (0.5 mg/L) and IBA (1.0 mg/L) with maximum mean number of roots (4.15) and mean highest length of root (3.96). Half strength MS medium containing 1 mg/ L IAA and 1.5 mg/L IBA reported the least root induction rate (61%) with minimum mean number of roots (1.48) and mean lowest length of roots (0.92) (Table 1).

Table 1: Effect of MS Medium Supplemented with IAA and IBA for Root Induction of *Cissampelos pareira*

IAA (mgL <sup>-1</sup> )	IBA (mgL <sup>-1</sup> )	Percentage of root induction	Mean number of roots	Mean length of roots (cm)
0.5	0.5	75 % <sup>b</sup>	2.50 <sup>b</sup>	1.21 <sup>c</sup>
1	0.5	78 % <sup>b</sup>	2.75 <sup>b</sup>	2.16 <sup>b</sup>
0.5	1.0	95% <sup>a</sup>	4.15 <sup>a</sup>	3.96 <sup>a</sup>
1	1.0	72 % <sup>b</sup>	2.46 <sup>b</sup>	2.21 <sup>b</sup>
0.5	1.5	70% <sup>b</sup>	2.35 <sup>b</sup>	2.08 <sup>b</sup>
1	1.5	61 % <sup>c</sup>	1.48 <sup>c</sup>	0.92 <sup>d</sup>

Table 2: Survival Percentage of Plantlets in Different Potting Media

Treatment	Ratio	Percentage of survival
Coco pellets	-	95 % <sup>a</sup>
Soil + Sand	1:1	60 % <sup>d</sup>
Soil + Coir dust	1:1	80 % <sup>b</sup>
Soil + Sand + Compost	1:1:1	70 % <sup>c</sup>
Soil + Coir dust + Compost	1:1:1	85 % <sup>b</sup>

The highest percentage of survival (95%) was observed in the plantlets acclimatized in coco pellets (Plate 1) while a significantly low survival percentage (60%) was observed in soil and sand mix (Table 2).

Coco pellet is a compressed coir dust disc that comes with added fertilizer and is covered in a bottom sealed bio degradable

net. Coir dust is found to be superior in characteristics such as structural ability, water absorption ability, drainage and cation exchange capacity compared to well-known potting media as sphagnum peat and sedge peat (Cresswell, 1992). Results of this study proved that coco pellets can be successfully used for acclimatization of *Cissampelos pareira* Linn.

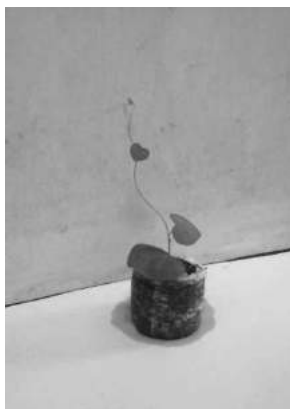


Figure1:  
An *in vitro* grown  
*Cissampelos pareira*  
Plantlet Acclimatized  
in a Coco Pellet

## CONCLUSION

Healthy plantlets of *Cissampelos pareira* can be successfully produced by rooting and acclimatizing *in vitro* generated shoot tips. The best hormonal combination for root induction from nodal explants is half strength MS medium supplemented with 0.5 mg/L IAA and 1.0 mg/L IBA and the best potting medium for acclimatization is coco pellets. The results of this study can be used for commercial production and future studies of this plant.

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## Callus Induction Protocol for *Aegle marmelos* (L.) Corr. (Beli) through Seeds Explants

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### ABSTRACT

*Aegle marmelos* (L.) Corr. commonly known as 'beli' in Sri Lanka is an important fruit tree with extensive medicinal properties. Roots and shoots being vital parts of indigenous medicine, destructive harvesting poses a serious threat to the sustenance of this plant. Though this plant is conventionally propagated by seeds and root suckers, the efficiency of these methods is not sufficient. Therefore, this study aimed to develop an effective protocol for callus induction for *Aegle marmelos*. Seeds were sterilized with 5% Clorox bleach (5.25% sodium hypochlorite as the active ingredient) for 5 minutes and established in Murashige and Skoog (MS) medium supplemented with various concentration and combinations of BAP ( $0.5 \text{ mgL}^{-1}$ ,  $1 \text{ mgL}^{-1}$ ,  $0.5 \text{ mgL}^{-1}$ ) and 2,4-D ( $1 \text{ mgL}^{-1}$ ,  $2 \text{ mgL}^{-1}$ ). The study was arranged according to the Completely Randomized Design (CRD) with five replicates. The growth and colour of callus were recorded accordingly. No significant difference ( $p \leq 0.05$ ) was observed within treatments used for callus induction from *Aegle marmelos*. Hence, callus can be generated from combination of  $0.5 \text{ mgL}^{-1}$  to  $1.5 \text{ mgL}^{-1}$  BAP and  $1 \text{ mgL}^{-1}$  to  $2 \text{ mgL}^{-1}$  2,4-D. The findings of the study can be used for future *in-vitro* propagation studies of *Aegle marmelos*.

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## INTRODUCTION

Traditional medicine based on herbs is still the primary source of health care for more than 60% of the world's population. According to Shrestha and Dhillon (2003), about 80% of developing countries directly depend on medicinal plants to treat ailments due to various reasons as affordability, accessibility, and low cost. Various plant parts of *Aegle marmelos* as leaves, fruits, stems, flowers, bark, and roots of different maturity stages are being used to treat diseases from ancient ages.

Though *Aegle marmelos* is conventionally propagated by seeds and root suckers, seeds have short viability and produce slow-growing seedlings which are liable to diseases and pests in the initial stage (Akter et al. 2013). According to Ray and Chatterjee. (1996) Vegetative propagation through root suckers is also slow and difficult.

*In Vitro* Propagation of tree species provides several advantages over conventional propagation as high speed of propagation, reduced space requirements, independence from climatic and seasonal variations, and year-round production. Hence, this study aimed to develop a suitable *in vitro* callus induction protocol for this important medicinal tree.

## MATERIALS AND METHODS

The study was conducted at the Tissue Culture Research Laboratory of the Department of Crop Science, Faculty of Agriculture, University of Ruhuna. Seeds were used as Ex-plants. Fresh, ripped fruits of *Aegle marmelos* were collected from healthy well-growing trees in hygienic and pollution-free areas in the month of October-December, from various regions of the Kamburupitiya area. Seeds were removed from the fruits with help of a scalpel and collected seeds were washed with a liquid detergent (2-3 drop of Teepol was used). Then, the seeds were kept under running tap water for 30 minutes and dipped in fungicide solution (Topsin Solution  $0.6\text{gL}^{-1}$ ) for another 30 minutes. Finally, they were taken to the laminar flow cabinet for further

surface sterilization. The above ex-plants were washed with 5% Clorox solution for 5 minutes and rinsed off with sterilized distilled water for 3 times to remove excess bleach. Then the seeds were immersed in 70 % alcohol solution for 30 seconds and again rinsed off with sterilized distilled water 3 times. Seeds were kept in distilled water until culturing.

Surface sterilized seeds were established in MS medium supplemented with six different treatments of BAP and 2,4-D (Treatment 1 (T1) - BAP  $0.5\text{mgL}^{-1}$  + 2,4-D  $1.0\text{mgL}^{-1}$ , Treatment 2 (T2) - BAP  $1.0\text{mgL}^{-1}$  + 2,4-D  $1.0\text{mgL}^{-1}$ , Treatment 3 (T3) - BAP  $1.5\text{mgL}^{-1}$  + 2,4-D  $1.0\text{mgL}^{-1}$ , Treatment 4 (T4) - BAP  $0.5\text{mgL}^{-1}$  + 2,4-D  $2.0\text{mgL}^{-1}$ , Treatment 5 (T5) - BAP  $1.0\text{mgL}^{-1}$  + 2,4-D  $2.0\text{mgL}^{-1}$ , Treatment 6 (T6) - BAP  $1.5\text{mgL}^{-1}$  + 2,4-D  $2.0\text{mgL}^{-1}$ ) to select best hormonal combination for callus induction of *Aegle marmelos*. After culture initiation, all the cultures were maintained under temperature between 25-28 °C, Relative Humidity between 50%-60% and 16 hour photoperiod.

Visual observations of callus (Growth and appearance) were monitored after five weeks from culture establishment. The appearance of callus was observed as brownish or non-brownish and compact or fragile. A scale was given to the observed quality of callus as poor callus, good callus, and excellent callus. Calli were categorized according to size and marks were given according to a scale to analyze the growth. Five replicates were allocated for each treatment and each replicate consisted of five test tubes containing an explant. The experiment was carried out in Completely Randomized Design (CRD).

The data were analyzed by the Minitab computer package. Non-parametric data were analyzed using Kruskal-wallis one way ANOVA test.

## RESULTS AND DISCUSSION

The callus could be induced using a callus induction medium from fresh seeds. Hormones play an important role in the callus induction rate with varying results in different hormonal treatments and

combinations. Rapid callus induction was obtained in the case of seed ex-plants irrespective of culture media used or growth regulators treated. Callus initiation is mainly done for the regeneration of ex-plants and extraction of secondary metabolites. As the tree is economically important for the preparation of popular ayurvedic preparations and various traditional medicines, the present study may contribute to the large-scale production of callus biomass and the synthesis of secondary metabolites from it. Callus induction was investigated using seed ex-plants of this species on Murashige and Skoog (MS) medium supplemented with different growth hormones. Callus induction was observed almost within 4-6 weeks after inoculation in a previous study and initially, callus was white in color which later became cream-brown in color (Shree *et al.*, 2017). According to Hazeena and Sulekha(2008), it was found that MS medium is more suitable for induction and maintenance of callus

when it is supplemented with different growth hormones. Besides, visual observations have indicated that the *Aegle marmelos* seed explants responded better for callus induction in MS media. Among the different concentrations and combinations tested, MS medium enriched with BAP and Kinetin stimulated the best response in terms of callus induction.

Callus morphology varied with different growth regulators used in the culture medium. According to the results of the present study, no significant difference in color (Non-brownish) and growth was observed within treatments used for callus induction from *Aegle marmelos*. Because of that, callus can be generated from combinations of 0.5 to 1.5 mgL<sup>-1</sup> BAP and 1 mg/L to 2 mgL<sup>-1</sup> 2,4- D. The combination with the lowest concentrations 0.5 mgL<sup>-1</sup> BAP and 1 mgL<sup>-1</sup> 2,4-D can be used for commercial purposes and further studies.

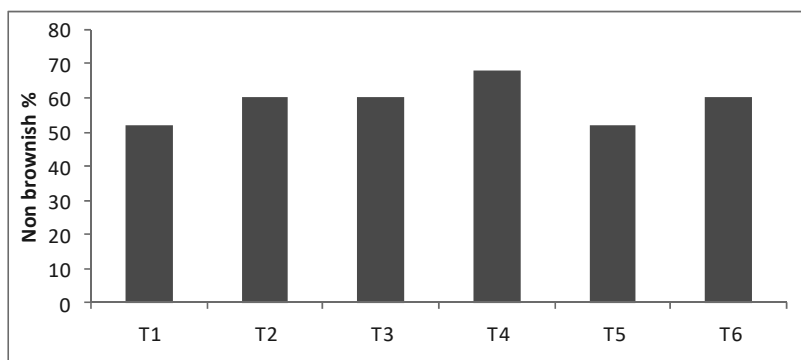


Figure 1. Callus Non Brownish % with Different Treatments

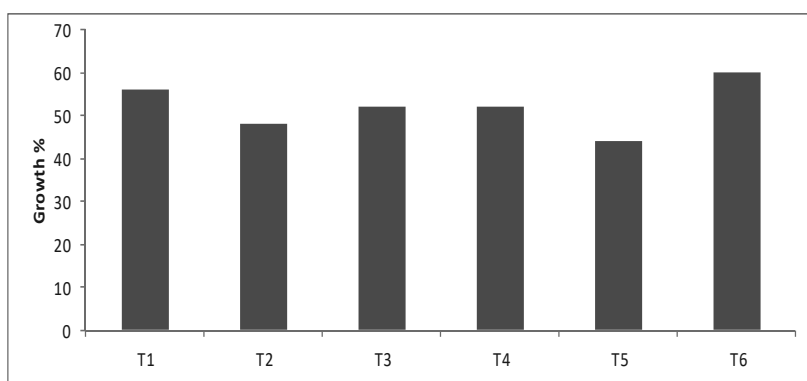
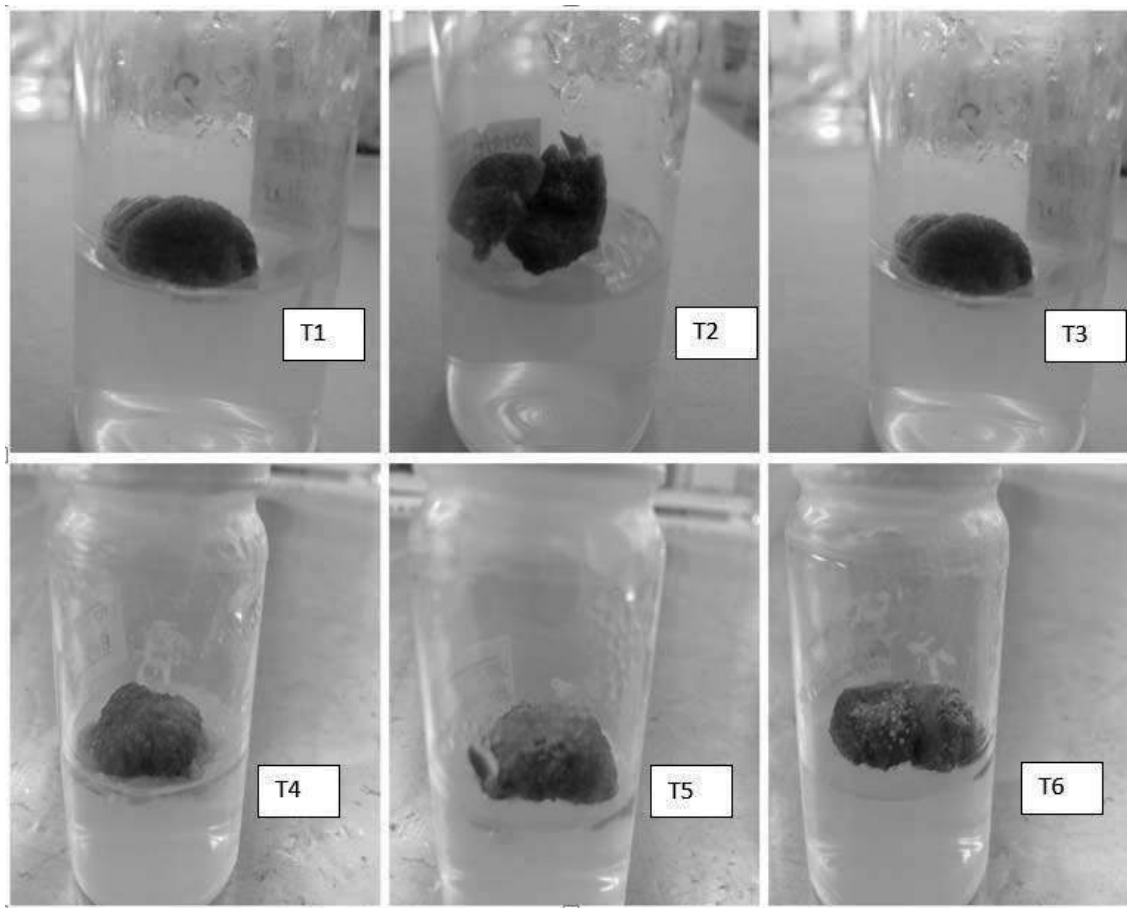


Figure 2. Callus Growth % with Different Treatments

Treatment 1 (T1) - BAP  $0.5 \text{ mgL}^{-1}$  + 2,4-D  $1.0 \text{ mgL}^{-1}$   
Treatment 2 (T2) - BAP  $1.0 \text{ mgL}^{-1}$  + 2,4-D  $1.0 \text{ mgL}^{-1}$   
Treatment 3 (T3) - BAP  $1.5 \text{ mgL}^{-1}$  + 2,4-D  $1.0 \text{ mgL}^{-1}$   
Treatment 4 (T4) - BAP  $0.5 \text{ mgL}^{-1}$  + 2,4-D  $2.0 \text{ mgL}^{-1}$   
Treatment 5 (T5) - BAP  $1.0 \text{ mgL}^{-1}$  + 2,4-D  $2.0 \text{ mgL}^{-1}$   
Treatment 6 (T6) - BAP  $1.5 \text{ mgL}^{-1}$  + 2,4-D  $2.0 \text{ mgL}^{-1}$

This graph contains results of callus induced from seeds that were tested for five weeks period under six different hormonal treatments (Figures 1 and 2)



**Figure 1** Visual Appearance of Callus (Size and Color) According to Treatments

## CONCLUSION

An efficient callus induction protocol was developed for secondary metabolites extraction, as well as the mass propagation of this important medicinal plant.

Callus can be generated through seed explants of *Aegle marmelos* from MS medium

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## Improvement of the Survival Rate of *In Vitro* Propagated *Dendrobium intermediate* CV 'White' during Acclimatization

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### ABSTRACT

*Dendrobium intermediate* cv 'White', an ornamental plant with exquisite flowers which is produced through *In vitro* propagation, undergoes hyperhydricity in *in vitro* conditions. As a result, they project a low survival rate during acclimatization which is a bottleneck for its success in micropropagation. This research aimed at overcoming the low survival rate during acclimatization of *Dendrobium intermediate* cv 'White' by improving the medium used in the pre-transplant stage. *In vitro* seedlings were cultured on Murashige & Skoog (MS) medium, without any growth regulators, with 3 sugar concentrations (3, 4 and 5% (w/v) at the pre-transplant stage for six weeks before being acclimatized in the protected house. After four weeks of acclimatization, the highest survival rate (100%), moderate survival rate (66.7 %) and lowest survival rate (12.5%) were observed in plants grown *in vitro* in MS medium fortified with 5, 4 and 3% (w/v) sugar concentrations respectively at the pre-transplant stage. Thus, increased sugar levels (5%, w/v) in the pre-transplant stage, can be recommended to achieve a 100% survival rate of *Dendrobium intermediate* cv 'White' during acclimatization. This is a promising solution to facilitate continuous mass production of *Dendrobium intermediate* cv 'White'.



## INTRODUCTION

Orchids are popular horticultural and ornamental plants mostly because of their exquisite flowers. *Dendrobium* spp. which is the largest genus in the family Orchidaceae, is a very important commercial plant. *Dendrobium intermediate* cv. 'White' is one of the most popular man-made hybrids of orchid and has a greater demand in commercial markets for cut flower internationally (Arditti and Ghani, 2000).

It is well documented that *in vitro* grown plantlets exhibit a low capacity for inorganic carbon assimilation because of their heterotrophic metabolism. The use of air-tight vessels in order to prevent contamination in tissue culture decreases air turbulence, limits the inflow of CO<sub>2</sub> and results in a very high air humidity and low irradiance inside the culture vessels. Under standard tissue culture conditions, the relative humidity is usually greater than 95%. It is also reported that *in vitro* leaves may not develop a waxy cuticle and functional stomata to the same extent as found in *ex vitro* plants due to the stress it experiences in *in vitro* conditions (Bolar *et al.*, 1998). During acclimatization of the *in vitro* grown plants, gradual lowering of the air humidity and ventilation is achieved by using loosely fitting closures or vents, which leads to increase plant transpiration and the development of functional stomata for controlling plant water loss. During the acclimatization process, seedlings need to overcome the critical phase when the heterotrophic behavior of the *in vitro* plants is shifted to autotrophic functioning, or else the survival of the plants during acclimatization would be hindered. However, certain abnormal morphology of the plants such as hyperhydricity, could be developed as a result of *in vitro* stress conditions which remains difficult to be reversed. Hence, efficient protocols have to be adopted to prevent or reduce the incidence of development of abnormal morphologies in *in-vitro* grown plants (Seelye *et al.*, 2003).

Although the *in vitro* propagation of *Dendrobium intermediate* is highly successful, when they are transplanted into the *ex vitro* environment, their survival is minimal. Accordingly, this research hypothesizes that, increased concentration of sugar in culture medium helps increase the survival rate of plants during acclimatization by means of reducing hyperhydricity, and thereby increases the survival rate of plants after acclimatization.

## MATERIALS AND METHODS

All the experiments were conducted at the Plant Tissue Culture Laboratory, in the Faculty of Science, Horizon Campus, Malabe, Sri Lanka.

### Plant Material

*Dendrobium intermediate* cv 'White' shoots were derived from seeds grown *in vitro* with an average initial height of 1.5 cm from the Plant Tissue Culture Laboratory of Horizon Campus, Malabe, Sri Lanka.

### Sterilization of Glassware

Culture jars and lids were initially cleaned with liquid soap (Teepol™) and tap water. Thereafter, CSUP method of sterilization (This method is called 'CSUP' as it was initially developed by the Crop Science department of University of Peradeniya) (Peiris *et al.*, 2012) was adopted and the culture jars and lids were sterilized thoroughly in 10% Clorox™ solution.

### Sub-Culturing of *D. intermediate* Shoots for *In Vitro* Pre-Transplant Stage

The blackened parts, dead leaves and the roots were cut and separated from the main shoot and were cultured on MS medium (Murashige and Skoog, 1962) with 3 different concentrations of sugar, (3% , 4% and 5%). Sucrose was the type of sugar used. Except for the variations in sugar concentrations across different media, all treatments consisted of 0.7% (w/v) agar and the pH was adjusted to 5.6±0.1. All culturing was done in the Laminar flow cabinet.

Each treatment consisted of 4 replicates with 4 shoots in each jar (or replicate). The cultured jars were covered with autoclaved polypropylene, labelled and stored for 6 weeks under conditions of average temperature of  $25\pm^{\circ}\text{C}$ , 12 hours of photoperiod, provided by white fluorescent tubes with an illumination of 1000 LUX.

### Acclimatization

After 6 weeks of growth under *in vitro* conditions, the plants were carefully removed from the culture jars assuring not to harm the plant parts, especially the tender roots, washed in lukewarm water to get rid of any remaining gel from the plant parts, soaked in a fungicide solution (Folicur tebuconazole, 2  $\mu\text{L/L}$ ) for about 2 minutes, and were then blotted using paper towels.

Plastic trays were prepared for acclimatization with a piece of nylon on the bottom of the tray, on top of which a layer of autoclaved coir dust and a layer of autoclaved sand were laid. The *in vitro* grown plants were transferred to the above trays, grown in the plant house for four weeks, and watered as required.

The survival rate, shoot length, root length and number of leaves per plant were assessed after four weeks of acclimatization. A completely randomized experimental design was used for this study.

### Statistical Analysis

Data from *in vitro* cultures were laid open to analysis of variance and significant

differences among the treatments (ANOVA) were tested by MINITAB software (Version 17.0 Minitab Inc., USA) (Method adopted is as stated by Gutierrez-Miceli et al., 2008).

### RESULTS

The survival rate, shoot length and the root length of the plants assessed after four weeks of acclimatization are directly proportionate to the concentration of sugar used in the culture medium at the *in vitro* pre-transplant stage in agar gelled medium. Four weeks after acclimatization, plants which were cultured in the medium consisting the highest sugar concentration (5%) presented the highest mean survival rate ( $100 \pm 0 \%$ ), mean shoot length ( $4.3 \pm 0.55 \text{ cm}$ ), mean root length ( $3.3 \pm 0.78 \text{ cm}$ ) and mean number of leaves per plant ( $12 \pm 6.7$  leaves). In addition, plants which were cultured in the medium consisting the lowest sugar concentration (3%) in the *in vitro* pre-transplant stage projected the lowest mean survival rate ( $12.5 \pm 0.34 \%$ ), mean shoot length ( $2.8 \pm 0.07 \text{ cm}$ ), mean root length ( $2.3 \pm 0.42 \text{ cm}$ ) and the mean number of leaves per plant ( $3 \pm 0$  leaves) (Table 1).

There was a significant difference in the mean values of the survival rate ( $P < 0.05$  and  $P = 0.00$ ) and shoot length ( $P < 0.05$  and  $P = 0.001$ ) whilst there was a moderate difference in the mean values of root length ( $P < 0.05$  and  $P = 0.0031$ ) and the number of leaves ( $P < 0.05$  and  $P = 0.026$ ) of the three different treatments after four weeks of acclimatization of Dendrobium intermediate cv 'White' plants (Table 1).

Table 1: Mean Values for 'Survival Percentage' (SP), 'Shoot Length' (SL), 'Root Length' (RL) of the plants and 'Number of Leaves per Plant' (NL), four weeks after acclimatization based on the concentration of sugar (w/v) used to culture the plants in the pre-transplant stage.

Treatments (sugar concentration)	SP (%)	SD	SL (cm)	SD	RL (cm)	SD	NL	SD
5%	100 <sup>a</sup>	0	4.306 <sup>a</sup>	0.55	3.362 <sup>a</sup>	0.78	12.69 <sup>a</sup>	6.7
4%	66.7 <sup>b</sup>	0.49	3.810 <sup>b</sup>	0.33	2.970 <sup>a</sup>	0.45	8.417 <sup>a</sup>	3.06
3%	12.5 <sup>c</sup>	0.34	2.850 <sup>c</sup>	0.07	2.350 <sup>b</sup>	0.42	3.00 <sup>b</sup>	0
Pooled Standard Deviation	0.339897		0.470887		0.584688		5.36226	

Means in the same column which do not share the same letter are statistically different according to Tukey's test at 5% level of significance. SD: Standard Deviation. N (Total number of plants acclimatized per

treatment) = 16. Survival percentage is given as the fraction of the total plants acclimatized per treatment.

Appearance of the plants grown in vitro under all three sugar concentrations appeared to be normal at the *in vitro* conditions. However, when the plants were removed from the jars for acclimatization, it was observed that the plants which were in 3% sugar level in *in vitro* were brittle implying that they were hyperhydric. Hyperhydricity refers to the extra water that apparently gives the plants the characteristic glassy appearance. Plants grown in culture media consisting of 4% and 5% sugar concentration were not brittle and

leaves were green, flexible and not wrinkled. Therefore, the plants grown in media consisting of 4 and 5% sugar cane were considered non-vitrified. However, plants which were cultured in agar-gelled medium consisting of 3% and 4% of sugar, in the pre-transplant stage had 50% and 75% of survival rate while plants which were cultured in medium consisting of 5% of sugar in the pre-transplant stage had 100% survival after transferring to the planthouse for ex vitro acclimatization (Figure 1).

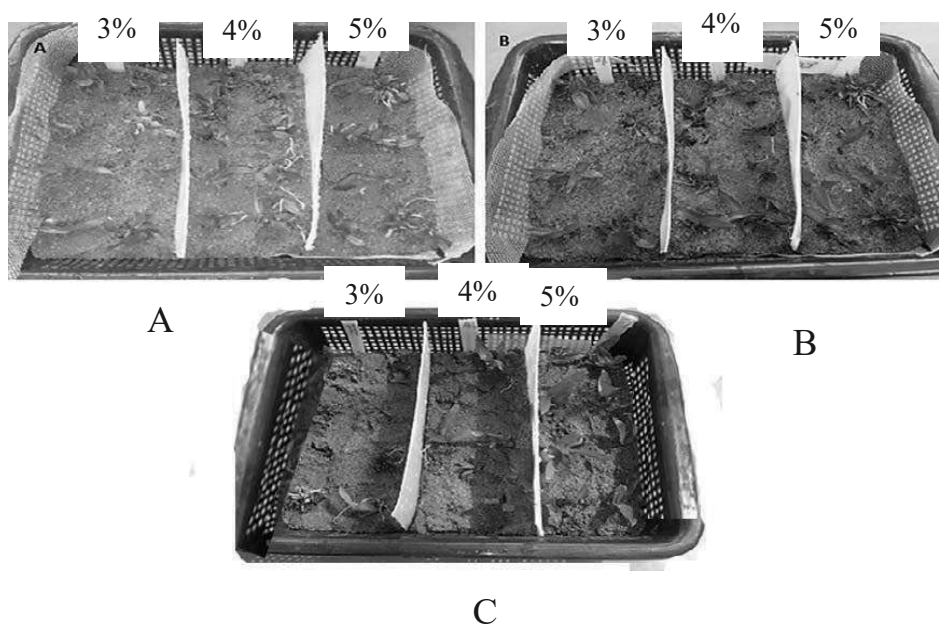


Figure 1: Acclimatized plants which were cultured in agar-gelled medium during the pre-transplant stage. In each tray first column indicates the plants which were grown in 3%, second 4% and last 5% of sugar during the pre-transplant stage in vitro. A) In the beginning (first day of acclimatization); B) Two weeks after acclimatization; C) four weeks after acclimatization

## DISCUSSION

The concentration of sugar in the culture medium has a significant role in the culture condition. It has been reported that an increase in the concentration of sugar results in a corresponding decrease of the water potential in culture medium. This decreases the incidence of hyperhydricity. It is proved that water logging of the apoplast is the major cause for the hyperhydricity. Water logging of the apoplast is thought to be caused by the ample availability of water in the medium. Apoplast is the space exterior to the plasma membrane of plant cells through which materials are able to diffuse freely. In the current study, the presence of more free water in the culture medium containing the lowest amount of sugar (3%), led to a higher water potential in the culture medium and those freely available water molecules have entered the plant shoots via osmosis leading to water logging in the intercellular air spaces and / or apoplast of the plant tissue. Apart from abundant availability of water, the high humidity in the headspace of tissue culture containers reduces transpiration from the leaves and it intensifies the incidence of water logging in the apoplast (Bottcher et al., 1988).

The bulk of the upward translocation in normally growing plants occurs in the xylem and is induced by root pressure and transpiration from the leaves. Transpiration from the leaves is there, but this is unlikely the cause of the surplus of water in the intercellular spaces since in hyperhydric tissues the water does not evaporate sufficiently. Possibly capillary forces are by some means the underlying mechanism in the water logging of the apoplast (Delarue et al., 1997).

Large part of the apoplast in hyperhydric plants is occupied by water and not with gas as reported by Gaspar et al., in 1987. Based on this information, it has been calculated that two-thirds of the air space in the apoplast is replaced by water in hyperhydric plants, and therefore gas exchange between the environment and the symplast is drastically decreased. The significance of an adequate gas-exchange between cells and

the environment is evident from the formation of *aerenchyma*, which is a soft plant tissue consisting air spaces, present especially in several aquatic plants when tissues are flooded and also from the abundance.

It is noteworthy, that there are only very few studies which have reported on an excess of water (Bottcher et al., 1988). It is also reported that the "extra" water is accumulated in the apoplast of plant cells and this was proven to be water with the use of technologies such as nuclear magnetic resonance (NMR) studies (Gribble et al., 1998) and by slight centrifugation of glassy tissues (Rojas-Martínez and de Klerk 2010).

The *in vitro* plants respond similarly as those plants which are subjected to flooding stress. Thus, as stated before, in hyperhydric plants, gas exchange by the symplast is reduced. Oxygen deficiency leads then to a high demand of energy due to the shortage of a final electron acceptor in the mitochondria. However, many adaptation to water logging occur in various stages of *in vitro* plants. These include metabolic adaptation involving fermentation pathways, and finally morphological changes such as *aerenchyma* formation like in plants subjected to flooding conditions.

Thus, it can be inferred that in the treatment which contained the lowest percentage of sugar (3%), lower solute concentration induced the water potential of the culture medium to be comparatively higher. This indicates that more free water molecules are available to be transported through the vascular system of the *in vitro* grown plants resulting in water logging of the apoplast. Water logging had caused oxygen deprivation resulting in oxidative burst where the ROS (Reactive oxygen species) level becomes extremely higher than the normal set point. High level of ROS (E.g. H<sub>2</sub>O<sub>2</sub>) in the plant tissue had triggered the closure of stomata disabling gas exchange between the plant and the surrounding environment. This process had further intensified the incidence of water logging in the intercellular space and apoplast of the plant tissue resulting in hyperhydric

condition of the plants. That is why the plant leaves were brittle even before acclimatization. The leaves were found to be yellow in colour because photosynthesis had not taken place due to the closure of stomata, which deprives the plant from gas exchange between the environments. Once the plants were transferred to *ex vitro* environment, the plants failed to survive due to the hyperhydric condition which prevailed within them. Hence, the orchid plants which were grown in culture medium containing 3% sugar in this experiment had failed to survive during the acclimatization phase.

Gaspar et al., (1987) have found in their study that usually, the stems of vitrified plants are thick and translucent; leaves are thick, wrinkled and/or curled and easily breakable which were observed in plant grown in 3% sugar levels of this study. Some researchers have attributed the malformations to chlorophyll deficiency and general plant hyperhydricity (Gaspar et al., 1987). The most prominent feature of hyperhydric plants is their vitreous and glassy appearance. Various researches done worldwide pose evidence for the development of hyperhydric conditions in tissue cultured plants and the development of symptoms including wrinkled, curly and brittle leaves as consequences (Dewir et al., 2006).

Conversely, in the treatment which contained the highest percentage of sugar (5%), in the pre-transplant stage, due to a higher solute concentration, the water potential of the culture medium was comparatively lower. As a result, not much

free water molecules were available in the culture medium to be transported into the vascular system of the *in vitro* grown orchid plants and hence, water logging in the apoplast had not been taken place. Therefore, plants which were grown in 5% treatment in the pre-transplant stage did not develop hyperhydric condition. This is the reason why 100% of survival was observed during acclimatization in plants cultured in medium fortified with 5% sugar. Hence, out of the three types of treatments, the one with 5% of sugar showed the best results with respect to survival rate, shoot length, root length, and number of leaves per plant.

The increase in the amount of sugar in the culture should be taken with caution and should not be progressive, because, according to Cappellades et al., (1991), high sugar concentrations in *in vitro* cultures favor carbohydrate accumulation and hinder photosynthesis.

## CONCLUSION

Low survival rate of *Dendrobium intermediate* cv 'White' during acclimatization is an immense issue which hinders its mass production. It is proven from this study that hyperhydricity can be overcome and 100% survival rate during acclimatization can be achieved by using semi solid MS medium fortified with 5% sugar in the pre-transplant stage during the *in vitro* propagation. Thus, a promising solution is proven herewith for continuous and mass production of *Dendrobium intermediate* cv 'White'



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## Production of Disease Free *Rumohra adiantiformis* (Leatherleaf Fern) Using *In Vitro* Propagation

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### ABSTRACT

This study investigated the use of rhizome tips as explants in regenerating disease-free plantlets of *Rumohra adiantiformis* (G. Frost) using the micropropagation technique. Rhizome tips of 0.5 cm, 1 cm, 1.5 cm, and 2 cm in length, and with and without outer skin were used as explants.

The highest regeneration rate (30%) was achieved with an explant size of one centimetre when the outer skin was not present in rhizome explants. Rhizome tips produced complete plantlets in Murashige and Skoog (MS) medium without any growth regulators in 80 - 90 days of culture initiation. *In vitro* multiplication of disease-free plants was achieved by culturing four months old *in vitro* plantlets in the MS medium supplemented with 2 mg/L Benzyl Amino Purine (BAP) and 0.1mg/L Naphthalene Acetic Acid (NAA). Plantlets produced clusters of shoot primordia which are known as green globular bodies (GGB) in the multiplication medium, 10 weeks after culturing. Plantlets were obtained by culturing 2-3 mm size GGB segments in the basal medium without any plant growth regulators. Disease indexing of the *in vitro* derived plantlets verified that at *in vitro* level 60% of the plantlets obtained from the rhizome tips of one centimetre were free from bacterial and fungal diseases.

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## INTRODUCTION

*Rumohra adiantiformis* (G. Forst), commonly known as Leatherleaf fern is one of the most popular cut foliage used in floral decorations. It has become indispensable to many floral designers across the world due to its dark green, versatile, long-lasting leaves (Reid, 2004, Cargo Handbook.com, n.d.). The majority of the fern production remains located in Central Florida although the offshore production has increased dramatically during the past years.

Hatton Foliage Company Ltd in Sri Lanka is one of the cut-foliage exporting companies, which sends its products mainly to the Netherlands. The nursery produces a wide range of cut foliage varieties for export markets. Leatherleaf fern is one of the main items that they have grown for export. The continuous supply of quality leaves should be guaranteed in exporting. To fulfil this requirement there should be a quick propagation method to produce disease-free plants. However, the whole mother plant stock in the nursery has been infected by the fungal and bacterial disease. Due to that, the production capacity has largely reduced and the company is unable to produce the number of leaves enough to export.

Leatherleaf fern is generally propagated by division of the rhizomes or by sowing the spores on a sterilized medium. As divisions from the mother plants are infected with diseases, common propagation methods cannot be employed because there is a possible danger of spreading these through the propagation material. However, the micropropagation technique has been successfully used in the propagation of disease-free plants (Bhagyalakshmi & Singh, 1988; Ramgareeb *et al.*, 2010; Sharma & Singh, 1997). There are several reports on the use of the micropropagation technique for the *in-vitro* rapid propagation of Leatherleaf fern (Amaki & Higuchi, 1990; María del Carmen Rocío *et al.*, 2011; Winarto & Teixeira da Silva, 2012). However, there have been no reports on the production of disease-free plants from infected mother stock of *Rumohra adiantiformis* to date.

Therefore, this study was carried out to propagate disease-free plantlets of *Rumohra adiantiformis* using micropropagation techniques.

## METHODS

### Obtaining Disease Free Explants

Rhizomes taken from the infected mother stock were potted in a sterilized mixture of coir dust, sand and compost (1:1:1) in a separate growth chamber and treated with 0.2 (Daconil™) chlorothalonil and 0.1% streptomycin sulphate as a foliar spray alternatively once a week for 12 weeks before harvesting the explants for the experiment.

### *In Vitro* Experiments on the Effect of Rhizome Tip Size and the Presence or Absence of Outer Skin on Regeneration and Contamination of Cultures

*In vitro* experiments were conducted to investigate the effect of the size of the rhizome tip and the effect of absence or presence of the outer skin on contamination-free cultures and plant regeneration. Rhizome tips of 0.5 cm, 1 cm, 1.5 cm, 2 cm in length and with and without outer skin were used as explants. Rhizome tips were harvested from the treated mother plants and washed under running tap water for 30 minutes while gently rubbing the rhizomes to remove outer scales.

Then the rhizome tips were surface sterilized by rinsing 3 minutes in 70% ethanol followed by 10% commercial bleach (0.5% NaOCl) with 0.01% Tween 20 (Polyoxyethylenesorbitan monolaurate) for 10 minutes. Each treatment contained 10 rhizome tips which were randomly selected out of the 80 rhizome tips used in the experiment.

### Culture Establishment and Evaluation

Cultures were observed weekly from the date of culture initiation and all the changes were noted for 12 weeks for each experiment. As the observations, % of contamination, % of regeneration (explants showed any kind of

growth) and the % of dead cultures were recorded.

Unless otherwise stated prewashed explants were soaked in the Benomyle (Benlate™) solution (6g/L) for 30 minutes before sterilization. The pH of all media used in the above experiments was adjusted to 5.7 before solidifying with 3.5 g/L phytagel™ before sterilization by autoclaving for 20 min. at 121 °C and 1.06kg/cm<sup>2</sup>. Flat bottom glass tubes of 20 x 120 mm size were used with 10 mL or 20 mL semi-solid medium, as appropriate to the experiment. Unless otherwise stated half-strength MS medium was used for culture establishment. All treatments contained 10 replicates per treatment. Cultures were kept at 25 ± 2 °C under a 14 h photoperiod of 60 µEm<sup>-2</sup> S<sup>-1</sup> light level supplied by cool white fluorescent tubes.

#### Disease Indexing of the *In-vitro* Derived Plantlets

Small pieces about 3x3 mm size sections obtained from the leaves and the basal parts of the in-vitro derived plantlets (3 months old plants) were cultured on the potato dextrose agar (PDA) and nutrient agar media in triplicates to find the pathogenicity of the *in vitro* derived plantlets. Cultures were incubated at room temperature conditions (25- 30 °C) for 8 - 10 days and observations were made on any fungal or bacterial growth in the culture medium.

#### Multiplication of the Disease Free Plantlets

Multiplication of plants was approached using Green Globular Bodies (GGB) according to Amaki and Higuchi (1990).

#### Statistical Analysis

Data was not amenable to statistical analysis as the low frequencies of regeneration observed under each of the treatment conditions.

#### RESULTS AND DISCUSSION

Size of the rhizome tips and the removing outer skin of the rhizome tips affected both the regeneration percentage and the percentage of contamination. During the first week, rhizome tips cultured with outer skin showed less contamination than the rhizome tips cultured without outer skin. Also, the rate of contamination was higher in the first two weeks for both treatments (Figure 1). However, during the experimental period, the contamination rate was less for the rhizome tips cultured without skin. The least contamination of 20% was observed for the rhizome tip size of 0.5cm cultured without outer skin, however, the regeneration percentage was very low. According to the experiment, the highest regeneration of 30% was obtained by the rhizome tips size of 1cm cultured without outer skin (Table 1). Previous research has also reported that contamination is the main problem of *in vitro* propagation of the ferns (Amaki & Higuchi, 1990; Valerie, 2015). However, the high rate of contamination observed in the current study must be directly related to the initial infections in the mother stock which were microscopically identified as fungus *Rhizoctonia* and bacterium *Xanthomonas*.

Table 1. Effects of the Size and the Presence or Absence of the Outer Skin of Rhizome Tips for Culture Initiation and Regeneration after 12 Weeks

Rhizome Size	Rhizome type	Contaminations (%)	Deaths (%)	Regenerations (%)
0.5cm	W <sub>1</sub>	40	60	0
	W <sub>2</sub>	20	70	10
1cm	W <sub>1</sub>	80	20	0
	W <sub>2</sub>	70	0	30
1.5cm	W <sub>1</sub>	80	20	0
	W <sub>2</sub>	80	0	20
2cm	W <sub>1</sub>	100	0	0
	W <sub>2</sub>	100	0	0

W1- with the outer skin, W2- without outer skin, n=10

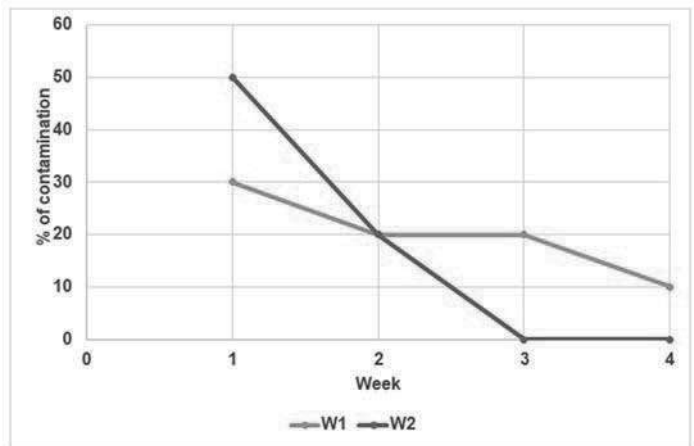


Figure 1. Contamination Rate of the Rhizome Tips Cultured with and without Outer Skin during First Four Weeks of Culture Initiation

Culturing of *in vitro* derived plantlets on nutrient agar medium revealed that 40% of them were infected with a bacterium similar to the bacterium present within the infected mother plants. However, any of the plantlets did not produce fungal mycelium on PDA or nutrient agar media. Plant tissue culture media are rich in nutrients and may provide suitable media for many environmental fungi and bacteria. Therefore, infections present in the explants become readily visible during the early stages of the cultures. However, some bacteria (i.e., *Xanthomonas*, *Pseudomonas*) associated with plant tissues are hardly visually expressed in culture media (Leifert & Cassells, 2001). The results

of the study are aligned with the reports of Leifert and Cassells (2001) that the bacterium present in some of the *in vitro* derived plantlets were not apparent while they are present in the culture media. Therefore, *in vitro* level, only 60% of plantlets obtained from the rhizome tips of 1cm were free from the disease (Figure 2). This shows that a higher percentage of plants can be made free of diseases when passing through *in vitro* conditions. These results are comparable with the findings of Sharma and Singh (1997), on high frequency *in vitro* multiplication of disease-free *Zingiber officinale* Rosc which were infected with Fungus *Fusarium oxysporum* f. sp. *Zingiber*

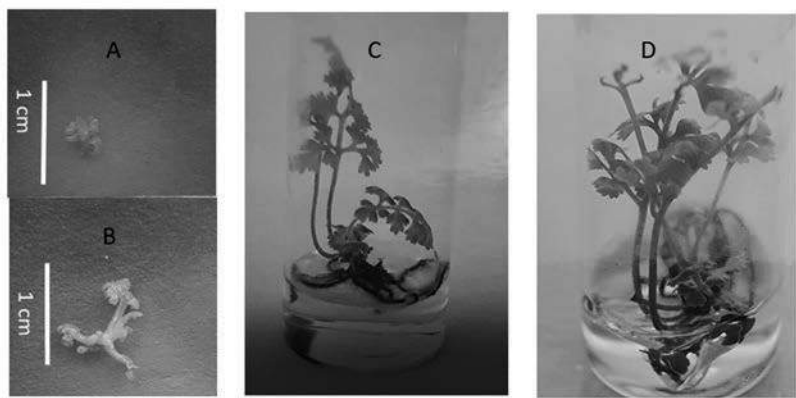


Figure 2. Disease Free Plantlets Produced from the GGB Segment of *Rumohra Adiantiformis*; A - GGB Segment Grown on Hormone Free Media After 2 Weeks; B - 4 Weeks Old Plantlet Produced from GGB; C - 12 Weeks Old Plantlet with Fully Grown Shoots and Roots, D - 16 Weeks Old Plantlet, Ready for Acclimatization

Investigations on culture medium suitable for multiplication of plantlets (data not shown) revealed that the full strength MS medium with 2mg/L BAP and 0.1mg/L NAA was suitable to multiply plantlets. In this media, plantlets produced a cluster of shoot primordia after 10 weeks of culture initiation. Microscopic observation revealed that the cluster of shoots primordial was similar to the Green Globular Body (GGB) which was described by Higuchi *et al.* (1987). Amaki and Higuchi (1990) reported that GGB can be obtained by culturing the rhizome tips of different ferns in MS media-contained BAP and production of GGB from the rhizome tips of *Rumohra adiantiformis* required full strength MS media contained 1mg/L BAP. However, our results revealed that GGB can be obtained by culturing plantlets instead of rhizome tips on media contained 2mg/L BAP and 0.1mg/L NAA. This method of multiplication appeared to be especially suitable under our situation where the supply of disease-free rhizomes was restricted due to the infections in the mother plants.

Plantlets were regenerated from the GGB, by culturing small segments (2-3 mm diameter)

on the MS media without any plant growth regulators. Multiplication efficiency of producing plantlets using GGB is reported to be high and suitable for the multiplication of many genera of ferns (Amaki & Higuchi, 1990; Higuchi *et al.*, 1987; Valerie, 2015; Yu *et al.*, 2017). However, in the current study, the multiplication efficiency of the *Rumohra adiantiformis* was not studied as it was beyond the scope of this study. Figure 2 shows the disease-free plantlets obtained from GGB.

## CONCLUSION

Rhizome tips obtained from infected mother plants of *Rumohra adiantiformis* (G. Frost) were successful as explants to produce disease-free plantlets. Growing plantlets in MS medium supplemented with 2 mg/L BAP and 0.1mg/L NAA resulted in the production of GGB bodies in a 10-week duration. These GGB produced plantlets following transferring to the basal medium without any plant growth regulator. At *in vitro* level, 60% of the plantlets produced using 1 cm size rhizome tips were free from bacterial and fungal diseases.

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## An Efficient Plant Regeneration Using Leaf Explant for *Osbeckia octandra* (L.) DC; A Valuable Medicinal and Ornamental Plant

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### ABSTRACT

*Osbeckia octandra* (Heen Bovitiya), which is one of the most valuable ayurvedic medicinal and ornamental plants in Sri Lanka is now threatened due to overexploitation in its natural habitat. In order to preserve this economically important plant species, a highly efficient *in vitro* clonal propagation system using leaf explants was developed in this study. The effects of three different concentrations of plant growth regulators: (6-benzylaminopurine (BAP), 1-naphthaleneacetic acid (NAA) and kinetin) and incubation conditions on plant regeneration were investigated. The plant growth parameters were analyzed in 15 biological replicates using one-way or two-way ANOVA. The present study revealed that the highest number of shoots per leaf explant with 92.4% shoot induction rate was achieved when young mature leaf explants were inoculated on Murashige and Skoog (MS) medium supplemented with 3 mg/L BAP and 0.5 mg/L NAA under dark conditions. When micro shoots were separated and subcultured on hormone-free MS medium with high sugar content (4%), shoots multiplied rapidly and a vigorous root system was developed under light conditions. The *in vitro* grown plantlets were successfully acclimatized and 89% of the regenerated plantlets survived. Our novel clonal propagation system will open new avenues for large-scale multiplication and improvement of medicinal and ornamental characteristics of this valuable species using biotechnological tools.

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## INTRODUCTION

*Osbeckia octandra* (L.) DC. A member of the family Melastomataceae is a endemic perennial shrub and it is widespread in the moist mid and low country up to 1500 m altitude in Sri Lanka (Jayaweera, 1982). It is one of the widely utilized plant species in indigenous ayurvedic medicine in Sri Lanka (Perera et al., 2013; Fernando et al., 1990). Huge quantities of leaf and root extracts have been used to prepare medicines for curing diabetes, haemorrhoids and hepatitis (Perera et al., 2013; Fernando et al., 1990; Thabrew et al., 2000). Besides its medicinal properties, it possesses high ornamental characteristics, because of the colour, size and shape of the flowers as well as plant architecture. For instance, it possesses many erect branches with bristly hair reddish-brown bark. Leaves are opposite, narrowly lanceolate or oblong-lanceolate and contain scattered long hairs beneath. Pale pink or nearly white flowers with round five petals give a more attractive appearance to the plant (Jayaweera, 1982) and therefore, *Osbeckia* can be used in landscape horticulture and as an ornamental potted plant.

This plant is mainly propagated through seeds, but plant propagation via seeds is not efficient due to the very low germination rate (Dassanayake et al., 2018). In Sri Lanka due to rapid industrialization, the natural habitats of this plant species have been threatened and currently, *O.octandra* is considered a vulnerable species. Therefore, several micropropagation techniques such as in vitro organogenesis and embryogenesis can be used for large-scale true-to-type plant propagation as few plant materials are required for the establishment of initial cultures. However, the application of in vitro techniques for *O. octandra* and also any member in the family of Melastomataceae has not yet been established. The first step towards the development of a more efficient in vitro regeneration system of *O. octandra*, we previously demonstrated a novel micropropagation system using nodal explants (Nagahatenna and Peiris, 2008). Here we report another new in vitro system using leaf explants, which are the most abundant

source materials for genetic transformation studies.

In vitro techniques have been used to induce genetic variability through mutagenic treatments and gene transformation techniques to produce new plant varieties rich in ornamental characters (Pellegrineschi et al., 1994; Shibata, 2008). Major drawbacks that exist for this potential are the lack of sufficient information about the wild, native plant species with high ornamental value and inadequate organized programs to introduce new species or varieties by the improvement of these plant species to suit the export and local demand. The innovative technologies introduced in our study will open new avenues for improving ornamental characteristics of *O. octandra* via mutagenesis, somatic hybridization, genetic engineering and gene editing when the in vitro regeneration protocol is perfected. Therefore, the objective of this study was to optimize an invitro protocol using leaf explant as it can be used for future ornamental crop improvements.

## MATERIALS AND METHODS

### Adventitious Shoot Induction from Leaf Explants

Leaves expanding from in vitro cultured shoots (Nagahatenna and Peiris, 2008) were excised and cut into approximately 1 cm<sup>2</sup> sections. They were cultured in vitro with their abaxial sides touching the Murashige and Skoog (1962) (MS) basal medium supplemented with different concentrations of cytokinines (2, 4 and 6 mg/L Kinetin and 1, 3 and 5 mg/L BAP) in combinations with NAA (0 and 0.5 mg/L) and 3% sucrose, 100 mg/L myo-inositol and solidified with 0.8% agar (pH 5.8). The effectiveness of light and dark conditions on the regeneration of leaf explants was evaluated by incubating at 25±2 °C with or without cool fluorescent light (900-1500 lux) and 16:8 h (day: night) photoperiod. Performances of the plants were observed at weekly intervals. Explants showing the signs of regeneration were transferred to light 3

weeks after culture initiation and average shoot length and the number of shoots per

### **Shoot Multiplication and Rooting**

When regenerated shoots reached a height of 0.2 to 0.4 cm, they were individually excised from leaf explants and transferred to vessels containing hormone-free MS medium supplemented with high sugar (4%) content. Cultures were incubated under light conditions described above and sub cultured every month. Performances of the plants were observed at weekly intervals. Average shoot length and the number of shoots per explant were recorded at the end of the 4<sup>th</sup> week.

### **Acclimatization of the Plantlets**

Fully developed plants with 8-10 cm shoots were transferred to pots containing sand: soil mixture (2:1) and kept inside a propagator for 2 months at 25 °C and 12: 12 h (day/ night) photoperiod.

### **Data Analysis**

The experiments were arranged in a completely randomized design. The effect of BAP and kinetin on shoot length were analysed using one-way and two-way ANOVA at different stages with SAS statistical software. The effect of BAP and kinetin on the number of shoots per explant was analysed by chi-square contingency test with MINITAB. Mean comparisons were done with Duncan's multiple range test (DMRT).

## **RESULTS AND DISCUSSION**

### **Adventitious Shoot Induction from Leaf Explants**

Shoot formation from in vitro leaf explants of *O.octandra* was highly benefited from a period of darkness, but there were a few plants that regenerated even without the dark period

explant were recorded from 15 biological replicates at the end of the 6<sup>th</sup> week.

(Table 1, Figure 1). The degradation of auxins in the media is known to occur more quickly under light relative to dark conditions (Gu and Zhang, 2005) and therefore, we speculate that light-incubated media may have caused a detrimental effect on shoot growth due to low auxin availability. Therefore, it is probable that observed higher shoot growth under dark conditions is a consequence of greater accessibility of cytokinines and auxins to the growing shoots. The highest percentage of shoot induction (100%) was achieved only when kinetin was used as the sole growth regulator except at 6 mg/L Kinetin. However, explants cultured on BAP containing media, produced the highest number of shoots per explant (Table 1). When NAA (0.5 mg/L) was added in combination with varying concentrations of BAP (1- 5 mg/L) and Kinetin (2-6 mg/L), shoot formation was markedly suppressed except with 6 mg/L kinetin and 3 mg/L BAP. Overall, 3 mg/L BAP with 0.5 mg/LNAA showed the highest shoot growth with  $22.6 \pm 4.7$  shoots per explant and  $1.4 \pm 0.5$  cm shoot length under dark conditions.

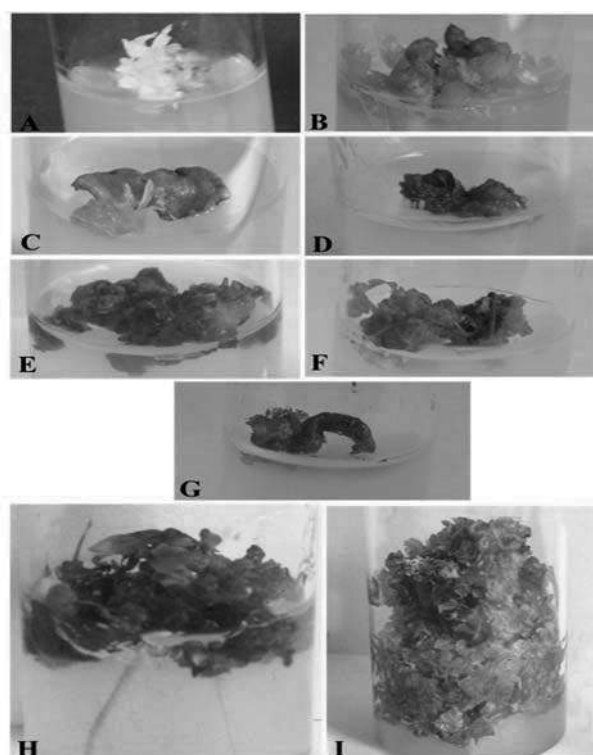
### **Shoot Multiplication and Rooting**

Regenerated shoots recovered, grew vigorously and developed a healthy root system upon transfer to hormone-free MS medium. The number of shoots, number of roots and root length was difficult to measure due to profuse shoot and root growth and therefore, shoot length was evaluated. The longest shoots ( $5.98 \pm 1.03$  cm) with a well-developed root system were observed in shoots multiplied in MS basal medium with 1 mg/L BAP as the only growth regulator (Figure 2A). A large number of plantlets were grown with roots by transferring the regenerated plants to a hormone-free MS medium.

**Table 1.** Induction and growth of shoots of *O.octandra* on different hormonal combinations 6 weeks after culture establishment

Treatment			% of shoot induction		Number of shoots/explant		Shoot length (cm)	
BAP	Kinetin	NAA	Dark	Light	Dark	Light	Dark	Light
-	-	-	-	-	-	-	-	-
-	2	-	80	-	4.7±1.5 <sup>a</sup>	-	1.3±0.4 <sup>a</sup>	-
-	4	-	100	25	7.6±2.3 <sup>b</sup>	1.2±0.2 <sup>a</sup>	1.5±0.6 <sup>a</sup>	0.6±0.2 <sup>a</sup>
-	6	-	100	-	10±2.4 <sup>c</sup>	-	1.5±0.7 <sup>a</sup>	-
-	2	0.5	33.4	-	2±0.3 <sup>d</sup>	-	2.1±0.9 <sup>c</sup>	-
-	4	0.5	44.5	-	5±0.8 <sup>e</sup>	-	1.7±0.5 <sup>a</sup>	-
-	6	0.5	100	33.4	9.8±2.1 <sup>c</sup>	1.5±0.6 <sup>a</sup>	1±0.1 <sup>b</sup>	0.4±0.1 <sup>a</sup>
1	-	-	62.5	-	15.7±2.7 <sup>f</sup>	-	1.2±0.3 <sup>a</sup>	-
3	-	-	72.6	-	14.8±2.1 <sup>f</sup>	-	0.8±0.1 <sup>d</sup>	-
5	-	-	58.3	-	9.6±1.9 <sup>c</sup>	-	0.6±0.2 <sup>d</sup>	-
1	-	0.5	20.3	-	18.7±3.5 <sup>g</sup>	-	1±0.6 <sup>b</sup>	-
3	-	0.5	92.4	-	22.6±4.7 <sup>h</sup>	-	1.4±0.5 <sup>a</sup>	-
5	-	0.5	40.6	-	7.3±2.4 <sup>b</sup>	-	0.7±0.3 <sup>d</sup>	-

**Note:** Data expressed as Mean ± SE from 15 replicates. Within columns, values followed by the same letter are not significantly different at the p = 0.05.



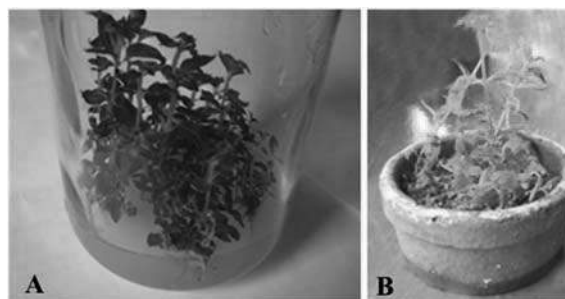
**Figure 1.** Adventitious shoot formation from the leaf explants of *O. octandra* on MS medium with different hormonal combinations. (A) (B) (C) Shoots regenerated at the leaf margins 3 weeks after culture establishment under dark conditions (D) Very few or no shoot induction under the light conditions 3 weeks after culture establishment (E) (F) Dark-incubated leaves 3 weeks after transferring to light (G) Few leaf formation 6 weeks post culture establishment from explants continuously incubated under light conditions (H) Dark-incubated explants 6 and (I) 8 weeks after transferring to light.

**Table 2.** Responses of different concentrations of plant growth regulators on shoot multiplication

Growth regulator concentrations (mg/L)			Shoot length (cm)
BAP	Kinetin	NAA	
-	-	-	0
1	-	-	5.98±1.03 <sup>a</sup>
1	-	0.5	4.87±0.92 <sup>b</sup>
3	-	-	5.24±1.3 <sup>d</sup>
3	-	0.5	4.47±1.38 <sup>c</sup>
5	-	-	4.67±1.78 <sup>b</sup>
5	-	0.5	2.36±0.91 <sup>e</sup>
-	2	-	3.22±1.38 <sup>g</sup>
-	2	0.5	2.89±1.31 <sup>f</sup>
-	4	-	3.27±1.21 <sup>g</sup>
-	4	0.5	0.81±0.32 <sup>h</sup>
-	6	-	2.11±0.73 <sup>i</sup>
-	6	0.5	2.63±1.04 <sup>f</sup>

**Note:** Data expressed as Mean ± SE from 15 replicates. Within columns, values followed by the same letter are not significantly different at the P = 0.05.

**Figure 2. (A)** Shoot multiplication and root induction of *O.octandra* on hormone-free MS medium. **(B)** *In vitro* rooted plantlets of *O.octandra* during acclimatization.



#### Acclimatization of the Plantlets

When rooted plantlets reached a size of 8-10 cm on growth regulator free medium, they were transferred to pots containing sterile sand: soil (2:1). Eventually, 89% of regenerated plantlets survived and exhibited similar morphological characters as the mother plants (Figure 2B).

## CONCLUSIONS

A highly efficient micropropagation system can be established using *in vitro* grown young leaf explants of *O. octandra*. Among all the tested hormonal combinations 3 mg/L BAP with 0.5 mg/L NAA produced the highest shoot induction (22.6±4.7 shoot/explant) under dark conditions.

The highest shoot length (5.98±1.03 cm) with a well-developed root system was observed in shoots multiplied in MS basal medium with 1 mg/L BAP as the sole growth regulator. Regenerated plants grew well and 89% of survival rate was achieved during acclimation.

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# **English Language, Literature & Education**



## A Study on the Impact of Online Monolingual and Bilingual Dictionary Use on ESL Learners' Vocabulary Acquisition and Retention

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### ABSTRACT

This experimental research comparatively analyzed the impact of online monolingual and online bilingual dictionary use in vocabulary acquisition and retention. Forty Engineering undergraduates in their first term at B1 level in proficiency were divided into two comparison groups: Online Monolingual Dictionary (OMD) and Online Bilingual Dictionary (OBD) groups. Then both groups were exposed to an unknown set of ten academic words using an online monolingual dictionary and an online bilingual dictionary (English-Sinhala/English-Tamil) respectively. After the treatment/exposure, the same vocabulary tests: pretest, immediate test and posttest, were administered in both groups to check the effectiveness of the treatments. While both classes significantly acquired and retained vocabulary under each online dictionary use, the independent sample t-test determined a statistically significant difference in the vocabulary retention of the online monolingual class over the online bilingual class at the immediate test as well as at the post test. The findings confirmed the hypothesis that online monolingual dictionary use is effective over online bilingual dictionary use in vocabulary acquisition and retention.

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## INTRODUCTION

Dictionary use is considered a beneficial tool in the field of language learning and teaching in improving language competency. The reason is that dictionaries contain a myriad of information in terms of phonology, morphology, grammar and semantics (El-Sayed & Siddiek, 2013; Hayati & Fattahzadeh, 2006; Luppescu & Day, 1993; Nation, 2001). Monolingual dictionaries (the target words are defined in the same language) and bilingual (the target words are defined in a second language, probably the first language of the user) are the two main categories which are currently popular among language learners and teachers. A third type, the bilingualized dictionary, has also been identified by researchers (Amirian & Heshmatifar, 2013; Fageeh, 2014). For the present study, however, only the monolingual and bilingual dictionary types have been considered.

Dictionary use and learning vocabulary are two interconnected areas. For instance, Schmitt (2002) identifies dictionary use as one of four main strategies which help the identification and retention of the meaning of unknown words (as cited in Yazdi, 2014). Thus, it is pertinent to probe further into the contribution of different types of dictionaries in vocabulary acquisition and retention in order to employ the effective method in the ESL classroom.

### **Monolingual and Bilingual Dictionary Use:**

According to the proponents, monolingual dictionaries offer attention to high-frequency words and means to employ them, along with the definitions (Ali, 2012; Hayati & Fattahzadeh, 2006; Yazdi, 2014). Furthermore, Ng (2016) identified the positive influence of monolingual dictionaries on improving L2 lexical knowledge by eliminating L1 interference and otherwise, while bilingual dictionaries aggravated the errors resulting from L1 interference.

Bilingual dictionaries provide the direct equivalent of a word from one language to another, which facilitates comprehension and saves time. Studies by Aust et al. (1993) and Hayati & Fattahzadeh (2006) highlight that

there are no significant differences in comprehension and vocabulary test scores of monolingual and bilingual dictionary users, except that the monolingual dictionary users consume more time in completing tasks. Hence, bilingual dictionaries are recommended for ESL/EFL courses where the time constraint is high. However, Hayati & Fattahzadeh's (2006) research also found that long term vocabulary retention was significantly higher with the users of monolingual dictionaries. This finding also conforms to previous research of Chastain (1988), which identifies a positive direct relationship between time and the level of retention: the longer the duration to search for vocabulary, the longer the retention level (as cited in Hayati & Fattahzadeh, 2006).

**Online Dictionary Use:** The field of ESL teaching and learning has not been immune to the rapid advancements of digital technology; one result being the advent of electronic or online dictionaries. Studies by Koga (1995), Chen (2011), Mekheimer (2012) (as cited in Fageeh, 2014), and Amirian & Heshmatifar (2013) and Wolter (2015) found online dictionary use to be more effective in vocabulary learning and retention over paper dictionaries. However, research studies that compare online monolingual (English) and bilingual dictionary (English and the user's L1) use are less in comparison to the same based on conventional paper dictionaries (Fageeh, 2014).

Thus, the objective of the present study is to build upon previous research on dictionary use and fill the gap related to studies comparing the effect of online monolingual and bilingual dictionary use on vocabulary learning and retention.

## METHODOLOGY

The participant group consisted of first term engineering undergraduates following the same discipline in a private university of Sri Lanka. This sample included male students at the B1 level of proficiency in English according to the common European Framework of reference. The ten target academic words tested in this study included isolated words

related to their discipline. Participants were initially exposed to a pre-test to form a homogeneous group in proficiency by giving a simple pre-test to verify their familiarity with the intended sample of words. Consequently, some students were eliminated and 40 students, who were oblivious of the intended vocabulary items, were selected as the sample and were randomly divided into two groups of 20 participants. These two classes used online bilingual dictionaries and online monolingual dictionaries respectively. For referential purposes, classes will hereafter be introduced in the text as the Online Monolingual Dictionary (OMD) and Online Bilingual Dictionary (OBD) groups.

**Materials:** The participants in the OMD group used the Collins Online Dictionary whereas Sinhala and Tamil students in the OBD group used Madura Online Dictionary and <http://dictionary.tamilcube.com/> dictionary respectively. Data was collected through immediate tests and posttests held individually at different intervals in the learning process. Ten words comprising nouns, verbs and adjectives were selected as the target academic words. Afterwards, students were given an immediate test which comprised of two tasks. One task was to match the underlined target word as they appear in a meaningful sentence to their definitions given below and a task to select the appropriate target word from a box to fill in the blanks in a meaningful sentence. Also, the posttest comprised of a task of substituting a bold word in a sentence using target words given in a box.

**Method:** Participants were informed of the purpose of this study and agreed to participate. Students in the OBD group explored the meaning of the target words using a bilingual dictionary in their respective L1 whereas the OMD group explored the meaning of target words in L2. Students were given a simple task of finding definitions of the target words in the worksheet from their respective dictionaries and producing them in the language as recorded in those dictionaries. The OMD group was constantly monitored during the learning process to avoid the use of

the online bilingual dictionary and the OBD group was monitored to avoid the use of the online monolingual dictionary. An immediate test was administered thereafter to verify the immediate retention level in each class after being exposed to respective dictionary use. The immediate test included matching underlined target words that appeared in meaningful sentences to their definitions given below and another exercise on using the target words given in a box appropriately to fill in the blanks in sentences. The test marks of the Bilingual class and the Monolingual class were compared through the independent sample t-test to assess whether there had been a statistically significant difference. Moreover, long-term vocabulary retention through respective methods was analyzed through a post-test administered in these two classes a week later. These test marks were also compared through the independent sample t-test.

## RESULTS AND DISCUSSION

**Test Results of the Immediate Test:** On the condition that awareness of the target words positioned at zero which was ascertained through the pre-test, the mean value of the immediate test in the OBD group was 7.155 whereas the mean value of the immediate test in the OMD group was 8.15. The immediate test results of the Online Bilingual Dictionary and the Online Monolingual Dictionary groups were compared through an independent sample t-test as follows:

$P(T \leq t)$  two-tail value obtained in the independent sample t-test is (0.029347384), which is less than the standard significance level of 0.05. Therefore, a statistically significant difference was identified in the test results of the OMD group over the OBD group in vocabulary internalization at the immediate test.

**Test results of the Post-Test:** The mean value in the OMD group at the post-test, which was administered a week later, stood at 7.825 whereas it was 6.7 in the OBD group. Independent sample t-test results of the means obtained are as follows:

Table 1. Test Results of the Immediate Test		
Immediate Test	Monolingual Class	Bilingual Class

Mean	8.15	7.155
Variance	2.028947368	1.833131579
Observations	20	20
Hypothesized Mean Difference	0	
DF	38	
t Stat	2.264266311	
P(T<=t) one-tail	0.014673692	
t Critical one-tail	1.68595446	
P(T<=t) two-tail	0.029347384	
t Critical two-tail	2.024394164	

**Table 2. Test Results of the Post-Test**

Post Test	Monolingual Class	Bilingual Class
Mean	7.825	6.7
Variance	2.823026316	2.115789474
Observations	20	20
Hypothesized Mean Difference	0	
DF	37	
t Stat	2.263894093	
P(T<=t) one-tail	0.014766782	
t Critical one-tail	1.68709362	
P(T<=t) two-tail	0.029533564	
t Critical two-tail	2.026192463	

P(T<=t) two-tail value (0.029533564) is lower than the standard significance level of

## CONCLUSION

The current research confirms the effectiveness of using online monolingual dictionaries as a pedagogical aid in long-term incidental vocabulary acquisition over the use of online bilingual dictionaries. The advantage of monolingual dictionaries over bilingual dictionaries could be attributed to several reasons. According to Laufer and Aviad (2006), students generally acknowledge the effectiveness of monolingual dictionaries over bilingual

0.05. Therefore, the mean value of the Online Monolingual Dictionary group is statistically significant over the Online Bilingual Dictionary group. Accordingly, vocabulary internalization through online monolingual dictionaries and online bilingual dictionaries, irrespective of their differences, have contributed to incidental vocabulary acquisition. On the condition that the awareness on target words positioned at zero in both classes before the treatment, the OMD group acquired approximately 8 words whereas the OBD group acquired approximately 7 words at the immediate test. On the contrary, the monolingual class and the Bilingual class have acquired approximately the same number of the target academic words at the post test.

The application of the independent sample t-test confirmed that the numerical difference was statistically significant both at the immediate-test and the post-test. Thus, the use of Online Monolingual Dictionaries has contributed effectively to internalize the target vocabulary over the Online Bilingual Dictionary at the immediate exposure. Furthermore, the posttests administered after a week have confirmed that the use of an Online Monolingual Dictionary positively affected long-term vocabulary internalization over the use of an Online Bilingual Dictionary. At the theoretical level, the aforesaid finding conforms to the study of Hayati & Fattahzadeh (2006) which identifies that long-term vocabulary retention was significantly higher with the users of monolingual dictionaries.

dictionaries, a factor which was long established by lexicographers and language teachers. Scholfield (2012) claims that the use of bilingual or semi-bilingual dictionaries are likely to demotivate second language learners of English when they rely on translations in L1. Thus, the requirement of habit formation in the target language is likely to be disrupted. Moreover, Nation (1990) advocates the use of monolingual dictionaries as Bilingual dictionaries offer the translation instead of a definition, which disturbs the development of

paraphrasing skills to prepare the learner for difficult vocabulary that they might encounter in future. Therefore, online monolingual dictionaries are recommended in SLA in resolving issues arising due to scarcity of vocabulary knowledge often projected in writing and speaking of ESL students. Specifically, online monolingual dictionaries exist under a range of reliable and trusted sources in contrast to bilingual dictionaries which are available for download. Therefore, as an educational

instrument, online monolingual dictionary usage deserves attention in educational pedagogy. The validity of the current research could be extended by analyzing the impact of this comparative study with a sample consisting of participants from different fields of study, genders and with students from a lower to advanced level in English. Moreover, a comparative study could also be done with an extended number of target words to validate the conclusion.

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## Incorporating a Task-Based Approach to Motivate Speaking in the General English Classroom

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### ABSTRACT

The speaking competency of students learning General English at Tertiary Educational Institutes (TEIs) has become a primary concern of many academics and policy makers. In such a context, this paper investigates the implications of incorporating a task-based speaking component to the General English curriculum at tertiary level. The target students join TEIs after finishing their G.C.E. Advanced Level. The students in this study had attended schools in the Western province in Sri Lanka and the majority belongs to middle-income families. They were selected from an institute, which has university status, providing English courses for General Purposes. An identical speaking task was administered, first without scaffolding and later with scaffolding to observe students' performance. It was observed that when a speaking activity is assigned, learners have the tendency to visualize it in L1 and convert it to L2. In a case where scaffolding items such as, note cards and strips are not allowed, learners memorize the lines or utterances and enact the given speaking task. Consequently, their discourse is impeded as they struggle for better vocabulary as well as sentences. Insights of the students' needs and their feedback led the institute to allocate extra time weekly for speaking.

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## INTRODUCTION

Teaching English has been an intensively researched area in the Sri Lankan context. From post-colonial times, English Language research paradigms have shifted, and pedagogical and andragogic approaches have been revised, restructured, and transformed by different national initiatives like *“English as a life skill”*. Nevertheless, the oral proficiency of school leavers and the job seekers is alarmingly poor. Oral proficiency is not tested at national level exams and the majority of students attend private institutes for English language education. Even though there are many trainers of English language all around the country, the common grievance articulated by the students and teachers alike is the poor speaking proficiency of the students. The same scenario was observed at the present institute among the students of Diploma in English program. Most of the population struggle when required to speak English in the classroom and they are very reticent and often opt for the mother tongue as the main medium of communication. This situation has nearly made “speaking in English –an impossibility.” However, during contact hours, a very interesting development was observed in the nature of English speaking of the students; the students’ production of the L2 was more grammatically accurate whenever the students were given a “grace period” or a “preparation time”. Conversely the same students were identified to be making the most fundamental errors and exhibited more reticence when the “preparation Time” was eliminated. Therefore, steps were taken to investigate this intriguing gap observed in the student population.

## OBJECTIVES OF THE STUDY

The primary objective of the study is to investigate the implications of incorporating a task-based speaking component to the General English curriculum at a TEI. It will provide implications, insights into the unexplored domains in ESL teaching with the primary focus on improving the speaking proficiency. The secondary objective is to provide insights to ESL teachers for their reflective practices. For example, it will be

beneficial to the teachers when identifying the learning gaps in the learners especially in “speaking. By understanding the needs of the ESL learners, teachers can provide more scaffolding via focussing on the learners’ needs and designing remedial pedagogical activities.

## THEORETICAL FRAMEWORK

There is a plethora of concepts and theories available in the ESL discipline that define speaking even though there is very limited empirical research on the relationship between speaking and writing competencies of ESL learners. First, one must take into account the concept of “Speaking”. It is “the process of building and sharing meaning through the use of verbal and non-verbal symbols, in a variety of contexts” (Chaney, 1998). In the ESL context, a learner should be able to perform the above in the similar manner as one would do in the native language. Nunan (2003) conceptualizes “Speaking in the ESL context” by identifying the following components.

- Produce the English speech sounds and sound patterns
- Use word and sentence stress, intonation patterns and the rhythm of the second language.
- Select appropriate words and sentences according to the proper social setting, audience, situation and subject matter.
- Organize their thoughts in a meaningful and logical sequence.
- Use language as a means of expressing values and judgments.

Furthermore, Kroll (1981) constructed a model of Speaking-Writing relationship in L1 for children grounded on the key bases namely; Preparation, Consolidation, Differentiation and Integration. According to this model, Kroll concludes that there is a very strong correlation between these two modalities and that children’s writing proficiency in L1 develops on the basis of their speaking proficiency. In most of the cases, L1 speaking proficiency precedes L1 writing proficiency. However, in the L2 context, circumstances and empirical evidence can be entirely different and

discreet as the amount of research done is noticeably inadequate. Williams (2008) points out that Kroll's theory for L1 Speaking and Writing correlation cannot be directly applied to the L2 context as cognitive and social factors may exert an influence on the L2 acquisition in the ESL scenario. Weissberg (2002) proposes that the written modality can be stronger than the Speaking modality after studying five Spanish ESL learners whose written productions were characterized by higher levels of accuracy and syntactic innovation which is the use of new morphological items. Interestingly, the same learners did not exhibit the same oral fluency claims Weissberg. Nevertheless, there he observed varying degrees of oral fluency even among the five students he studied and concluded this phenomenon to be an asymmetrical development for the binary modalities. One of the very few studies pertaining to the development and the causal relationship between speaking & writing modalities was conducted by Mochizuki. Mochizuki (2008) conducted research into the proficiency levels of speaking and writing modalities by administering speaking and writing tasks for a group of 81 ESL university students. His finding was that the students used more low-frequency words in Speaking than in Writing. However, the findings of Mochizuki cannot be generalized into other contexts as he did not use the identical task for both modalities hence resulting in the task effect scenario. One other study which investigated the modality difference was Kormos and Trebits (2012) study. However, the main objective of this study was to analyse different aspects of narrative tasks whereas modality difference was studied conjunctively. Their finding was that learners used a wider range of vocabulary in the written form than in Speaking but noted similar grammatical complexity in both modalities.

## **METHODOLOGY**

In order to investigate the differences between the production/performance in the two modalities; namely speaking and writing, the identical task was administered with two different approaches. The first approach was to administer the task which was a role play

without any scaffolding in the form of role cards or dialogue cards or scripts. Subsequently, the same task was administered with the scaffolding in the form of role cards or dialogue cards or typescripts. The identical task was used in order to minimize the "task effect" on the results so that falsifications will be nullified.

## **DATA COLLECTION AND ANALYSIS**

A sample of 30 students was given a role play centred upon socialization in the day to day context. The role plays were video recorded and transcribed verbatim. The scripts used by the same participants for the second phase were collected. The videos were watched, and the transcripts were read. Subsequently, the video transcripts were compared with the scripts (scaffolding) used by participants for the second phase. The transcripts were marked with comments and specific descriptive chunks called "open coding" (Merriam, 2009). Thereafter, a process of clustering was done where the data was narrowed to "thematic units" and "core categories" in order to shed light on the patterns/differences surfacing in the data.

The video tapes/transcriptions and scripts were analysed in the following aspects.

### **Vocabulary Range**

ESL learners struggle with lack of vocabulary, the participants in this study also exhibited the same characteristic. However, they exhibited a wider range of vocabulary and density when preparation time was given. The incongruities in vocabulary choice were shown in the following ways.

### **Language Transfer**

Language transfer or L1 interference is a very common occurrence in the ESL context. It is the scenario where the learners of a second or a foreign language used the more familiar mother tongue structures in the learning process of the second language which subsequently hinders accurate L2 communication as old habits of the first language continue to be present in an intimidating way while the new habits (the second language) are being learned. In many second language learners, L1 inference acts

as a negative agent rather than a productive tool for Second Language Acquisition. (SLA)

### **Circumlocution**

Circumlocution is a communication strategy very commonly used by second language learners in the communication process in the event of linguistic inadequacy in the second language. In brief, when they lacked the precise word for a particular English word, they opted to use the Sinhala word (native word) in recounting or defining a concept instead of saying or writing the specific words. This sample of students has used circumlocution in the following main ways.

- Using familiar vocabulary (Example: using the word teacher when they didn't know the word lecturer)
- Using synonyms (Example: using the word small instead of minute)
- Using categories (furniture, jobs, and clothing). (Example: using the word type of furniture when the word closet was not known)

### **Approximation**

It is a strategy frequently used by learners to describe a term in the second language which is in this case English with the help of another word which is closely related to the original term. This sample even used phrases such as 'kind of', 'a sort of', 'almost like' as a word which closely resembles the target word.

Examples:

- *"A sort of a hole with water"* to mean *"puddle"*
- *"almost like a long bus"* to mean *"coach"*
- *"kind of a very big prawn"* to mean *"lobster"*

However, at times approximation has a tendency to deliver the incorrect message since these approximations seem to use certain incorrect terms which share several semantic features. As shown above, the third example used by these learners, does not exactly convey the correct meaning which in fact leads to certain semantic misunderstandings.

### **Grammatical Accuracy**

The accuracy level of the second phase was higher than the first phase owing to the grace period given. Nevertheless, it was found that the syntactic complexity is similar in both phases. The most common errors which were observed in phase 1 which were rectified by students in phase 2 were,

#### **The Omission of S in the Third Person Singular**

In the role plays and skits observed in this study, the students were able to rectify several errors. "The omission of 's' in the third person singular is one of the errors most easily rectified by these learners. Once preparation time is provided it allows them a grace period for formulating grammatically correct sentences which is not provided in Phase 1.

#### **Using the Past Form of Verbs in the Making of Simple Passive Instead of Past Perfect**

This is another prominent error which was rectified by the participants in Phase 2. As mentioned in the previous explanation the participants corrected this particular error after discussing with the fellow participants. Nevertheless, compared to the error correction percentage of the *"omission of 's' in the third person singular"*, the accuracy rate is much lower.

#### **Confusion between Present Perfect Tense and Past Tense**

The participants rectified more than 50% of the errors committed in Phase 1. Seemingly, their difficulty was recalling the past tense form and differentiation between present perfect tense and past tense scenarios.

#### **Omission of Articles (a/an/the)**

Omission of articles (a/an/the) is the most recurrent error observed in this study and rectified by the participants in Phase 2. This error can be caused by the absence of such a feature in their L1. The participants rectified this error subsequently as they recall the grammar rules within the preparation time given.



## CONCLUSION

Language learners employ different types of strategies in the process of learning. They are cognitive, metacognitive, and socio affective strategies. Even in the ESL context, these strategies are consciously or unconsciously utilized by the learners. However, in the event of speaking, the appropriacy of these strategies used by students is of great relevance as speaking is the most difficult skill to master for the ESL speakers. This sample of students performed better when they used writing as a scaffolding which exemplifies the use and emphasis of the effect of writing on speaking. Therefore, rather than discouraging the habit of writing before

speaking, it may be useful to motivate them to write more as it would eventually affect their oral fluency in a positive way. The classroom activities must be modified and tailored in a speech fronted manner with more tasks requiring spontaneous language production within the grace period. A practice like Journal writing can be incorporated into the tasks as it broadens learner vocabulary. Since Journal Writing is not evaluated the tense/stress factor is naturally eliminated from the L2 learners' which encourages to allow affective filter leading to enhanced L2 production and acquisition. This can be adopted as an effective strategy for enhancing oral fluency of the ESL students in the Sri Lankan classrooms.

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# SICASH

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## Effectiveness of L2 Grammar Videos: A Dialogue between Teachers and Learners

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### ABSTRACT

Throughout the years it has been debated whether it is necessary to teach grammar, and what the most effective methods of teaching grammar are. This research addressed several aspects of using technology in the field of education such as technology in language learning, the video as a learning tool, and its relevance to grammar learning and the teacher's role in a technology-driven classroom. The study examined the perspectives of the teachers and the students towards L2 (Second Language) grammar videos and the effectiveness of such videos through a mixed method: Embedded Experimental Model. The sample included 120 young adults aged 18 – 24 who studied at a private campus in Sri Lanka and two teachers. A major finding of the study is that the students expect their teachers to explain what is on the video while playing it or after the video in order to clarify their doubts and for improved understanding. Consequently, the teachers can use L2 grammar videos as a scaffolding tool. The statistical analysis proved that the experimental group scored more in the tests compared to the control group. Further, there is a discrepancy between the teachers' perceptions on L2 grammar videos and the students' preferred types of grammar videos.

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## **INTRODUCTION**

Grammar is one of the most pressing concerns of second language learners and teachers. It has been debated whether it is necessary to teach grammar, whether grammar is required for second language proficiency and what the most effective methods for teaching grammar are. Ellis (2002) has claimed that “despite the significant changes in approaches to language teaching that have occurred in recent years, the status of grammar instruction is an issue that language teachers still have to resolve” (cited in Richards & Reppen, 2014, p.5 ). With this note, it is evident that teachers themselves can explore different methods of teaching grammar and utilize effective methods in their teaching context. Development of the information communication technology opened new methods of teaching enabling the teachers to use computers, multimedia projectors and digital videos. This study focuses on the effectiveness of using L2 grammar videos in teaching grammar.

The selected teaching context is a private campus in Sri Lanka which offers a Diploma in English programme. Although the teachers use a well-organized course book which covers the four skills and grammar, the students’ proficiency in grammar with regard to the marks obtained in the tests has not satisfactorily improved. Further, the management of the selected teaching context reinforces the utilization of resources such as technological equipment to the maximum in order to retain their students. In view of this, teachers have been using grammar videos which are available on the internet to teach grammar and it is worthwhile to examine the effectiveness and the pedagogical value of such videos in the teaching- learning process. This study addresses four research questions namely, (1) What are the teachers’ perspectives on using grammar videos in the L2 classroom? (2) How do teachers use grammar videos in the L2 classroom? (3) What are the students’ perspectives on using grammar videos in the L2 classroom? (4) Is it effective to use grammar videos in the L2 classroom?

The utilization of technology, especially the use of videos, addresses different theoretical

underpinnings and those theories and models play a distinguished role in the learning process. The scaffolding theory (Vygotsky, 1997), (Puntambekar & Hübscher, 2005) which examines the manner in which the teacher and use of material influence the learning process identifies the use of technological resources, peer interactions and teacher-led discussions as forms of scaffolding. Noticing Hypothesis (Schmidt, 2010) suggests that “input does not become intake for language learning unless it is noticed, that is, consciously registered” (p.721). Grammar videos can be used to facilitate noticing as the videos focus on a particular grammar form which draws the attention of the learner through various methods such as cartoons, animations, pictures and sounds. Multiple Intelligences Theory (Gardner, 2008) and Multimodal learning preference (Miller, 2001) apply to the visual learning which is apparent in videos. Earlier mentioned theories and models provide a rationale for using L2 grammar videos in the teaching process.

## **METHODOLOGY**

Mixed Methods - Embedded Experimental Model design is used in order to find the effectiveness of using L2 grammar videos. According to the classification provided by Creswell and Plano-Clark (2011), qualitative data support the quantitative experiment as it includes qualitative data gathering during, before and or after the intervention. This study was carried out in a private institution in Sri Lanka which offers a Diploma in English programme to young adults aged 18 – 24 years who have sat for the G.C.E. Advanced Level Examination. The population of the study includes all the students who are enrolled in the Diploma in English which comprises of nine batches with 20 - 40 students per batch. The course aims to develop the competency of the students from Common European Framework of Reference (CEFR) band A1 to band B2 and at the time of the intervention, a course book which is designed for CEFR band A1 is being used by the teachers. The sample of the students includes 120 students and two teachers (Teacher A and B). In order to have consistency and comparability, the two teachers selected for the study have two

batches; one batch for the experimental group (Group X, Group X1) and the other for the control group (Group Y, Y1) which are considered as pillars of any experimental research.

Quantitative part of the research is facilitated through the Pretests and Posttests which are connected to the intervention. Both experimental and controlled groups were given pretests and posttests with regard to the selected grammar points namely, Past simple and Countable and uncountable nouns. Data is analyzed through the SPSS statistical software. Qualitative data is gathered through interviews, classroom observations and focus group discussions. A semi-structured, One-on-One interview with both close-ended and open-ended questions was conducted with the two selected ESL teachers in order to find out their perspectives and experiences on using grammar videos which address the research questions. The classes which undergo the experimental treatment were observed twice as a non-participant observer by using a classroom observation protocol while the teacher was using the L2 grammar video. Two focus group discussions were carried out with the learners to understand their perceptions on the use of L2 grammar videos and to support the statistical data obtained through the pre and posttests. Three students with varying competency levels were selected from each experimental class for this discussion. The aim of the focus group discussion was to obtain detailed information on students' perspectives on using grammar videos and how they relate to that experience.

## **RESULTS AND DISCUSSION**

Considering the demographic data, it is observed that there is a slight difference between the number of males and females though the females accounted for 59% of the sample and majority of the students are 19 years old. G.C.E. O/L results obtained for English Language suggest the proficiency level of the selected sample. Although the classes have a mixed ability group of students, the majority of the sample is concentrated within the range of 'C' and 'S' passes which are at the bottom of the results range.

Usage and the effectiveness of grammar videos emerged as a common theme for all the research questions. Usage and effectiveness are interrelated as the effectiveness of videos affects the usage of such videos in the class. Grammar videos available on the internet is categorized into five types for the purpose of the study. They are (1) Videos in which a narrator teaches the grammar point without any images (2) Videos which contain an animated conversation and a teacher explaining the grammar point before or after that animated conversation (3) Videos in which a narrator teaches the grammar point with images (4) Videos in which a teacher teaches the grammar point as in a real classroom situation (5) Videos which highlight the grammar point through animated or authentic conversations. The effectiveness of each type of video may differ and, in this research, statistical data (See Appendices: Table 1 to 16) is collected only for two types of videos due to the time constraints. In addition, the students explained their point of view on the selected grammar videos during their focus group discussions.

### **Videos in which a narrator teaches the grammar point without any images**

The first intervention was carried out by using a video in which a narrator is teaching the grammar point without any images. In this video, the students cannot see a teacher. They only see a screen with the grammar point and hears the voice of the narrator. For the intervention, a video which focuses on past simple tense was selected and the selected video presented the rules explicitly. Both teachers agreed that they use this type of video. Teacher A prefers this video especially when the grammar point is difficult as this type of video gives the form clearly. Teacher B also upholds the same point of view and said that since this type of video provides the structure of the grammar form clearly, it will be easier for the students to internalize the form. Pretest and posttest results of the intervention show the effectiveness of this type of videos. A paired-samples t-test was conducted to find out the effectiveness of grammar videos based on the hypothesis that H0: mean difference of Pretest1 and Posttest1 = 0, H1: mean difference of Pretest1 and

Posttest1  $\neq$  0. Statistical analysis of the test results of group X (Teacher A's class) found that there was a significant difference in the scores of pretest ( $M=8.16$ ,  $SD= 4.322$ ) and posttest ( $M=10.87$ ,  $SD=4.061$ ) conditions;  $t= -5.831$ ,  $p= .000$ . As  $p \text{ value}= 0.000 < \alpha = 0.05$ , the null hypothesis ( $H_0$ ) is rejected at 5% level of significance (See Table 1 and 2). These results suggest that when a grammar video is shown the students acquire the particular grammar form, thus increasing the posttest results. Similar to Teacher A's class, the statistical results of Teacher B's Group X1 found that there was a significant difference in the scores of pretest ( $M=8.27$ ,  $SD= 3.906$ ) and posttest ( $M=11.91$ ,  $SD=3.085$ ) conditions;  $t= -4.819$ ,  $p= .000$ . As  $p \text{ value}= 0.000 < \alpha = 0.05$ , the null hypothesis ( $H_0$ ) is rejected at 5% level of significance (See Table 3 and 4). According to the above statistical analysis of the results of the two experimental groups, it is evident that videos in which a narrator is teaching the grammar point without any images are effective. Moreover, the teachers' view of this type of video is positive, as discussed earlier. However, the students' perceptions towards this video are negative compared to the other types of videos. Students who were selected for the focus group discussion from Group X mentioned that this video is fast, and it would be better if the teacher explained the grammar form again. The focus group of Group X1 mentioned that they prefer the video with animation to this narration only video as this video is relatively similar to the way their teacher explains which reduces the degree of motivation to watch the video. It is evident that the students expect a different experience from the grammar videos. Data collected through the classroom observation which was conducted during the intervention reinforces the negative view of the students towards the videos in which a narrator is teaching the grammar point without any images. It is observed that the students were watching the video in a passive manner. They did not respond to the video and just engaged in watching the video without displaying any emotion or enthusiasm. Considering the data collected through various research tools, it is evident that there is a discrepancy between teachers' perceptions and the level of motivation of the students which increases the

effectiveness of the selected type of grammar video. Students' distaste towards this type of video may be due to the absence of images or animations in the video. Availability of images in the video facilitates the learning process as it stimulates the visual spatial intelligence – Multiple Intelligence theory of the students. As mentioned earlier, the teachers have a high regard for this type of video due to the explicit presentation of the form and the usage of the particular grammar point. Regardless of the students' views, it should be noted that this grammar video produced a statistically significant set of posttest results.

### **Videos which contain an animated conversation and a teacher explaining the grammar point before or after that animated conversation**

Videos which contain an animated conversation and a teacher explaining the grammar point before or after that animated conversation is the second type of video that was used for the classroom intervention of this study. This is a combination of the traditional teacher explanation and real-life examples through conversations. Both teachers agreed that they use this type of video in the classroom. According to teacher A, this is the ideal type of grammar video to be shown in the classroom as it contains both teacher explanation and conversation. Teacher B believes that the students like the animated conversations and they feel more comfortable and secure since this video contains an explanation done by a teacher. However, she is anxious about the students being reliant on the teacher's explanations. As in the first intervention, a paired-samples t-test was conducted to find out the effectiveness of the grammar video. Statistical analysis of the test results of group X found that there was a significant difference in the scores of pretest ( $M=10.29$ ,  $SD= 2.155$ ) and posttest ( $M=10.97$ ,  $SD=2.433$ ) conditions;  $t= -2.701$ ,  $p= .010$ . As  $p \text{ value}= 0.010 < \alpha = 0.05$ , the null hypothesis ( $H_0$ ) is rejected at 5% level of significance (See Table 5 and 6). The paired-samples t-test which was conducted with Group X1 found that there was a significant difference in the scores of pretest ( $M=10.50$ ,  $SD= 2.425$ ) and posttest ( $M=11.68$ ,  $SD=2.147$ ) conditions;  $t= -3.144$ ,  $p= .005$ . As  $p \text{ value}= 0.005 < \alpha = 0.05$ ,



the null hypothesis (H0) is rejected at 5% level of significance (See Table 7 and 8). The analysis of the statistical data above suggests that the videos which contain an animated conversation and a teacher explaining the grammar point before or after that animated conversation are effective and this is supported by the students' perceptions towards this type of video. Students from Group X stated that they like this video. However, their most preferred video was the video in which a narrator is teaching the grammar point with images. The students of Group X1 had a different view compared to group X students. According to them, the most preferred video is the video which contains both the animated cartoon and the teacher explanation. They hold a positive opinion about the animation and the high level of motivation created by the video. In addition, they appreciated the fact that it had a teacher explanation in addition to the animated cartoon. The varied preference levels of this type of video is clearly revealed in the mean differences of the tests. Group X1's mean difference is higher than group X's thus aligning with their responses given during the focus group discussion. However, in general both groups were active learners during this intervention as they responded towards the dialogue in the animated cartoon which was shown in the video. It is noted that both teachers and students had a favourable attitude towards this video and it suggests that the teachers can utilize this type of videos more often.

#### **Videos in which a narrator is teaching the grammar point with images**

Videos in which a narrator is teaching the grammar point with images is another type of grammar videos available on the internet. This is similar to the earlier discussed narration only version except for the images provided in the video. Both teachers claimed that they use this type of videos as they contain images to teach the grammar form. The students from Group X mentioned that the video with both the narration and the pictures is better compared to the video which had only the narration. Moreover, they selected this type of video as their most preferred type of grammar video. The students from Group X1 also stated

that this video is better compared to the video which has only the narration although their most preferred video is the type which has both animation and teacher explanation. Considering the focus group discussions, it is evident that the students prefer grammar videos with images or animations compared to the ones without any images. Gardner's multiple intelligences theory (1993) suggests that human beings are equipped with visual spatial intelligence and as this video contains images it would result in increased motivation to learn the grammar form. In addition, the images, boldfacing and animation in this type of videos attract students' attention. According to Schmidt's Noticing hypothesis (1990) "input does not become intake for language learning unless it is noticed, that is, consciously registered" (p.721) and these features draw attention towards the grammar form thus resulting in increased level of acquisition.

#### **Videos in which a teacher teaches the grammar point as in a real classroom**

Videos in which a teacher teaches the grammar point as in a real classroom situation is similar to the traditional classroom setting in which a teacher is teaching the grammar point by standing in front of the black/white board. The teachers appear in the video write the grammar point on a board and explains it as the real teacher explains it in a real classroom. Both teachers claimed that they use this type of grammar videos. However, they use it for different reasons. Teacher A uses it in order to add an effect by creating excitement in students as they are going to learn from a different teacher. Teacher B uses this type of video as it is similar to the actual classroom setting and she assumes that the students feel comfortable in learning grammar in a classroom setting.

#### **Videos which highlight the grammar point through animated or authentic conversations**

The last type of video is videos which highlight the grammar point through animated or authentic conversations. They use subtitles for the conversations and highlight the grammar form in the subtitles. In addition,

they present real life situations which is an important aspect of language learning. The two teachers have opposing ideas regarding this video. Teacher A claimed that she uses it very rarely since she believes this type of video is not effective for the particular teaching context as the proficiency level and

the exposure to the target language of the students are very low. However, Teacher B believes that this type of video is useful as it enables the teacher to show how the particular grammar form is used in the real world.

## CONCLUSIONS

In conclusion, the study focused on examining the effectiveness of L2 grammar videos with regards to young adults. Both quantitative and qualitative data were obtained and the findings conclude that the use of L2 grammar videos are effective to a certain extent and the effectiveness of such videos may depend on the type of video and the teacher's role played in a technologically- driven classroom.

Findings of the study will help the educators to broaden their knowledge on L2 grammar videos and use them effectively. More importantly, it suggests that there should be a congruence between the teachers' attitudes towards the grammar videos and the students' needs and expectations with regard to grammar videos.

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## APPENDICES

Table 1. Paired Samples Statistics of Group X – Intervention 1

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Pretest1	8.16	38	4.322	.701
	Posttest1	10.87	38	4.061	.659

Table 2. Paired Samples Test of Group X – Intervention 1

		Paired Difference					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference	Confidence of the			
					Lower	Upper			
Pair 1	Pretest1 - Posttest1	-2.711	2.866	.465	-3.652	-1.769	-5.831	37	.000

Table 3. Paired Samples Statistics of Group X1 – Intervention 1

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Pretest1	8.27	22	3.906	.833
	Posttest1	11.91	22	3.085	.658

Table 4. Paired Samples Test of Group X1 – Intervention 1

		Paired Difference					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference	Confidence of the			
					Lower	Upper			
Pair 1	Pretest1 - Posttest1	-3.636	3.540	.755	-5.206	-2.067	-4.819	21	.000

Table 5. Paired Samples Statistics of Group X – Intervention 2

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Pretest2	10.29	38	2.155	.350
	Posttest2	10.97	38	2.433	.395

Table 6. Paired Samples Test of Group X – Intervention 2

		Paired Difference					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Interval Difference	Confidence of the			
					Lower	Upper			
Pair 1	Pretest2 – Posttest2	-684	1.561	.253	-1.197	-171	-2.701	37	.010

Table 7. Paired Samples Statistics of Group X1 – Intervention 2

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Pretest1	10.50	22	2.425	.517
	Posttest1	11.68	22	2.147	.458

Table 8. Paired Samples Test of Group X1 – Intervention 2

		Paired Difference		Std. Error Mean	95% Interval Difference	Confidence of the	t	df	Sig. (2-tailed)
		Mean	Std. Deviation						
					Lower	Upper			
Pair 1	Pretest2 – Posttest2	-1.182	1.763	.376	-1.963	-.400	-3.144	21	.005

Table 9. Paired Samples Statistics of Group Y – Grammar Form 1

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Pretest1	7.79	38	4.443	.721
	Posttest1	11.61	38	3.753	.609

Table 10. Paired Samples Test of Group Y – Grammar Form 1

		Paired Difference		Std. Error Mean	95% Interval Difference	Confidence of the	t	df	Sig. (2-tailed)
		Mean	Std. Deviation						
					Lower	Upper			
Pair 1	Pretest2 – Posttest2	-3.816	3.074	.499	-4.826	-2.805	-7.651	37	.000

Table 11. Paired Samples Statistics of Group Y – Grammar Form 2

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Pretest2	9.37	38	2.823	.458
	Posttest2	10.71	38	2.155	.350

Table 12. Paired Samples Test of Group Y – Grammar Form 2

		Paired Difference					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Interval Difference	Confidence of the			
					Lower	Upper			
Pair 1	Pretest2 – Posttest2	-1.342	2.419	.392	-2.137	-.547	-3.420	37	.002

Table 13. Paired Samples Statistics of Group Y1 – Grammar Form 1

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Pretest2	10.41	22	4.205	.897
	Posttest2	12.64	22	3.346	.713

Table 14. Paired Samples Test of Group Y1 – Grammar Form 1

		Paired Difference					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Interval Difference	Confidence of the			
					Lower	Upper			
Pair 1	Pretest2 – Posttest2	-2.227	4.117	.878	-4.052	-.429	-2.538	21	.019

Table 15. Paired Samples Statistics of Group Y1 – Grammar Form 2

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Pretest2	9.00	22	1.852	.395
	Posttest2	10.86	22	2.416	.515

Table 16. Paired Samples Test of Group Y1 – Grammar Form 2									
		Paired Difference					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Interval Difference	Confidence of the			
					Lower	Upper			
Pair 1	Pretest2 – Posttest2	- 1.864	2.396	.511	-2.926	-.801	- 3.648	21	.002



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## Property, Sustainability and Well-Being: The Perspectives of the American Colonizers and the Natives in William Faulkner's *Go Down, Moses*

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### ABSTRACT

This article primarily, considers the different points of view held by the Native Indians and the White man concerning property in Faulkner's novel, *Go Down, Moses*. Subsequently, these findings are examined to ascertain how their opinions on property influence their viewpoints on sustainability and well-being. This paper has two objectives. One is to expose how these two cultural groups considered sustainability and well-being in the framework of their own concepts of property and the way Faulkner exposes these differences artistically. The other aim is to examine the possible reasons which could have led the author to work on this idea of property. Faulkner being a well-known humanist, one wonders whether the injustice done to the Natives from the very inception of the conquering of America which finally culminated officially with the Removal act of 1830 and all that followed with the implementation of this act was playing on his conscience or whether this theme of property was a response to the aftermath of the Civil war of 1861 and the devastation of the South. Once the distinctive views of property are explained, Faulkner's artistry is demonstrated wherein he invents characters in environments specific to them, so that they could be endowed with certain traits which could bring out these concepts. To conclude, Faulkner's penchant towards the Natives observed in the novel, strengthens his universal reputation of being a humanist. In his work, Faulkner gives an explicit and implicit view on property and the reasons for this are examined.

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## INTRODUCTION

The Cambridge dictionary very basically defines property as 'an object or objects that belong to someone'. In the context of this paper, which deals with the contradictory views on property and proprietorship (the owning of property) held by Native Indians and the Euro-Americans, the word 'belong' given in the definition is of great significance. This paper will mainly focus on land and its ownership. The American colonizers believed that land had to belong to them through private ownership in order to be able to transfer it to their descendants while the Natives could not even understand the concept of land ever being able to belong to someone. The reasons for this difference in opinion, the authors stance on this subject, and the manner in which sustainability and well-being stem from proprietorship will be discussed in this paper.

## METHODOLOGY

Going through the website Google Scholar on articles written on William Faulkner and his works it was revealed that though research had been done on Native Indians, land and law, none of the papers compared the opposing vision of the Natives and the Euro-Americans on the possession of land. As the theme of the conference is sustainability and well-being, it was decided to combine this theme with the principal one and research how the idea of sustainability and well-being could be drawn out from the main theme. The research done was quantitative and the tools used were books, journals and internet in order to obtain new information for the paper.

### Conflicting Views

Native Indians<sup>1</sup> were of the opinion that the earth could not be appropriated by anyone, as

Indians were part of it and one with it. The earth having the status of mother, was a temporary abode in their circular perception of life and death. Smohalla, a chief of the Shapatin tribe, magnificently illustrates this belief of the Indians and their close relationship to the earth when he complains to the authority, against the Whites who ask him to labour the earth; he compares this act, to that of cutting up the bowels of his mother; which he says could result in her not accepting him in her bosom once he is dead. He continues further by drawing a parallel between excavating stones from the earth and digging deep into the skin of his mother in order to remove her bones. This, he continues, would impair him from entering her body to be born once again when he dies (Jacquin, 1990, p9). On the contrary, according to Roy Harvey Pearce, the American colonizers were of opinion that 'the whole earth is the Lord's garden, and he hath given it to the sons of Adam to be tilled and improved by them. Why then should [they] stand starving here for places of habitation, (...) and in the meantime suffer whole countries, as profitable for the use of man, to lie waste without any improvement.' (Pearce, 1967, p21) This diametrically opposed points of view on property and proprietorship obviously entail a different view of sustainability and way of thinking in the two ethnic groups, and this unfortunately led to the disintegration and destruction of the wilderness and the routing of the Indians from their lands by the Euro-Americans because of their superior machinery and weapon power.<sup>2</sup>

Oscar N. E. Kjell, in his research paper on sustainability and well-being, states that Lélé and Norgaard (1996) believe, that sustainability is the "the ability to maintain something undiminished over some time period" (p355). However, he goes further to say that this straightforward definition,

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<sup>1</sup>Berkhoffer, R.F. in the *White man's Indian* p3 says, "The first residents of the Americas were by modern estimates divided into, at least two thousand cultures and more societies, practiced a multiplicity of customs and lifestyles, held an enormous variety of values and beliefs (...) by classifying all these many peoples as *Indians*, Whites categorized the variety of cultures and societies as a single entity for the purpose of description and analysis, ..."

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<sup>2</sup>Francis Jenning states that 'When Europeans began their astounding voyages to dazzling 'new' worlds, [...] On a thousand frontiers Europeans used technology of superior ships and guns to gain beachheads; then they imposed on top of indigenous the devices best understood by the conquerors' p3

studied in a scientific context could lead to several questions such as what should be sustained, for which duration and for what socially desirable aim/s?<sup>3</sup> In the context of this paper, it would refer to the sustainability of property where the aim would be well-being.

By explaining the contradictory perceptions of the Native Indians and the Euro-Americans towards the sustainability of their property and well-being, one could comprehend better the fragmentation of the wilderness which was so sacred to the Native Indians. McLuhan is of the opinion that the Indians who respected the earth, as well as all animals and objects which constituted their territory, did not impose their will on either of them and above all considered private ownership as the road to poverty, not to riches (McLuhan, 1974, p8). The Native Indians had no private possessions and hence, they lived in community. Sustainability for them was based on their circular perception of life. They lived in a community and once dead, entered the earth to be born again. On the contrary, the Euro-Americans had a linear perception of life and the sustainability of their property was crucial to their happiness which in fact, was the strengthening of their clan and family name through riches. This, they believed could be done, solely through transmitting their ownership of land and chattel<sup>4</sup> in the form of heritage to their offspring. In *Go Down, Moses*, Faulkner exposes this idea of sustainability of property and the idea of well-being of the Euro-Americans when he states that the wilderness- the whole, the habitation of the bear and the Indians was fragmented, delineated and measured by the White Anglo Saxons into 'mathematical squares of rank cotton' (Faulkner, 1990 p337) and they 'translated it into something to bequeath to

their children, worthy of bequeathment for [their] descendant's ease and security and pride to perpetuate [their] name and accomplishments' (Faulkner, 1990, p 245).

### **Observing Faulkner's originality in Conveying His Concepts**

Norman Rudich is of opinion that it is rare to find Faulkner, 'describe a natural environment, a social or political situation into which he then introduces his characters', quite the opposite of Zola and Balzac. On the contrary, 'environment, external fact, is for Faulkner the natural extension of human life processes, the modes in which people experience life.' (Rudich 1981, p55)

The Euro-Americans, descendants of the Puritans and Protestants, were heavily influenced by Christian religious writings which brought forth the whole concept of the Chosen People and the establishment of the land of Canaan. "And I will give unto thee, and to thy seed after thee, the land wherein thou art a stranger, all the land of Canaan for an everlasting possession; and I, will be their God" (Genesis. Ch17:8). Hence, the Europeans who came in quest of a new land considered New England as the Promised Land. Whereas, in the South, the pastoral Garden of Eden metaphor was popularized because of the luxuriant green vegetation and its natural environment.

Faulkner's ingenuity at designing characters through their natural environment is observed when in the creation of Sam Fathers, he uses the essence of the communities of the South, the Whites, the Native Indians and the African slaves. Sam Fathers, in *Go Down, Moses* is said to be of mixed origins; white, Negro and Indian, representative of the three ethnic groups which constitute the population composition in the South which is tantamount to the mythical Garden of Eden. He is heir to the buck, the deity of the wilderness as the author states, that 'there was something running in Sam Fathers' veins which ran in the veins of the buck too, (Faulkner, 1990, p334) thus implying that Sam Fathers, typical of the South, was also the Indian of the wilderness who was one with it.

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<sup>3</sup> Citation for published version (APA): Kjell, O. (2011). Sustainable Well-Being: A Potential Synergy Between Sustainability and Well-Being Research. Review of General Psychology, 15(3), 255-266. <https://doi.org/10.1037/a0024603>

<sup>4</sup> Cf to entry on Property, John Bouvier, *A Law Dictionary, Adapted to the Constitution and the Laws of the United States*, <https://legal-dictionary.thefreedictionary.com>

The ever present, Isaac McCaslin, the young white boy initiated into the ways of the Indians by Sam Fathers is the protagonist of the novel and he is the instrument through which Faulkner expresses his ideas. Philip M. Weinstein proves this, when he says that Faulkner has involved his opinion so deeply in the character of Isaac McCaslin that he cannot allow him to drift.

The protagonist of the wilderness, Old Ben, the bear, is described as, "not even a mortal beast but an anachronism indomitable and invincible out of an old dead time, a phantom, epitome and apotheosis of the old wild life" (Faulkner, 1990, p185). The Bear is an "anachronism" and in reality, it should not exist. Old Ben is "Absolved of mortality" and he is ubiquitous and omniscient, this elevates him to a certain level of grandeur. The adjective 'old' appended to the Bear is in no way pejorative. It connotes a sense of agelessness when used to identify Sam Fathers and the wilderness. Old Ben is similar to "the wilderness, the big woods, bigger and older than any recorded document (Faulkner, 1990, p183) which encompasses all time and space; circular recurrent time and mythic space which characterizes it. Old Ben is "tremendous, red-eyed, not malevolent but just too big, too big" (Faulkner, 1990, p185). The Indian, being commonly referred to as the 'Red Man', makes the mentioning of the colour red significant here. It could point out that, Old Ben embodies the wilderness with which the Indians identify themselves.

Dogs are generally considered as man's friend and they live among humans in civilized societies. Hence, the dog named Lion, a huge, wild Airedale, could be the representative of the Euro-Americans. Lion, "with cold yellow eyes and a tremendous chest and over all that strange color like a blued gun barrel....the yellow eyes blinking sleepily at nothing: the indomitable and unbroken spirit, there was nothing of petty malevolence (...) but a cold and almost impersonal malignance like some natural force" (Faulkner 1990, pp 209/210) makes Boon living in Euro-American society and working for the Whites, blurt "Jesus, Jesus. - will he let me touch him" (Faulkner, 1990, p 211) and then it is said that he knelt and touched him. The invocation of Christian

imagery and actions point out Lion's connection to White Christian society. Lion is deified. Boon kneels beside it. The words 'indomitable' and 'unbroken spirit' elevate Lion to the status of THE dog fit to combat THE bear. Peter Swiggart, seems to predict the combat between Lion and Old Ben and the ensuing victory of white civilization over that of the Natives when he says that Lion will be "the instrument of Old Ben's death and Sam Fathers suicide,"

In addition to Faulkner's technique of extracting characters from their surroundings, he symbolically explores their relationship to prove his concepts. The final combat between Lion and Old Ben is a classic example where symbolically the rise of American civilization over that of the aboriginal inhabitants is illustrated. Thus, recalling the conquest of America, the lore of the Chosen People and the quest for the Promised land of the Euro-Americans. It is noteworthy that the wilderness and the bear, Old Ben which represent Indian values, serve as a measuring rod by which to judge the attitudes of the Euro-Americans and to disclose their cultural and conceptual difference in relation to the Natives, the most striking among them being that of property, notably land.

### **What is it That Inspired Faulkner to Work on Property?**

When in 1958, a student questioned Faulkner concerning how he wanted his readers to sympathize in the Old Ben and hunter conflict, the author replied, "Well, not 'sympathize.' I doubt if the writer's asking anyone to sympathize, to choose sides. That is the reader's right. What the writer's asking is compassion and understanding, that change must alter, must happen and change is going to alter what was. That no matter how fine anything seems, it can't endure, because once it stops, abandons motion, it is dead. It's to have compassion for the anguish that the wilderness itself may have felt by being ruthlessly destroyed by axes, by men who simply wanted to make that earth grow something they could sell for a profit, which brought into it a condition based on evil human bondage. It is not to choose sides at all - just to compassionate the good splendid

things which are a part of man's past too, part of man's heritage too, but they were obsolete and had to go." (Frederik, L, & Blotner G.& J. 1957/58) An alignment of Faulkner's ideas with that of the Native Indians' is obvious here. He is somewhat animistic and quite humanistic. It seems that he does not recognize these struggles politically, but only in terms of individual character, the furthest his humanistic vision can explore.

William Faulkner, American and a Southerner, answering a question on his sentiments concerning the destruction of the South and the subsequent modernization taking place, recalls nostalgically, , "that (the modernization) to me is sad and tragic thing for the old days, the old times to go, providing you have the sort of background which a country boy like me had when that was part of my life" (Frederik, L & Blotner G. &J.L.,1957/1958). Faulkner loved his South and was very disappointed by the consequences the Civil war -which commenced in 1861- brought upon his region. The whole system of the South was in disarray in the aftermath of the war. It is this frustration, that encouraged Faulkner to create his imaginary and fictional space called Yoknapatawpha, his "own little postage stamp of native soil"<sup>5</sup> which could be considered as the microcosm of the macrocosm of the South. He goes on to say, "that by sublimating the actual into the apocryphal I would have the liberty to use whatever talent I might have to its absolute top. It opened up a gold mine of other people; I created a cosmos of my own. I can move people around like God....<sup>6</sup> Yoknapatawpha became the solid base for his works whereby, Faulkner exposed his ideas, concepts and opinions using the history, geography, customs and language of the South through his fiction. He could afford to be ahistorical at times because Yoknapatawpha was imaginary terrain and this is what he did in *Go Down, Moses* specially in the context of the Native Indians. Yoknapatawpha was also used as a confessional to expose the crimes and sins of the South and express his pain and suffering

at the changes coming upon his region. One could surmise that the Indian removal act of 1830<sup>7</sup> and its outcome too, troubled the author. Being a son of the South and an ardent lover of his region, his sole wish was that its archetypal style of life would continue. He expected a kind of sustainability but unfortunately, it turned out to be otherwise. Hence, his quench for longevity, sustainability and well-being was satisfied I believe, by the establishment of his legendary fictional space, Yoknapatawpha. It is noteworthy that Yoknapatawpha, gave Faulkner, the free hand to expose the concepts of property and possession of the Euro-Americans and the Natives.

To conclude, coming from totally distinct backgrounds, the Natives and the American colonizers held completely opposite views on life and living. Therefore, it was impossible for them to see eye to eye on property and ownership of land and hence, on sustainability and well-being which to a great extent originated from it. It is also evident that Faulkner, though of Euro-American descent, had a proclivity for the Native Indians and sympathized with their cause.

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<sup>5</sup>Faulkner's interview with Jean Stein (1956) *Paris Review*

<sup>6</sup>idem

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<sup>7</sup>Berkhoffer, R.H., *White man's Indian* p157- The Indian removal act clearly dealt with land. Very basically, it meant that Natives were displaced from the States they lived in to the less productive areas of these territories or at times completely pushed out of the boundaries and all this, because the Whites needed more land for agricultural purposes and expansion of their families.

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## Lessons Learnt: A Study of Student Feedback Regarding Online Proficiency Assessment

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### ABSTRACT

Subsequent to the revolutionary advances in technology and its remarkable impact on universities, online summative assessment has become increasingly commonplace and popular in the academia. Consequently, online English language proficiency assessment has also gained momentum globally. This study was conducted at a Sri Lankan private university where online assessment is utilized as the standard summative test for several modules including EAP (English for Academic Purposes) module. The main objective was to explore undergraduates' perceptions of the online EAP assessment and its effectiveness and feasibility in gauging competency of English among ESL (English as a Second Language) learners. A quantitative approach was chosen for this study where a questionnaire was used as the primary data collection tool. The sample was a convenience sample of 120 undergraduates who had taken the online test. The findings revealed the undergraduates' displeasure regarding several aspects of online English assessment. They were critical of the reading component of the online test in addition to experiencing time management issues, technical limitations that marred their performance.

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## INTRODUCTION

In today's highly dynamic teaching /learning milieu, practices like online learning, flipped classrooms and blended learning have become the norm. According to Larreamendy-Joerns and Leinhardt (2006) two positive phenomena can be observed in the latest developments in the sector of education "the merging of online teaching and learning into the stream of everyday practices at universities, and the increasingly salient role of distance programs in institutions of higher education" (p. 572). In this contemporary context, the use of computer-assisted assessment (CAA) is also being established as a standard form of assessment in the higher education sector. The term computer-assisted assessment (CAA) can refer to any kind of evaluation process where computer-based tests are utilized to assess the learners' aptitude, knowledge, and skills of a subject matter. There is a substantial body of research examining the types of assessments, the feasibility of such assessments and how different higher education institutes have adapted and adopted these computer based online assessments for the purposes of delivery, marking and even analysis of specific components of their curricular.

Regardless of the mode, online or Face to Face, assessment is a core wheel in the machinery of higher education as stated by Bransford, Brown, and Cocking (2000). In their opinion "teaching and learning processes need to be assessment-centered to provide learners with opportunities to demonstrate their developing abilities and receive support to enhance their learning". As commonly distinguished, formative assessment is designed to foster learning while summative assessment is widely used for validation and accreditation purposes. In the view of Sorensen & Takle, (2005) "Effective integration of formative assessment in online learning environments has the potential to offer an appropriate structure for sustained meaningful interactions among learners and the teacher, and foster development of effective learning communities to facilitate meaningful learning and its assessment". A significant number of research studies highlight the potential of

formative assessments to enhance learner engagement thus promoting effective learning in the long run. According to Gikandi et al (2011) "effective application of formative assessment in online learning environments can offer an innovative pedagogical strategy to facilitate such opportunities". However, when examining the current practices around the globe it is evident that formative assessment is not the most widely used form but summative assessment. As discussed by Pachler et al (2010) summative assessment is given prominence in the domain of online learning in higher education despite the versatility of formative assessment as a more concrete mode of learner engagement. Further, with this transition to computer-based platforms, language proficiency is also being tested via these online applications in both formative and summative forms. A considerable amount of research has been conducted on online summative assessments such as Marriot's (2009) learner preference study and Stevens' (2018) study on how to create assignments without imposing an undue strain on the teachers.

### Objectives of the Study

As mentioned in the introduction, embedding technology in language proficiency assessments is becoming increasingly commonplace and research on this trend is also relatively progressive. However, there is a paucity of research that focus on the learners' feedback and their experiences and feedback concerning their perceptions of online assessments especially with regard to EAP (English for Academic Purposes) modules among ESL learners. Researchers of this study believe that in order to develop and improve online assessment of Language proficiency, studying students' perspectives is essential. According to Laurillard (2008) "It is imperative that students' views regarding changes in educational techniques be taken into serious consideration to ensure a smooth and successful transition. If students' perceptions remain elusive, technological measures taken to solve problems in education may end up as 'sub optimal' solutions"

Therefore, the primary objective of this study is to explore undergraduates' perceptions of the online EAP assessment and its effectiveness and feasibility in gauging competency of English among ESL (English as a Second Language) learners. When the students' perceptions are identified, they can be used as a platform to further improve the online assessment applications, the framework of the questions and the teachers' perceptions as well. All this can lead to more informed decision making on the part of the faculty. In addition to the primary objective, the secondary objective is to identify the negative features of the administered online test hence to design an informed plan for an enhanced implementation on future occasions.

### **Theoretical Framework**

This study is anchored on the social constructivist theory propagated by Lev Vygotsky in 1978. As further explained by Elliott et al (2000) Constructivism is 'an approach to learning that holds that people actively construct or make their own knowledge and that reality is determined by the experiences of the learner'. Therefore, in this context the learners' prior experience with online assessment can play a major role in shaping their perceptions. Vygotsky (1978) was of the opinion that "cognitive development stems from social interactions from guided learning within the zone of proximal development as children and their partner's co-construct knowledge". Constructivist theories basically underpin a distinctly learner-centered approach which in this case is applicable as most of the learners today are receptive towards computer-based assessment rather than traditional paper-based assessments. In the constructivist learning set up, the learners are given much choice with regard to determining the content that needs to be taught and tested. In fact according to Brooks & Brooks (1993) a teacher who is implementing a constructivist approach to teaching "allow student responses to drive lessons, shift instructional/assessment strategies, and alter content" which is the essence of this study as it is rationalized on the premise of learners' perspectives on online assessments.

## **METHODOLOGY**

A quantitative method was chosen as the aim was to take a relatively large sample. A questionnaire was used as the primary data collection tool. The sample was a convenience sample of 120 undergraduates who had taken the online test for the subject English for Academic Purposes. The questionnaire consisted of two parts and each part consisted questions under the following categories.

### **Part 1**

1. Students' Prior Experiences of Online Study and Assessment (Yes/ No questions)
2. Student perceptions regarding the Online Assessment System - Screen and Interface Design and System Use (Likert Scale)
3. Evaluation of the EAP online (mid exam) quiz (Likert Scale)
4. Student perceptions regarding the Online Assessment System (Likert Scale)

### **Part 2**

Two open-ended questions seeking their overall opinion of the online assessment and the technical difficulties they experienced while attempting the test.

## **RESULTS AND DISCUSSION**

According to the demographic data, it is observed that majority of the sample is male accounting for 52 % while the remaining 48 % is female. The first section of Part 1 of the questionnaire contained six yes/no questions on Students' Prior Experiences of Online Study and Assessment. It is noted that although the majority of the students have prior experiences with online study and assessment, their experiences with regard to online English assessments are minimal (See table 1 to 6).

Section two contained eight statements with a Likert Scale that ranges from 1 to 5 denoting low and high, respectively. These statements measure the student perceptions

regarding the Online Assessment System with special reference to Screen and Interface Design and System Use (See table 7). According to the statistical analysis, the mean value is concentrated around 3 which suggests a neutral position. Further, the low Standard Deviation value which is concentrated around 1 suggests that there is minimal variation among the sample.

Section three contained 16 questions regarding the EAP online assessment. The responses were recorded on a Likert scale ranging from totally disagree to totally agree and statistical data was obtained using SPSS software (See table 8). The statement "Proper instructions were given by the invigilators in the labs" received a Mean value of 3.76 with a Standard Deviation of .698 suggesting that the average student has a neutral attitude towards the instructions given by the invigilators. Next statement "The number of questions in the exam was manageable" resulted in a Mean value of 2.78 and Standard Deviation of 1.111. Accordingly, it is evident that the average student found the number of questions not manageable. Another related statement "Duration of the exam was adequate" received  $M=2.33$ ,  $SD=1.040$  which strengthens the previous statement about the number of questions. Accordingly, the duration of one hour is not adequate to answer 50 questions. In addition, the randomization of questions is considered a hindrance resulting  $M = 2.59$ ,  $SD = .974$ . However, the statement "Question by Question format made me feel better in the exam" accounted for a Mean = 3.16 and  $SD = 1.037$  suggesting that the format of the questions had a neutral impact on the students. This section included several statements related to the reading comprehension of the online exam. The results of the analysis for the statement "It was easy to read and answer the reading comprehension" was  $M=2.78$ ,  $SD= 1.063$ . It suggests that the students find it difficult to do the reading comprehension. However, it should be noted that the students were given a hard copy of the text as an additional resource and they found it useful owing to  $M=4$ ,  $SD= .926$ . The analysis of the statements "The difficulty level and the length of the reading passage was manageable" and "The

number of questions in the reading passage was manageable" received  $M=2.80$ ,  $SD= 1.017$  and  $M=2.88$ ,  $SD= .963$  respectively. The questionnaire included two statements about the questions about punctuation marks. They were "It was easy to read and answer the questions on punctuation marks" and "The difficulty level of the questions on punctuation marks was manageable" resulting in  $M = 3.52$ ,  $SD= .799$  and  $M=3.43$ ,  $SD= .857$ . These statistical data suggest that the students hold a neutral attitude towards the questions about punctuation marks. Academic vocabulary was another area which was tested at the exam the two statements attribute to that are "It was easy to read and answer the questions on academic vocabulary" and "The difficulty level of the questions on academic vocabulary was manageable". They received  $M = 3.35$ ,  $SD= .913$  and  $M=3.28$ ,  $SD= .907$  respectively suggesting that the students had a neutral attitude towards those statements. Statements related to the questions about the academic writing style also received a neutral attitude. The analysis of the statements "It was easy to read and answer the questions on academic writing style" and "The difficulty level of the questions on academic writing style was manageable" received  $M= 3.45$ ,  $SD = .934$  and  $M= 3.32$ ,  $SD= .850$  respectively. Last statement of this section was "Cheating was difficult" received a mean value of 4 and a standard deviation of 1.106 suggesting that the students agree with the statement.

The last section of part one of the questionnaire included eight statements to investigate the student perceptions regarding the Online Assessment System. A Likert scale ranging from totally disagree to totally agree was used and statistical data was obtained for each statement (See table 9). The eight statements included in this section were Online exam made me feel less anxious, Online exam is more systematic, Online exam is more student- friendly than the written exam, Online exam is more convenient than the written exam, The content of the online exam was covered in the EAP lectures, Prior practice is needed to face an online English exam, Online exam can be applied to the semester 1 English module as well and I think online exams for the English module should

continue. Mean value of all these statements is concentrated around 3 and 4 while standard deviation showed a lower value. It suggests that the students hold a neutral attitude towards the statements given in this section.

Part two of the questionnaire included two open ended questions namely, What is your overall opinion on the EAP online exam? Explain and Did you face any difficulties (technical/practical) during the EAP online exam? Explain. After careful analysis of the 120 undergraduate respondents' answers it was revealed that they exhibited a preference for online assessment in comparison to paper-based examinations. However, most of them were critical of the time allocated for the test saying that, their scores would have been significantly better had there been more time to complete the evaluation. Further, they were of the opinion that a reading comprehension question is a defective choice as they found it extremely difficult to scroll up and down from the passage to the questions while they were randomized

among other questions. Further, the randomization of questions was not well received by the participants as they had found it frustrating with a large number of different types of questions ranging from writing mechanics, tenses, Academic Vocabulary to other grammar structures. Another finding is that the students lacked practice with regard to online assessments which they believed had a negative impact on their overall grades.

## **CONCLUSION**

In conclusion, it can be said that a substantial degree of modifications and revisions on the part of the assessment framework is needed in order for the university in this study to implement a more learner friendly and an accurate mode of online summative assessment of language proficiency in the future. The researchers believe that the preferences and concerns of the students must be addressed in a systematic manner for a successful transition towards more online assessments across the curricular.

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## APPENDICES

Table 1. I have used Web for Educational Purposes		
	N	%
Yes	118	98.3%
No	2	1.7%

Table 2. I have attended an online course before		
	N	%
Yes	73	60.8%
No	47	39.2%

Table 3. I have taken some kind of online assessments before		
	N	%
Yes	106	88.3%
No	14	11.7%

Table 4. I have taken an online quiz on the web		
	N	%
Yes	111	92.5%
No	9	7.5%

Table 5. I have taken some kind of online assessments / exams at SLIIT		
	N	%
Yes	120	100.0%

Table 6. I have taken an online exam for English before the EAP mid online		
	N	%
Yes	31	25.8%
No	89	74.2%



Table 7. Statistics

	Sample Size (n)	Mean	Median	Mode	Std. Deviation	Skewness	Std. Error of Skewness
Overall framework and operation levels of the system were clear and smooth	120	3.41	3	3	1.03	-0.471	0.221
Overall interface operation method was easy and appropriate	120	3.45	3	3	0.94	0.024	0.221
Exam interface was clear and easy to operate	120	3.33	3	3	1.08	-0.171	0.221
Exam interface design was appropriate	120	3.35	3	3	1.04	-0.339	0.221
Log-in interface was clear and easy to operate	120	3.62	4	4	1.15	-0.564	0.221
It was easy to browse the questions	120	3.46	3.5	3	1.15	-0.333	0.221
I followed the instructions without any problem	120	3.43	3	3	1.19	-0.303	0.221
Seeing the count down on the pane made me progress better	120	3.38	3	3	1.31	-0.43	0.221

Table 8. Statistics

	Sample Size (n)	Mean	Median	Mode	Std. Deviation	Skewness	Std. Error of Skewness	Std. Error of Skewness
Proper instructions were given by the invigilators in the labs.	120	3.8	4	4	0.698	-0.685	0.221	0.221
The number of questions in the exam was manageable	120	2.8	3	2	1.111	-0.028	0.221	0.221
Question by Question format made me feel better in the exam	120	3.2	3	4	1.037	-0.14	0.221	0.221
Duration of the exam was adequate /enough.	120	2.3	2	2	1.04	0.296	0.221	0.221
Answering shuffled/mixed questions was easy.	120	2.6	3	3	0.974	-0.207	0.221	0.221
It was easy to read and answer the reading comprehension.	120	2.8	3	3	1.063	0.104	0.221	0.221
The hard copy of the reading passage was very useful.	120	4	4	4	0.926	-0.905	0.221	0.221
The difficulty level and the length of the reading passage was manageable	120	2.8	3	3	1.017	-0.025	0.221	0.221
The number of questions in the reading passage was manageable	120	2.9	3	3	0.963	-0.164	0.221	
It was easy to read and answer the questions on punctuation marks.	120	3.5	4	4	0.799	-0.206	0.221	
The difficulty level of the questions on punctuation marks was manageable.	120	3.4	3	4	0.857	-0.156	0.221	
It was easy to read and answer the questions on academic vocabulary.	120	3.4	3	3	0.913	-0.285	0.221	
The difficulty level of the questions on academic vocabulary was manageable	120	3.3	3	3	0.907	-0.438	0.221	
It was easy to read and answer the questions on academic writing style.	120	3.5	3	3	0.934	-0.388	0.221	
The difficulty level of the questions on academic writing style was manageable	120	3.3	3	4	0.85	-0.494	0.221	
Cheating was difficult	120	4.1	4	5	1.106	-1.241	0.221	

Table 9. Statistics

	Sample Size (n)	Mean	Median	Mode	Std. Deviation	Skewness	Std. Error of Skewness
Online exam made me feel less anxious	120	3.34	3	3	0.874	-0.039	0.221
Online exam is more systematic	120	3.58	4	4	0.836	-0.663	0.221
Online exam is more student- friendly than the written exam	120	3.34	3	3	1.119	-0.088	0.221
Online exam is more convenient than the written exam	120	3.3	3	3	1.058	-0.023	0.221
The content of the online exam was covered in the EAP lectures.	120	4.14	4	4	0.759	-0.83	0.221
Prior practice is needed to face an online English exam.	120	3.66	4	4	0.974	-0.318	0.221
Online exam can be applied to the semester 1 English module as well.	120	3.5	4	4	1.188	-0.627	0.221
I think online exams for the English module should continue	120	3.57	4	4	1.228	-0.696	0.221



## Sustainability in the Face of Adversity – In Nathaniel Hawthorne’s *The Scarlet Letter*

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### ABSTRACT

This paper considers the levels of sustainability or to say it differently the extent to which the four main characters of *A Scarlet Letter* are able to endure hardships in the face of the rigid structure of the Puritan society which brings upon them, nothing but adversity. These characters are namely, Hester Prynne, her legal husband Roger Chillingworth, the pastor Arthur Dimmesdale, all of them caught up in the love triangle and Pearl, Hester Prynne’s daughter, the outcome of her illicit relationship with the minister. The objective of this research paper is to observe the way in which Hester Prynne, the protagonist, positively and gradually integrates into this environment of an unforgiving Bostonian Puritanical society through her fortitude to face up to the hard times imposed on her as a result of her behaviour. Initially, the reader gets an insight into the story line of *The Scarlet Letter*, the Puritan period and its society. The significance of symbolism in this novel is also discussed. Secondly, the ambiguity, the transformation and evolution of the four characters throughout the duration of the novel is considered. Finally, by using the weaknesses of the other characters as a foil, the sustainability and endurance of the protagonist is appreciated proving that despite great adversity sustainability in life is yet possible.

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## INTRODUCTION

It is said that, Mrs Hawthorne was visibly disturbed after her husband Nathaniel Hawthorne, read his work *The Scarlet Letter* to her. Hawthorne himself, describes it as “a tale of human frailty and sorrow” and a “hell-fired story”. The author, born in 1804 in Massachusetts and whose ancestry traces back to the Puritan period published his masterpiece, *The Scarlet Letter* in 1850. The novel though written in the 19<sup>th</sup> century is set in the backdrop of the by gone Puritan era and brings out the beliefs, norms and behaviour of that society. The purpose of this paper is to examine the stoicism of the protagonist, Hester Prynne, in the face of untold suffering and misery brought upon her by her so called misbehaviour.

A search done on the website, Google Scholar indicated that though many research papers have used various aspects of the novel, to mention a few; love, adultery, Puritan society and its culture, symbolism etc. a paper discussing the strength and the level of endurance of Hester Prynne and the manner in which she managed to survive in the callous Bostonian Puritanical society was yet to be published. In addition, the use of internet; notably Google, to gather knowledge of recent research, the reading of journals and critical works on *The Scarlet Letter* helped in the gathering of data to write this paper.

## THE STORY IN BRIEF

Hester Prynne, a young, married European woman crosses the Atlantic and lands in New England. Having been informed that her husband, Roger Chillingworth was lost at sea while journeying to New England, she is attracted to a young pastor, Arthur Dimmesdale. Hester is accused of having committed adultery with this pastor, and given birth to Pearl, a little girl child. The novel is the story of Hester who is obliged to perpetually wear the red-letter “A” which

stands for adultery, on her bosom. This symbol being a constant reminder of her act of adultery, it makes her undergo untold suffering, face terrible insults and isolation at the hands of the inhabitants of the Puritan town, Boston. It is probably the immense effort Hester had to put in for survival in this society, that prompted Hawthorne to call his work an infernal story. The paper will be discussing Hester's endurance or in other words her level of sustainability to all the adversity that befalls her in the Bostonian environment.

Among the several themes of *The Scarlet Letter*, the principal one is the struggles faced by a so-called, adulteress in the context of a straightjacketed Puritan society. Working on this theme of Hester's conflict with the society she lived in, gives an insight into the nature of the 17<sup>th</sup> century Puritanical society. This being done even more through the eyes of a person, Hawthorne who is a descendant of the Puritan lineage, gives more authenticity and veracity to the description. Therefore, it could be stated that *The Scarlet Letter* implicitly contains a historical theme, that of the Puritan era. This points out that the novel could be classified as a historical novel although out of period. The question now is what is this Puritan society upon which it is said, the foundation of American culture, governance, forms of art and literature are built?

## THE PURITANS

In Chapter 17 of the book of Genesis<sup>1</sup>, it is stated that “when A-braham was ninety years old and nine, the Lord appeared to A-brahm, and said unto him, I *m* the Almighty God; walk before me, and be thou perfect. And I will make my covenant between me and thee, and will multiply thee exceedingly. (...) As for me, behold, my covenant is with thee, and thou shalt be a father of many nations. (...) and I will establish my covenant between me and thee and thy seed after thee in their

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<sup>1</sup>The Book of Genesis, the first book of the Hebrew Bible and the Christian Old Testament, is an account of the creation of the world, the early history of humanity, Israel's ancestors, and the origins of the Jewish people.

... Genesis ends with Israel in Egypt, ready for the coming of Moses and the Exodus. Genesis narrates the primeval history of the world (chapters 1–11) and the patriarchal history of the Israelite people (chapters 12–50) [en.wikipedia.org > wiki > Book\\_of\\_Genesis](http://en.wikipedia.org/wiki/Book_of_Genesis).

generations for an everlasting covenant, to be a God unto thee, and to thy seed after thee. And I will give unto thee and to thy seed after thee, the land wherein thou art a stranger, all the land of Ca-na-an for an everlasting possession; and I will be their God," It is on this belief that the Puritan ideology was founded.

In a Europe, troubled by famine and religious persecution, the Europeans who were anchored in the word of God believed that they should flee from Europe and find their land of Canaan which was promised to them by God, in the Bible. Therefore, they set sail, crossed the Atlantic and landed in the area around Massachusetts Bay and settled there. To them, this was the Promised Land indicated by God. They fervently believed in the Bible and thus abided very closely to the scriptures. Consequently, they considered themselves to be an untainted people and using the Latin word *Puritas* which means pure in English, they baptized themselves as The Puritans. The stereotypical image of the Puritans is that they are a group of individuals who considered hard work as a norm. Moreover, they were firm devotees of the Frenchman, Jean Calvin's theories which explained 'Predestination' and 'Grace'. Hence, they saw their future written in the new land which they would discover.

Though the Puritans chose to be attired in black, red and blue had a special significance in their lives<sup>2</sup>.

## THE SCARLET LETTER "A" AND ITS EVOLUTION

It is this letter "A" which helps to unravel the story line in *The Scarlet Letter*. It had been imposed on Hester Prynne by the law, as a symbol of civil punishment, for her so called incorrect behaviour. At the onset, the scarlet letter acts as a catalyst to rekindle the antagonism of the people towards her for what they believe is an utterly odious act she committed. Hawthorne says, 'on the breast of her gown, in fine red cloth, surrounded with an elaborate embroidery and fantastic flourishes of gold thread, appeared the letter "A." (Hawthorne, 1969, p66). At this point in time of the novel, one believes that this letter "A" could stand only for adultery but the elegant and nonchalant manner in which Hester exhibits the symbol makes one wonder whether she is defying the law? A disciple of Ann Hutchinson? An Antinomian? Therefore, "A" for Antinomianism?<sup>2</sup> The physical image of the letter A has a triangular shape. When inversed it could take the outline of a heart. Is it not possible that Hester yearns for the law of the heart –the law of the Antinomians- so that

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<sup>2</sup>This could be the reason for red being chosen for the letter 'A' which was to be affixed on Hester's bosom. Hawthorne in his novel, brings out symbolism, psychology and the myth making beliefs, prevalent in American literature which has its roots in Puritan culture. The symbol of the letter "A" which winds through the story line of the *The Scarlet Letter* is solid evidence. The psychological manipulation of Dimmesdale, the church minister by Roger Chillingworth the so called physician, the hallucination of the minister seeing the symbol of the scarlet letter in the firmament, the elements of witchcraft being mentioned in the novel brought out by the character of Mistress Hibbins, who was the sister of Governor Bellingham and a suspect in the witch trials of 1655, all point out to *The Scarlet Letter* being based on Puritan dogma.

<sup>3</sup>Antinomianism, (Greek anti, "against"; nomos, "law"), doctrine according to which Christians are freed by grace from the necessity of obeying the Mosaic Law. The antinomians rejected the very notion of obedience as legalistic; to them the good life flowed from the inner working of the Holy Spirit. In this circumstance they appealed not only to Martin Luther but also to Paul and Augustine.

The ideas of antinomianism had been present in the early church, and some Gnostic heretics believed that freedom from law meant freedom for license. The doctrine of antinomianism, however, grew out of the Protestant controversies on the law and the gospel and was first attributed to Luther's collaborator, Johann Agricola. It also appeared in the Reformed branch of Protestantism. The left-wing Anabaptists were accused of antinomianism, both for theological reasons and also because they opposed the cooperation of church and state, which was considered necessary for law and order. For similar reasons, in the 17th century, Separatists, Familists, Ranters, and Independents in England were called antinomians by the established churches. In New England, Anne Hutchinson was accused of the doctrine when she said that the churches were preaching "the covenant of works." The Evangelical movement at the end of the 18th century produced its own antinomians who claimed an inner experience and a "new life," which they considered the true source of good works. <https://www.britannica.com/topic/antinomianism>



she would be able to get rid of her badge of ignominy which she would have to wear for the rest of her life? Couldn't this Scarlet letter be a sort of a placard carried in protest of the law of the Puritans?

It is said that when sporting the scarlet letter "A", "both men and women who had been familiarly acquainted with Hester Prynne were now impressed as if they beheld her for the first time – was that Scarlet Letter, so fantastically embroidered and illuminated upon her bosom. It had the effect of a spell, taking her out with the ordinary relations with humanity, and enclosing her in a sphere by herself" (Hawthorne, 1969, p39). It is from this juncture onwards that differentiation commences and the protagonist has to battle through the hostility and show her power of endurance or sustainability in an uncanny, antagonistic society. Hester, accompanied by her daughter, must face up to extreme public discrimination and much disgrace.

As time goes on, one observes the different way in which the characters, Chillingworth, Dimmesdale and Hester evolve. A gradual transformation taking place in Hester is visible. With time she tries to integrate into the Bostonian society by running errands for the villagers and seeing to their well-being and even caring for those who are sick. This, changes their mindset towards her, and they begin to forget the denotation of the Scarlet Letter. It is said that, "Individuals in private life, meanwhile, had quite forgiven Hester Prynne for her frailty; nay, more, they had begun to look upon the scarlet letter as the token, not of that one sin, for which she had borne so long and dreary a penance, but of her many good deeds since." (Hawthorne, 1969, p194). This is a psychological approach which demonstrates that humans forget with time and that time is a great healer of pain and suffering. The villagers had even begun to use the possessive pronoun 'our' on Hester Prynne and they even called her "the town's own Hester -" (Hawthorne, 1969, p194) It is also said that "the scarlet letter now had the effect of the cross on a nun's bosom" (Hawthorne, 1969, p194). She rises to the stature of a Sister of Mercy in the eyes of the villagers. So much so, that she is raised from sinner to Sainthood among the townsfolk. Her strength to

implement her strategy (if one may call it so) of regaining her place in society relegates the original and obvious significance of the scarlet letter into oblivion in the minds of the inhabitants. Her helpfulness, kindness and courage are appreciated by the people "that many people refused to interpret the scarlet "A" by its original signification. They said that it meant 'Angel' because she was very sympathetic towards her fellow inhabitants. Some folk construed it as 'Able';" so strong was Hester Prynne, with a woman's strength." (Hawthorne, 1969, p193). While Hester struggles to find her way out in life by voluntarily serving those who despise her, which is a very bitter task, she thereby, shows her fortitude in the face of adversity. She has also to manage her former husband and paramour in the meantime so that no clashes will occur and her path to redemption will not be marred. On the contrary, the male characters, Dimmesdale and Chillingworth have a different technique of confronting the problem and moving forward in life.

### **THE CHILLINGWORTH AND DIMMESDALE RELATIONSHIP**

Chillingworth obliges Hester to keep silent about their marriage while the pastor refuses to publicly own up to paternity of Pearl until a certain time. According to Roger Chillingworth's stratagem he wishes to take revenge from the pastor by inflicting a slow death on him. Chillingworth secretly approaches the minister, Dimmesdale in the guise of being a physician and wanting to help him because it has been revealed that Dimmesdale is not in the best of health. As Chillingworth's ulterior motive is revenge, he torments and tortures his 'patient' in silence under the pretext of treating him and emotionally pulls down Dimmesdale who is suffering in silence for his sin of fathering a child out of wedlock and not accepting it. Furthermore, the punishment inflicted on Hester to wear the Scarlet Letter, affects Dimmesdale as he is partly the reason for it. He is so disturbed by the situation that; he even hallucinates. This is confirmed when it is said that, "we impute it, therefore solely to the disease in his own eye and heart, that the minister, looking upward to the zenith, beheld there the appearance of an immense letter -the

letter "A"- marked out in lines of dull red light. Not but the meteor may have shown itself at that point, burning duskily through a veil of cloud; but with no such shape as his guilty imagination gave it; or, at least, with so little definiteness, that another's guilt might have seen another symbol in it. (Hawthorne, 1969, p187). He sees it because he shares the guilt of the miserable condition imposed on Hester by the law of the land. The Scarlet Letter, considered a symbol of adultery, Arthur Dimmesdale believes that through self-mutilation, by having a mystic "A" "imprinted on his breast and eating into his flesh" (James, 2002, p280) he could pay penance for his share of adultery. This shows the physical and moral decline in him. The minister's guilt gnaws his conscience daily and in addition to that, the daily treatment and advice given by the quack doctor Chillingworth, brings about his untimely death as he was overwhelmed by the happenings and had no more will and energy to withstand the psychological influence he experienced in this situation.

The hunchbacked, bent Roger Chillingworth suggesting more the devil in appearance, triggers Dimmesdale's death. Obsessed by taking revenge from Dimmesdale, in the process of implementing his Machiavellian plan against the minister, Chillingworth gets so engrossed in it, that he depends on his enemy for existence. When the minister collapses on the scaffold, it is said that "Old Roger Chillingworth knelt down beside him' with a blank, dull countenance, out of which the life seemed to have departed" (Hawthorne, 1969, p262). It is obvious here, that he is on the path to departure. He is unscrupulous, seeing the minister dying, Chillingworth blurts out "Thou hast escaped me!" (Hawthorne, 1969, p262) several times. The relationship between the quack doctor and the fake minister seems ambiguous. The charlatan wants his supposed patient to live on so that he could execute his revenge further and gain satisfaction from it. It seems he is quite aware that the death of the minister would make him aimless in life and he would have nothing to live for and therefore hasten his death. As expected, within the space of one year of the minister's death, Roger Chillingworth passes away.

## PEARL

Pearl is the love child of Hester and the reverend. A live, walking symbol of their illegitimate relationship, all the more conspicuous because her mother made it a point to dress her in red quite often. A child, having a troubled childhood, even though quite young, she always stood up for her mother, against the village children's insults and protected her mother's interests. On the contrary, she always harassed Hester, questioning her frequently about their predicament. Pearl, the solace of Hester is instrumental in shaping the personality of her mother. The very fact of being by her side all the time prevents Hester from deviating from her path towards redemption. Pearl, yet a child, confronts adversity in a remarkable manner. This is done under the protection and guidance of Hester. She grows up from a baby to a girl, travels to Europe and marries into a noteworthy family and leads a respectable life. Therefore we observe a transformation process in Pearl too.

## DISCUSSION

*The Scarlet Letter*, does not really examine the personality of Hester closely. It assesses the events and circumstances which led to the formation of her character. Her reasons for marriage to Old Roger Chillingworth are unclear. Believing him lost at sea, she is attracted to a handsome young minister and commits adultery. But the question here is, was adultery really committed? She was supposedly a widow. The appearance of Chillingworth changes the entire picture. The townsfolk's claim that she is an adulteress is confirmed. This is the watershed in the development of her character. Hardships make her pause and consider her future strategies. By executing her plan, she is transformed and is able to win over the very people who punished her and spend her old age in the very same town she was disgraced and pass away peacefully. This in itself is a victory which indicates her strength of confronting difficult circumstances and overcoming them.

## CONCLUSION

To conclude, it is obvious that Hester Prynne, the protagonist, was the only person endowed with the highest level of sustainability in antagonistic surroundings. She developed

courage and inner-strength when honed by hardships which was quite different to the behaviour of Arthur Dimmesdale and Roger Chillingworth who on the contrary, weakened in adversity.

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## Perception of Postgraduate Students on Emergency Remote Teaching (ERT) During the COVID-19 Lock-Down: A Cohort Study in a Public University in Sri Lanka

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### ABSTRACT

Emergency Remote Teaching (ERT) is a temporary shift from an instructional delivery to an alternate delivery mode, perhaps online, due to the current pandemic situation, which involves the use of fully remote teaching solutions or some blended learning as a hybrid. The present study was conducted with a cohort of students (n=37) within the age range 25-35, pursuing a Master's degree program in a public university in Sri Lanka to elucidate their perception about ERT. In the pre-COVID-19 time, the major portion of the course has been offered face-to-face. However, due to the crisis situation under the COVID-19 lock-down since March 2020, the course has been shifted totally to online modes, considering ERT, with the concurrence of the students. All online sessions and activities were carefully selected, planned and executed to ensure effective learning takes place. Sessions were delivered asynchronously using the Learning Management System of the institute, WhatsApp and emails. After completion of the course, an online perception survey was conducted using a Google Form to obtain their feedback. The data was cross-tabulated, and a factor analysis was performed. The results revealed that the students perceived all the activities conducted as Emergency Remote Teaching (ERT) highly positively, during the COVID-19 lock-down period. The findings of the present study will give all educationists an opportunity to re-visit the courses offered totally face-to-face until now, and to think of moving towards blended learning to facilitate the 21<sup>st</sup> Century learning.

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## INTRODUCTION

It has been reported that the learning process of approximately 1.6 billion learners across 194 countries world-wide got affected due to the closure of educational institutes during the COVID-19 pandemic situation (UNESCO, 2020a). The countries who have been using blended learning approaches with the online teaching component for several years, if not for decades, somehow continued to deliver the courses during the lock-down using online modes. The other countries, including Sri Lanka, faced enormous difficulties in continuing the disrupted education for their learners. Prior to lock-down, sufficient attention was not paid on including a significant online component in their course curricular, and on the other hand, the digital literacy and connectivity of the students, and possession of digital devices by students were always in question (UNESCO, 2020b).

Blended learning is characterised by combining well-planned, face-to-face, on-ground learning with online and e-learning modes to different degrees, however, there exists several detailed definitions (Kim, 2007). Offering courses online, trying to mimic the blended learning during an emergency situation might not work for both teachers and learners as both groups may have not been prepared for this unplanned teaching-learning experience. In a lock-down situation similar to the recent experience due to the COVID-19 pandemic, the online offering of courses can correctly be defined as Emergency Remote Teaching (ERT). As explained by Hodges *et al* (2020), ERT is a temporary shift from an instructional delivery to an alternate delivery mode, perhaps online, due to the current pandemic situation, which involves the use of fully remote teaching solutions or some blended learning as a hybrid. The students of Sri Lanka with no exception, faced the disruption in the education process during the recent COVID-19 lock-down. Many teachers have tried various ways of offering the course contents through online modes. Although primary, secondary and tertiary students were under the 'sympathy' spotlight, little attention has

been paid to the postgraduate students. In fact, the effectiveness of the delivery modes used in the postgraduate courses which started offering 'unplanned' online contents has always been questioned.

This study is based on the ERT conducted targeting a cohort of postgraduate students in a public university in Sri Lanka during the COVID-19 lock-down period, mainly focusing on the perceived effectiveness of the ERT activities and the perception of students about the 'new' learning experience.

## METHODOLOGY

The study was conducted with a cohort of 37 students within the age range 25-35, pursuing a Master's degree program in a public university in Sri Lanka. In the pre-COVID-19 time, the major portion of the course has been offered face-to-face. However, due to the crisis situation under the COVID-19 lock-down since March 2020, the course has totally shifted to online modes, considering Emergency Remote Teaching (ERT).

The phone numbers and email addresses of all the students were obtained through the Learning Management System (LMS) of the institute. With the assistance of the students, a WhatsApp group was created for the course. A written consent on the willingness to commence the disrupted academic program was obtained at the beginning of the lock-down (on 30<sup>th</sup> March) from each student via WhatsApp. In addition, emails were also used in parallel, to communicate with the students. Students had the freedom to use any of the two. Six different asynchronous-type online activities, targeting all three domains of learning, were planned to constructively align with the intended learning outcomes of the course, and delivered for six consecutive weeks on every Saturday. The basis for online activities were derived primarily from research into approaches to student learning as described by Entwistle and Ramsden (1983) according to the levels of cognitive domain (Bloom *et al*, 1956). With the consent of the students, it was decided that the time to commence the activities was 8.00



a.m. All instructional materials were uploaded to LMS and the WhatsApp group, and the same were sent via emails too, making three options available for the students. Out of the six activities, four activities had submissions (assignments) with deadlines. Submissions were also made possible with the aforesaid three modes.

After completion of the course, an online survey was conducted using a Google Form to get the feedback of the students. The survey in this study included five dimensions and 16 questions assessed on a 5-point Likert scale. All students responded within a span of 2 days. Data was analysed descriptively and for possible inferences, the associations were tested. Exploratory Factor Analysis was performed for data reduction, treating Likert scale questions as continuous 1–5 variables. Only the results of the content analysis are presented in this article.

## RESULTS AND DISCUSSION

WhatsApp is being widely used among undergraduate students as it is a free messenger application that works across multiple platforms (Gon and Rawekar, 2017). In this study too, out of all the three modes of communication, WhatsApp was found to be the most convenient for the students, even to upload their assignments (data not shown).

The PCA component matrix of the study accounted for 72.3% of the total variance in our dataset and yielded 4 predictor factors (Table 1). It was noted that, factors had high internal consistency (Cronbach alpha = 0.79–0.88). The association between demographic characters and the survey items were found to be non-significant ( $p>0.05$ ).

Table 1. Predictor Factors Identified using Principal Components Analysis on Survey Items answered by Students.

Factor ( $\alpha$ coefficient)	Description of higher score in the survey item	Mean (SD) <sup>a</sup>	% Agree <sup>b</sup>
Overall learning experience ( $\alpha=0.84$ )	◦ I had a very different learning experience through these online activities	4.46 (0.75)	92
	◦ I learnt a lot in relation to subject matter through these online activities	4.81 (0.46)	97
	◦ I learnt many other things too, other than the subject matter through these online activities	4.43 (0.76)	92
	◦ The variety of activities helped me to learn the subject easily	4.64 (0.55)	97
Technology used ( $\alpha=0.88$ )	◦ Teacher used technology to support my learning	4.54 (0.66)	100
	◦ Amount of technology used in these sessions was manageable	4.70 (0.46)	97
Self-reflection about learning enhancement ( $\alpha=0.79$ )	◦ These online activities helped me to understand how I learn best	4.42 (0.89)	86
	◦ I learnt more effectively and easily through these online activities compared to my usual classroom lectures	3.76 (0.81)	62
Technology, connectivity and economics ( $\alpha=0.82$ )	◦ I had to spend a lot of money (for devices, data etc) for these online activities	2.45 (0.91)	14
	◦ I had a very difficult time in downloading and uploading the documents due to poor connectivity	2.68 (0.92)	27

<sup>a</sup> Items were coded 1 to 5, with 1 being minimally endorsing (strongly disagree), 3 neutral, and 5 highly endorsing (Strongly agree)

<sup>b</sup> Percentage of students with mean item score  $\geq 4$

**Learning Experience:** More than 92% of the student cohort agreed that they had a different learning experience through the

online activities that they have done during the ERT period (Table 1). In addition, almost all the students had a perceived



improvement in subject-related knowledge supported by a variety of activities carefully selected, which gave them an opportunity to get exposed to new dimensions of learning as well. It is well-established that careful planning and delivering of online activities can enhance student learning experience (Nguyen, 2017).

**Technology Used:** In online environments, it is inevitable to use technology. However, students learn best when technology supports the learning process (Raja and Nagasubramani, 2018). In the present study, almost all the students were of the opinion that, the amount of technology used in these activities supported the learning (Table 1).

**Self-Reflection about Learning Enhancement:** About 86% of the respondents perceived that, they were able to recognize their learning styles and preferences through these online activities. As a result, only 62% agreed that they have learnt more effectively and easily through ERT compared to usual on-ground classroom activities (Table 1). This indicates that, making all-online will not create a positive impact on student learning to compensate face-to-face classes (Ebner and Gegenfurtner, 2019; Callister and Love, 2016).

**Technology, Connectivity and Economics:** In Sri Lanka, the computer literacy and the digital literacy of the age cohort 25-35 are 46.1% and 68.2% respectively (DCS, 2019). Within the same age cohort, the internet use and email use are 56.1% and 25.8% respectively. However, within the tested cohort, the digital literacy and the internet usage were found to be 100% (data not shown). It is of paramount importance that the teachers consider the affordances of devices and connectivity that the learners will have, to support the online learning, in the digital classroom (O'Doherty et al, 2018). Results of the present study showed

that students were not deprived of the required devices or the lack of connectivity (Table 1).

### **Perception about Individual Learning Activity:**

More than 90% of the students agreed that they have learnt new subject matter from all the 6 activities (Figures 1-6), which clearly indicates that the learning has taken place with the selected Emergency Remote Teaching (ERT) strategies. Narrated PowerPoint presentations uploaded as a video was found to be a new learning experience for the students (Figure 1) where *ca.* 92% of the students seemed to have enjoyed, although the activity was focused on the first two levels in the Bloom's taxonomy (Bloom *et al*, 1956). Pedagogical effectiveness of the narrated slides has already been well-established as a valuable resource for student learning (Walker, 2007).

Even though only 75-77% of the students enjoyed the activities 2 and 3 which were focused on the applying and analysing levels in the Bloom's taxonomy (Figures 2 and 3), it was apparent that more than 85% students learnt new technologies through both activities. As explained by Sull and Cavanaugh (2014), the audio files are an integral component in distance learning. In this study, the assignment submission as an audio file was found to be a new experience to the students.

Video-based learning (VBL) has widely been employed to enhance learning in the recent years (Giannakos, 2013). The online activity 4 was on VBL, targeted on the 5<sup>th</sup> level, i.e. evaluating level in the Bloom's taxonomy (Figure 4). Although VBL is not new to the Sri Lankan context, the way the activity was planned and delivered made more than 89% of the students perceived that they have learnt a new technology with enjoyment.

Figure 1. Perception of students (n=37) about the *Online Activity 1*: An activity that requires remembering and understanding on a topic through a narrated and animated PowerPoint presentation. (*Submission not required*). Discussion threads through WhatsApp.

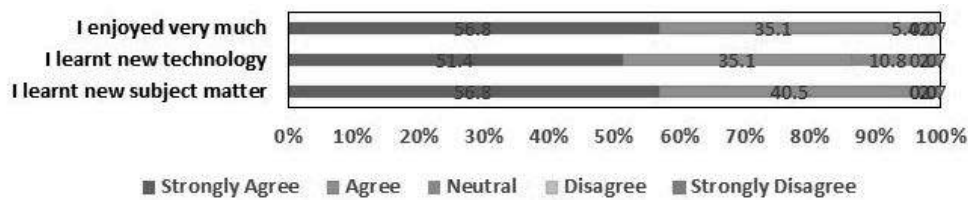


Figure 2. Perception of students (n=37) about the *Online Activity 2*: An activity that requires applying and critical analysis of 2 scenarios. (*Submission required*: in the form of an audio file, as if the student calls a client to give his consultancy service). Discussion threads through WhatsApp.

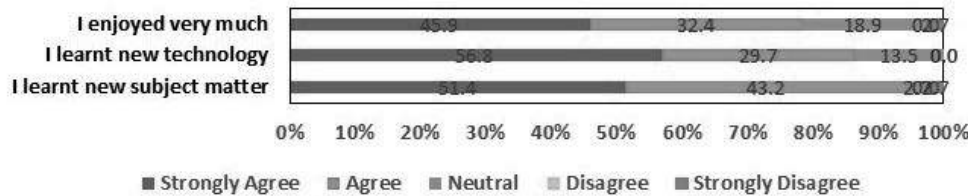


Figure 3. Perception of students (n=37) about the *Online Activity 3*: An activity that requires student's ability to collate information from online sources, and situational analysis (*Submission required*: in the form of a Word document/PDF). Discussion threads through WhatsApp.

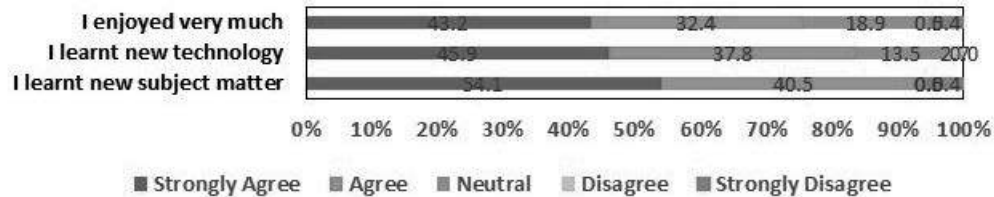


Figure 4. Perception of students (n=37) about the *Online Activity 4*: An activity that requires 'practical thinking' and evaluating scenarios through the videos, and finally to answer the given set of questions. (*Submission required*: in the form of Word document). Discussion threads through WhatsApp.

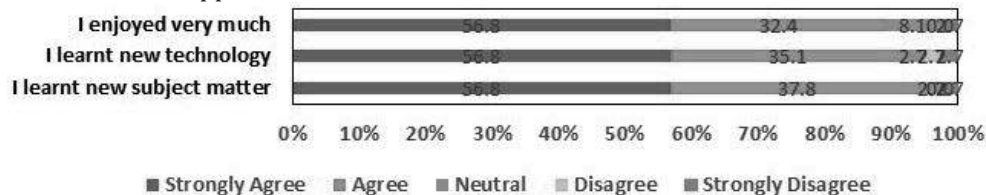


Figure 5. Perception of students (n=37) about the *Online Activity 5*: An activity that requires students to read the given study material and find answers for the given questions that promote 'higher-order thinking'. (*Submission not required*, but the motivation was a 'promise' saying one of the questions will appear at the final exam). Discussion threads through WhatsApp.

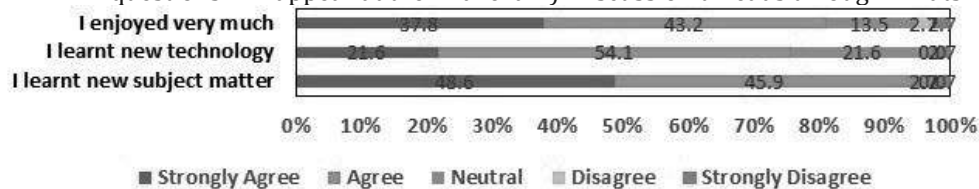
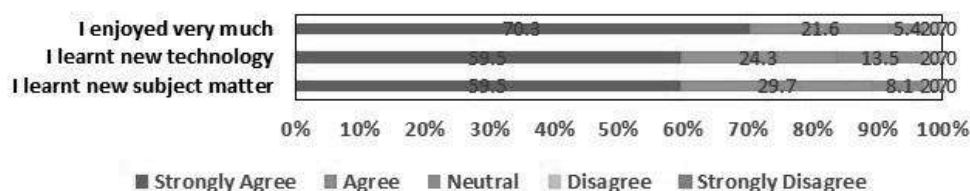


Figure 6. Perception of students (n=37) about the *Online Activity 6*: An activity that requires creativity, based on the basic understanding on principles of the topic (*Submission required*: in the form of PowerPoint presentation). Discussion threads through WhatsApp.



The least preferred activity among all was based on a reading material with the 'read-out-loud' option (Figure 5), which had the focus on higher-order thinking skills. Although the perception of the students on this activity was not that satisfactory, more than 94% of the students agreed that they have learnt new contents. As described previously, guided reading questions positively impact student motivation to learn (Brown et al, 2016). Creativity is one of the most important twenty-first century skills and central to higher education (Jahnke, 2017). Of all, the activity which touched the creativity, the highest order of the Bloom's taxonomy, was found to be the most liked activity (Figure 6). Learning the subject matter effectively through a new technology with enjoyment was the key here.

It was noteworthy that the assignment submission rate was 100%. Even though the online activities were not pre-planned at the time of commencement of the course, students perceived all the activities conducted as Emergency Remote Teaching (ERT) positively, during the COVID-19 lock-down period. The

student performance evaluated through several formative assessments conducted online also cross-validated the enhanced learning experience in students (data not shown). As explained by Alqurashi (2019), student satisfaction is used as one of the key elements to evaluate online courses, while perceived learning is considered as an indicator of learning. Careful selection, proper planning and execution of activities for online learning can enhance student learning as described previously (Wong et al, 2019).

## CONCLUSION

It was noted that the online activities conducted asynchronously as Emergency Remote Teaching during the COVID-19 lock-down period created a positive impact on student learning while giving the students an opportunity to learn new technology with enjoyment. The findings of the present study will give all educationists an opportunity to re-visit the courses offered totally face-to-face until now and to think of moving towards blended learning (Kim, 2007) to facilitate the 21<sup>st</sup> Century learning.

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## The Public Primary School Teachers' Perception of Integrating Information and Communication Technology for Teaching & Learning in the Zonal Education of Colombo, Sri Lanka

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### ABSTRACT

This study examined teachers' perceptions of integration of information and communications technologies (IICT) for teaching and learning in the primary sections of the public schools in the Zone of Colombo, Sri Lanka. It has been noticed that there is a considerable delay in technology acquaint in public schools in Sri Lanka. Thus, it is important that teachers and other educational professionals in the school system are equipped with up-to-date trends in education and that they accept the new educational challenges that are emerging. Even though the government has offered IICT infrastructure facilities to Secondary schools, Primary section IICT infrastructure has been neglected. Thus, more attention should be focused on factors which influence IICT and how teachers can apply their ICT skill to the teaching and learning process and improve the subjects, especially Mathematics, English and Social Science (MES), in their classroom activity. Therefore, the study investigated 120 teachers from the primary sections of the public schools in the Colombo Zone, under the criteria of ICT available primary schools and ICT not available primary schools. This study utilized a quantitative approach based on a Technology Acceptance Model (TAM). Data were collected through questionnaires and analysed by using Statistical Package for the Social Sciences (SPSS software). The results of the analysis revealed that the R Square value was 20.4% of the variation in the perception of teachers explained by their knowledge & skill (KS), ICT Training and ICT experience and the p-value of independent variables were less than 0.05. The research identified that lack of knowledge and skill, inadequate teacher training, and lack of ICT experience are the hindering or impeding factors of IICT in the school environment. Hence, the knowledge of ICT was influenced by penetrating ICT, the skill of ICT was influenced by training and the experience of ICT was influenced by professional development. Future research could focus on classroom observations to determine the actual integration of ICT in the teaching and learning process.

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## INTRODUCTION

Integrated ICT (IICT) is used for the teaching-learning process in many schools in the world as it promotes autonomous learning, student-centred learning, higher order thinking, problem-solving, cooperative learning and curriculum differentiation. IICT promotes effective teaching and learning, effective collaboration, effective sharing, effective time management and effective productivity. To reap such benefits, Sri Lanka has to encourage teachers to integrate ICT into the teaching and learning process. Even though the Sri Lankan government has offered ICT infrastructure facilities and ICT training to teachers, it has not achieved the anticipated outcomes. The advocates of IICT emphasize that ICT in the teaching and learning process is essential for the provision of opportunities to enable students to function in the information society as the traditional methods of teaching do not prepare the students to be that productive. Teachers are the individuals with the capacity to properly guide the students in the pitch of ICT or IICT, to prepare them for the challenges of the future. Successful integration of ICT into the teaching-learning process, among other things, is dependent on the preparation of teachers. Millennium students have the ability to use any technology they come across. Teachers, therefore, have to transform their attitudes and opinions as far as the teaching activities are concerned and adopt technology in order to perform the pedagogic activities with ease and confidence. The quality of secondary education depends on the quality of primary education and it would be significantly enhanced if ICT is treated by education policymakers as a comprehensive stage of education rather than a subject of education. ICT opens tremendous possibilities for teachers to enhance their teaching performance.

The study is potentially significant to primary teachers, the school management, policy makers, students, parents, and researchers. These groups can benefit from the findings and recommendations of this study. The researchers hope that the effective use of IICT for teaching and learning in the primary

section of a school is a new topic to investigate because very few studies have been carried out in Asian countries regarding IICT for primary education. Thus, to find out the challenges and barriers related to primary teachers' perception of the teaching and learning process, a study should be undertaken.

## Theoretical Framework

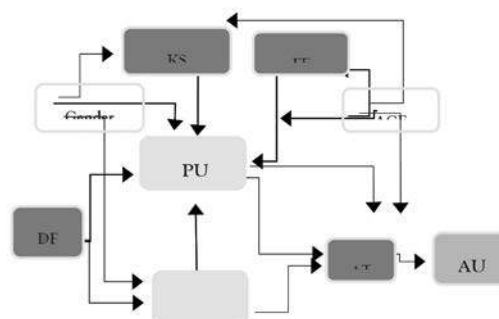


Figure 1. Technology Acceptance MODEL - TAM

A wide range of theoretical models have been announced to measure a user's degree of technological acceptance. In this study, the TAM theory has been used. The questionnaire based on the TAM includes as external variables, perceived usefulness and ease of use, user satisfaction and attribute of usability. (Appendix 1)

## MATERIAL AND METHOD

The study was carried out in the Colombo Education Zone in the Colombo District, Sri Lanka. 10 1AB schools were randomly selected under the criteria of 'ICT available schools' and 'ICT unavailable schools' from the 20 1AB national schools in the zone of Colombo. Respondents were asked to read the statements given and choose their answers based on a 5-Likert scale.

## Analysis Techniques

Few objectives were analyzed. First, the key factors that influence effective IICT in the teaching and learning process were examined. Then the influence of teachers' perception of IICT on each influencing factor

was determined accordingly. Lastly, the proposed hypotheses were validated.

### Variable Measurement

The objective of the questionnaire approach is to evaluate the IICT. The questionnaire contains demographic factors as an external variable, KS, facilitating factors (FF), perceived usefulness (PU) perceived ease of use (PEOU), ATT, and attribute of usability. Gender and age are also moderating the model. (Appendix 1)

### RESEARCH METHOD

The questionnaire was designed and developed based on the Technology Acceptance Model (TAM). The survey was divided into 5 main parts. The first part is respondents' detailed information, and the other four are factors which influence IICT such as the teacher's knowledge and skill, teachers' ICT training, ICT experience and ICT resource with the perception of IICT, based on a 5-Likert scale ranging from 5 = Strongly Agree, 4 = Agree, 3 = Neutral, 2= Disagree and 1= Strongly Disagree. Moreover, the research included a three-way analysis such as ICT AVAILABLE schools survey, ICT UNAVAILABLE schools survey and both ICT available and unavailable schools' surveys and then came to a reliable decision.

### External Variables

They represent the challenges that teachers face from the outside of their sphere of control during the IICT teaching and learning process. These challenges include Demographic factors.

### Knowledge and Skill – KSs

KS refers to a level of satisfaction in teachers using IICT in teaching and learning Table 1.

Table 1 - Results of Significance test for kss

Table 1	t	df	sig
KS1	-4.917	119	.000
KS2	-3.030	119	.003
KS3	-4.006	119	.000
KS4	-4.923	117	.000
KS5	-	118	.000
KS6	10.202	118	.000
KS7	-6.282	118	.000
	-9.565	119	.000

**H1:** There is a relationship between primary school teacher's KS with PU in the use of IICT in the public primary schools in the Colombo Zone.

### Perceived Ease of Use (PEOU)

It represents the degree to which they believe that using a particular system would be free from effort. ICT training and PD are considered as PEOU.

Table 2 – Results of t-test for PEQUs.

	t	df	Sig. (2-tailed)	Mean Diffe
PEOU1	.551	119	.583	.050
PEOU2	-.088	119	.930	-.008
PEOU3	-14.726	116	.000	-1.513
PEOU4	-10.757	118	.000	-1.269
PEOU5	-11.217	118	.000	-1.378
PEOU6	-10.525	119	.000	-1.325
PEOU7	-12.727	116	.000	-1.436

**H2:** There is a relationship between PEOU with PU in the use of IICT in the public primary schools in the Colombo zone in Sri Lanka.

**Facilitating Factors:** ICT resource availability, i.e technical help, internet infrastructure, hardware, software, training, online help to work with canvas

**H3** There is a relationship between FF with PU in the use of IICT in the public primary schools in the Colombo Zone in Sri Lanka.

Table 3 – Basic statistic of facilitating factors

Table 3 One-Sample Statistics				
	N	Mean	Std. Deviation	Std. Error Mean
FF1	115	2.31	1.195	.111
FF2	112	2.81	1.332	.126
FF3	115	2.89	1.356	.126
FF4	113	2.57	1.209	.114
FF5	113	3.28	1.176	.111
FF6	112	2.77	1.308	.124

**Attitude Toward Use:** The teacher's positive or negative feeling about performing the target behaviour in ICT practices or ICT experience has been taken as ATT.

Table 4 – Frequency of teacher's attitude

Level	Frequency	Percent
Strongly Disagree	6	5.0
Disagree	3	2.5
Neutral	19	15.8
Agree	50	41.7
Strongly Agree	42	35.0

**H4:** There is a relationship between ATT with PU in the use of IICT in the public primary schools in the Colombo zone in Sri Lanka.

**3.6 Perceived Usefulness (PU)** – It signifies the degree to which they believe that using a technology would enhance their job performance.

**H5:** There are relationships between primary school teachers' PU with KS, FF, PEOU, ATT in the use of IICT in primary school.

Table 5 – Statistical results for variable related to PUs

TABLE 5	F	Sig	t	df	Sig (2tailed)
PU1	2.262	.135	3.541	116	.001
PU2	.834	.363	2.763	116	.007
PU3	.065	.799	3.026	115	.003
PU4	.246	.621	2.868	115	.005
PU5	2.969	.085	3.326	115	.001
PU6	.723	.397	5.636	115	.000
PU7	.571	.451	3.007	115	.003
PU8	6.484	.012	3.916	115	.000
PU9	7.253	.008	5.125	115	.000
PU10	5.143	.025	3.957	115	.000
PU11	2.662	.106	5.419	114	.000
PU12			5.394	109.991	.000
PU13					

**H6:** There is a relationship between primary school teachers' gender with PU and ATT in the use of IICT in primary schools.

**H7:** There is a relationship between primary school teachers' age with PU and ATT in the use of IICT in primary schools.

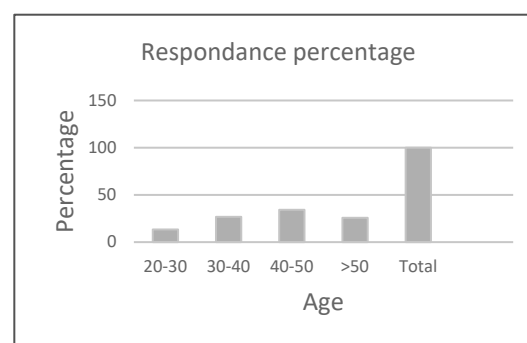


Figure 2 – percentage (%) distribution of age

## Result of Analysing Constructs

Table 7 presents the analysis of the Model summary, ANOVA analysis and correlation coefficient. R Square value was 20.4% of the variation in the teachers' perception of their experience, knowledge & skill, ICT training and available resources. The Durbin-Watson (DW) statistic should fall within the acceptance range from 1.3 to 2.50 in order to ensure that there is no autocorrelation problem in the data.

Table 6. Model Summary (ICT Lab available)

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.451 <sup>a</sup>	.204	.145	.712400	1.375

a. Predictors: (Constant), ATT, KS, PEOU, FF

b. Dependent Variable: PU

Table 7. ANOVA Table for the fitted model

	Sum of Squares	DF	Mean Square	F	Sig.
Regression	4.950	4	1.238	3.451	.014 <sup>c</sup>
Residual	19.366	54	.359		
Total	24.316	58			

Table 8 shows that the P value for the model was 0.014 ( $p < 0.05$ )

The researchers chose 4 factors such as FF, KS, PEOU, and ATT which influence IICT according to teachers' perception (PU). From these four factors, three factors were highly significant according to the correlation coefficient.

Table 8. Properties of the estimators of the fitted model

	Un-standardized Coefficients		t	Sig.	Co linearity Statistics	
	B	Std. Error			Tolerance	VIF
(Constant)	3.693	four.446	8.282	.000		
FF	-.155	.106	-1.458	.151	.674	1.484
KS	.232	.123	1.887	.064	.665	1.503
PEOU	.292	.122	2.396	.020	.679	1.472
ATT	-.229	.103	-2.220	.031	.821	1.217

Mainstream of the constructs were significant, so the model was highly significant. The results were clearly presented, and descriptive. The inferential statistical analyses were tabulated and discussed.

## FINDINGS

Table 5 shows the measurement of the perception of teachers on the use of ICT in

primary schools. The p-value of perception was less than 0.05 of 11 items. In those 13 items, the 10th item was "Through the ICT, we can teach English/ Math/ Social Science or Health Science comfortably and effectively." 93% of teachers agreed that the IICT make easy and effective teaching and learning processes especially in Mathematics, English and Social Science [MES] effectively. According to Table 10, the p-value of independent variables were less than 0.05, the teachers' KS was 0.064, PEOU was 0.020 and ATT was 0.031, a significant source of perception of teachers on the use of ICT in the primary sections of the said schools. Teachers' perceptions are that KS, ICT experience and ICT Training are the main factors that influence IICT in teaching and learning in classrooms. Most respondents, proved by 69.9%, said modern technology improved teaching performance. This means that most of the teachers are average users and they know how to use their computers but are not up to the standard. In other words, the user level is inadequate without the proper PD and training. 94% of teachers agreed that a proper level of training will improve their teaching performances, but that it is not being provided adequately. Only 4% disagreed with 2% being neutral. It was revealed that 39.2% of teachers have more than 10 years of ICT experience. 23.3% of respondents disagreed and 24.2% strongly disagreed on 10 years of experience. 13.3% were neutral. 53.1% said they did not come across facilitated computer labs. Most of the public schools do not have or have insufficient ICT resources or facilitated ICT labs in their schools.

All 120 research participants responded to the entire survey questionnaire. The findings focused on the following areas: ICT knowledge and skills, ICT training, ICT experience, ICT resources, frequency of ICT, ICT use for teaching and the influence of ICT on students' learning.

## DISCUSSION

94% of teachers agreed that a proper level of training could improve their teaching activities, but that it is not sufficiently provided to them. The overall response for this was their willingness to improve and practice ICT training for teaching practices. 39.2% of teachers had more than 10 years of ICT experience. However, they are not given the opportunity to use ICT in schools. Some other surveys indicate that they do not have enough ICT experience, or they do not get an opportunity to practice ICT. Hence more opportunities should be given to teachers without any restrictions. 53.1% said they do not have computer lab facilities. Further, most of the primary sections of public schools lack ICT resources or facilitated ICT labs. Also, the most cited barriers are lack of resources, lack of knowledge and skill, lack of time, lack of experience, lack of training and support. The quality of secondary education depends on the quality of primary education and it would be significantly enhanced if ICT is treated by education policymakers as a comprehensive stage of education rather than a subject of education. IICT promotes effective teaching and learning, effective collaboration, effective sharing, effective time management and effective productivity. ICT opens tremendous possibilities for the teaching performance.

## CONCLUSION AND RECOMMENDATIONS

Research has indicated that IICT certainly have the potential to revolutionize the quality of education, but the issues are the lack of ICT knowledge and the skills, inadequate ICT training and experiences on how best to use these instruments to deliver their subject matter and failure to engage learners through ICT. Teachers of the primary section of public schools in the Colombo education zone are not confident enough to work with ICT in their classrooms due to the following reasons: Poor ICT training, insufficient skill updates, and lack of confidence hindering the knowledge gain on how to handle the different aspects of ICTs' media. Hence this would lead teachers to hesitate to engage in

IICTs in-training and/or learning performances.

### Recommendations

For the integration of ICT, the primary school teachers at public schools must be lifted up via penetrating ICT activities by the stakeholders of the education system as follows:

- The teacher development communities need to be introduced to some effective system such as a support desk, online material, resources, seminars, workshops on sharing knowledge and skills to advance their ICT knowledge and skills.
- Adequate ICT training opportunities for primary teachers should be prioritised by the Ministry of Education in Sri Lanka, enabling teachers to influence and enhance teaching and learning in primary classes.
- ICT training for teachers is vital for future conception, so the quality of training needs to be considered by policymakers.
- Teachers must update themselves on how these new ICTs can be used as better resources which will help teachers and students.
- Teachers must be given ICT literacy and the knowledge to integrate it into the subjects of MES. At the conclusion of the training, teachers should be well prepared with not only theory, but also the practical real-time skills to transmit the proficiencies to the students.



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## Appendix 1.

<b>1.Perceived of Usefulness - PU</b>	Perceived of usefulness is perception of primary teachers toward effectiveness teaching and learning by using IICT	<p>PU1 ICT enables the students to be more energetic and engaging in the lesson</p> <p>PU2 ICT helps to prepare updated teaching resources &amp; materials to teach in a short period.</p> <p>PU3 I assume that integrating ICT in teaching makes learning more efficiency.</p> <p>PU4 Students are more effective when play any academic series if audio or video</p> <p>PU5 ICT enables the students to express their idea and thoughts better.</p> <p>PU6 Through the ICT, we can teach English/ Math/ Social / health science Comfort-ability.</p> <p>PU7 ICT empower students learn English Sound &amp; pronunciation real / Math Efficiency</p> <p>PU8 ICT improve students to talk in English with confident / work in Math without complete ability.</p> <p>PU9 It's easy to vibrant millennium students with I ICT to concentrate the activity.</p> <p>PU10 I can keep the students under the control during the learning progress if I use ICT</p> <p>PU11 ICT qualifies students to behave social ethically</p> <p>PU12 Using computer reduces time wastage in classroom activities and gain more knowledge and satisfaction.</p> <p>PU13 Our students performed well in the grade five scholarship {Please mentioned the percentage of success</p>
PEOU	Perceived Ease of use refers to easiness, comfortable, effort free that teachers feel when using IICT during the teaching activities	<p>PEOU1 It's easy to vibrant millennium students with integration of ICT to concentrate the activity</p> <p>PEOU2 I can keep the students under the control during the learning progress if I use ICT</p>
KS	Knowledge and skill refer to a level of satisfying that teachers of using IICT in teaching and learning	<p>KS 1 I am familiar with Modern ICT tools and usually use computer &amp; internet for preparing updated materials for teaching activity</p> <p>KS2 I communicate with students and parents through the email or WhatsApp or Instagram independently.</p> <p>KS3 I am using a computer lab to teach my subject in order to provide an effective way of teaching</p> <p>KS4 I go through many websites and select very popular and reliable websites before I start the lesson to teach in which related to my subject and promote my students to access those websites and get more information.</p> <p>KS5 I use some software to teach Number system in Mathematics /English Phonics and spellings/ to show the visual picture in Social or health science.</p> <p>KS6 The use of computers and internet has improved my teaching performance.</p> <p>KS7 I feel very confident when I use computer to teach</p>
ATT	<b>Attitude:</b> Davis (1989) refers to ATT as "an individual's positive or negative feeling about performing the target behavior (e.g., IICT)"	<p><b>ATT</b></p> <p>ATT1 I'm willing to improve &amp; practice ICT training for teaching &amp; learning</p> <p>ATT2 The use of ICT guides the teachers to improve teaching with updated materials</p> <p>ATT3 I have less than five years of Experience as a computer teacher</p> <p>ATT4 I have more than five years of Experience as a computer teacher</p> <p>ATT5 I have more than ten years of Experience as a computer teacher</p> <p>ATT6 I am using computer/laptop/iPhone for more than 10 years</p> <p>ATT7 I feel very confident teaching while using computer</p>
<b>Facilitate factor</b>	The availability of the related resources i.e technical help, internet infrastructure, hardware, software, training, online help to work with Canvas	<p>FF1 We have enough software to performing teaching and learning activities</p> <p>FF2 We have got facilitated computer lab to teach</p> <p>FF3 We can use computer lab for academic purpose when we are free.</p> <p>FF4 All computers and ICT tools go waste at our school</p> <p>FF5 Presence of provision from the management encourage me to use the computer lab</p> <p>FF6 The ICT amenities in my school are will functioning and can be use freely.</p>



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## Examining the Mode of Teaching English as a Second Language in Gampaha District Non-Urban Government Schools of Sri Lanka

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### ABSTRACT

Teaching English as a second language (TESL) has been a major educational policy in Sri Lanka since early 1950s. Moreover, the second language teaching commences from Grade 3; in fact, since late 1980s, the Communicative Teaching Method has been used and one of its key components is the student centered education (SDE), which means creating an interactive and supportive learning environment, where the teacher becomes a facilitator scaffolding the learning process (National Education Commission, 2014). However, as per the G.C.E.O/L English Language Performance Evaluation Report issued by the Department of Examinations (2017), nearly half of the students (45.10%) have failed English. In fact, the failure rate in Gampaha educational zone is higher (43.6%), than Colombo (27.3%), which further questions the plight of non-urban government schools in Gampaha district. Thus, the objective is to examine whether the prevailing English teaching mode and the environment is learner centered, and if not, what are its causes. The study adopts a mixed method approach, comprising both qualitative and quantitative data: questionnaires and lesson observations. The research sample consists of fifty-eight; fifty students and their relevant English teachers. The findings of the study indicate that the prevailing mode of TESL in the majority of schools is not learner centered. In fact, even though many teachers respond saying that they create cooperative learning in class, as per the observations and disparity between the responses given by students and teachers, it is evident that the respective approach is not followed practically in class.

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## **INTRODUCTION**

In Sri Lankan government schools, English is taught from grade 1 to grade 13 and at the end of grade 11 and 13, G.C.E. Ordinary Level and Advanced Level examinations are held. In fact, the Department of Examination (2013) states that, passing, at least, the G.C.E.O/L examination, certifies one's eligibility for higher education, and to secure a medium level occupation and also as a basic requirement, to follow certain courses in international universities. However, even after 11 or 13 years of learning English as a main subject, there are students who are still unable even to pass the General English paper at the Ordinary Level and Advanced Level examinations. Thus, it is required to examine the prevailing teaching mode in these schools. In fact, as per the Communicative Teaching requires, and National Education Commission states the learning environment plays a central role in the education of a learner as it provides the platform through which the learner acquires knowledge, skills and attitudes which result in life-long learning (National Education Commission, 2016). As per the glossary of education (Glossary of Education, 2014) definition, student-centered learning refers to a learning experience, where instructional approaches and academic-support strategies are utilized to address the distinct learning needs, interests, aspirations, or cultural backgrounds of students.

In the light of the Second Language Acquisition there are three main theories that provide the background for this study. According to Krashen's Conversation Theory (1970), the effectiveness of English language teaching relies on the interactive communication between the teacher and the students. Then, as per Long's Interaction Hypothesis Theory (1980), the teacher has to provide feedback on issues students encounter during the student centered environment such as lack of comprehension which might occur during the interaction. This is further emphasized by Merrill Swaine (1985) via his Comprehensible Output Hypothesis Theory

that the opportunity should be given to the students to utilize the language as much as possible. Furthermore, Blum (2007) highlights that the best practice to promote student-teacher connectedness during class is to reduce "teacher talk" time and increase "student talk" time by incorporating peer review, group work and student-to-student discussions.

Therefore, it is evident that though all infrastructure or resources are provided, the student centered education is required for effective learning, where teachers are not dominant characters. In fact, prominence should be given to students and they should be encouraged to interact with the teacher, without being passive listeners.

## **METHODOLOGY**

Kelaniya educational zone, located in Gampaha district, is one of the eleven educational zones in the Western Province which consists of 115 schools. According to the grades that are taught, these schools have been divided into four categories. They are 1AB, 1C, 2 and 3 which respectively consist students from grade 6-13, grade 1-13, grade 1-11 and grade 1-5. Thus, the research focused on the Biyagama Education Division, which consists of eleven government schools. Among them, five schools were selected: three belonging to 1AB, one belonging to 1C and one belonging to type 2 school. In fact, all these schools are non-urban; located outside the town. These schools were selected since there was no research conducted based on TESL in those schools and also due to the fact that they are located in Gampaha district, which had a higher failure rate in O/L English (43.6%), compared to Colombo (Department of Examinations, 2017). The sample consisted of fifty-eight participants. This included fifty students from nine classes; one O/L and one A/L class from four schools and one O/L class from the fifth school, which belonged to category 2 and had only one grade 11 class. From each class, five students were selected according to the systematic sampling. In addition, their respective English language teachers; numerically eight, were selected.

Data was gathered following the mixed method approach, since it comprised both qualitative and quantitative data: questionnaires and lesson observations. All the selected nine classes were observed during the English language period. In fact, this approach enabled to compare the responses given in the questionnaires and data gathered during observations. In fact, the mixed method approach provided more validity to the conclusion arrived by the end of the research.

After obtaining the approval from the principal, data was gathered using both qualitative and quantitative methods: separate questionnaires for students and teachers, and informal class observations. These questionnaires and observations were focused on the prevailing learning environment and how much the teachers considered the knowledge and prior experiences of their learners when teaching English and how much they tried to accommodate their learners' strengths and interests towards the subject. Eventually, all data was both quantitatively and qualitatively analyzed.

Concerning the limitations of the study, it has to be stated that the results cannot be generalized to all the government schools in Sri Lanka since the study mainly focused on

the selected non- urban government schools located in the Biyagama Divisional Secretariat. In addition, the data was collected from students who were present during that English period, and it was apparent that in some schools, especially the Advanced Level students seemed to be avoiding the English period. Thus, it also highlights the lack of interest students have in learning English.

RESULTS AND DISCUSSION

During the analysis of data, it was evident that there were disparities in their responses with what was observed and also with the responses given by the students. First, the teaching methodology used by these teachers was examined. Only five teachers responded saying that they follow the "Translation Method", "Student Centered Method", "Discussion", "Communicative Approach" and "a combination of different methods". However, during the observations, it was visible that except one teacher, who mentioned the Communicative Approach, none of the other methods were utilized by other teachers during the observations.

Then, it was examined in depth, the frequency of using several teaching strategies in order to make the teaching learner centered.

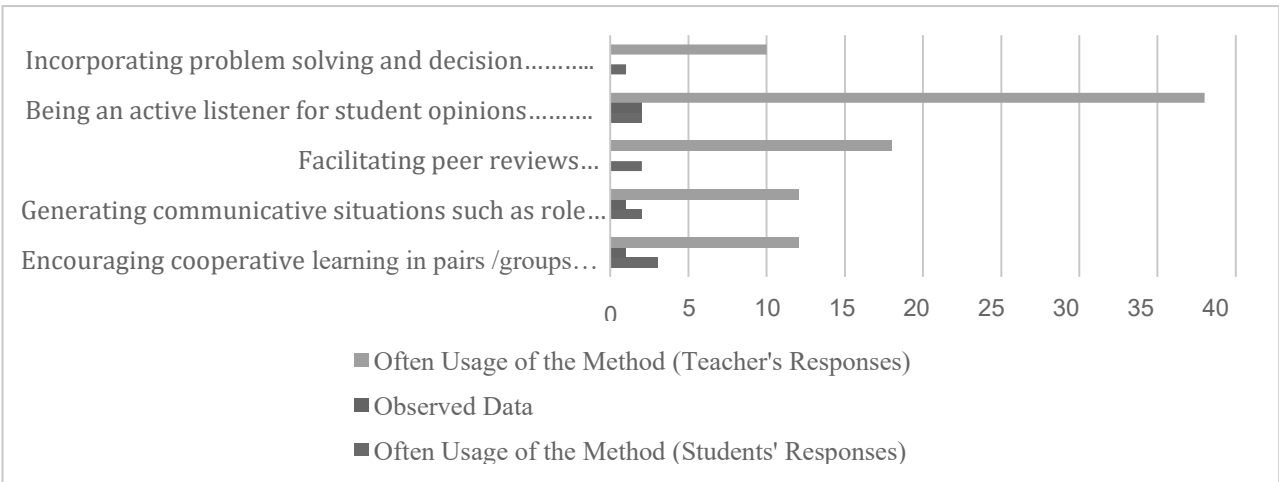


Figure 1. Usage of Learner Centered Strategies in the Class

As demonstrated, Figure 1 compares the number of students and teachers who mentioned that the given methods are practiced often in class, along with what was observed by the researcher. In fact, as per the students' opinion, the mostly used strategy was the teacher being an active listener to students' opinions, whereas with regards to teachers, the mostly utilized teaching strategy was corporative learning via pairs or group. However, the response was given by only three teachers and also during the observations only one teacher among them incorporated the mentioned practice whereas all the others were not engaged in most of the given student centered practices. In order to conduct the above strategies, there should be active student involvement in the classroom.

Subsequently, the teachers were questioned on the best practice they use when teaching a new lesson. The most commonly given responses were “using previous knowledge”, “visual aids”, and “discussions”. In fact, these were common for both O/L and A/L English language teachers. Nevertheless, during the observations, three teachers taught new lessons and among them only one used visual aids and elicited student responses by having a brain storming session on that. Grammar is also another essential requirement for language learning. Therefore, teaching grammar has to be interesting and engaging, so that students learn grammar rules practically using their previous knowledge and in different interactive methods or activities. This is called deductive method where grammar is not taught in isolation.



Figure 2. Method Used to Teach Grammar

However, when comparing the given responses (Figure 2) with the observed facts, it was evident that only two teachers followed the deductive method when teaching grammar. In fact, they elicited examples from students first and then explained the grammar behind it. However, it is evident that there is a lack of learner centered education when teaching grammar.

Moreover, the study also gathered data via observations which were conducted throughout the English period of each class, focusing whether the teaching is based on effective measures and best practices in order to provide learner centered education. Overall, the most common fact which was observed in half of the classes, is that the relevant lessons were conducted with minimum attention given for students. As a result, many students were inattentive.

In fact, during group activities in one class, the teacher simply asked the students to group themselves and continue the activity neglecting those who were seated at the back of the class. Due to that, those students did not answer any of the questions. Moreover, in an A/L class, a similar situation was observed where students were engaged in their own work without accomplishing the given task while the teacher sat at her table, and reproaching them for the noise. However, in two classes which were taught by the same teacher, students were more involved in activities such as picture descriptions. In fact, they were engaged in those activities in forms of pairs and groups. Overall it was observed that majority of the classes are not learner centered, and unfortunately the teachers also do not attempt to make the class student centered, rather he or she plays the

traditional teacher centered role with less concern paid to the learning process.

## **CONCLUSIONS**

There are several key findings which are evident from the data analysis. First, it is evident that other than one teacher, all the others are not aware about the Communicative Approach teaching method. In addition, concerning the mostly used teaching practice, there is a discrepancy among the data gathered from students, teachers and observations. In fact, even though many teachers respond saying that they create cooperative learning in forms of student groups or pairs, during the observations, it does not occur in many classes. Therefore, a significant concern arises whether the teachers practically follow their responses in reality as well.

Overall, it can be concluded that the majority of the selected government schools do not practice student center education

when teaching English for Ordinary and Advanced Level students. Therefore, it can be recommended that strategies should be created in providing more opportunities for learner centered practices focusing all four skills: reading, writing, listening and speaking. Moreover, the teacher needs to cater to the learners' needs and be a facilitator by involving all students intellectually, aesthetically, and emotionally as much as possible in acquiring English language competency.

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## Design of a Framework for Professional Development Programs for Teachers in the Use of Interactive Touch Screen

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### ABSTRACT

The aim of this study was to design a framework for professional development programmes for teachers in the use of Interactive Touch Screen (ITS). At present ITSs are distributed in selected schools in Sri Lanka. Although, in these schools, selected teachers are trained on the use of the ITS, comprehensive training on the instructional strategies of ITS is yet to be provided. The objectives of the study were (1) Analyse the current usage of ITS of teachers in the school system, (2) Design and develop a professional development program (PDP) for teachers on the use of ITS, (3) Implement the PDP and evaluate the effect on the teachers and (4) Reflect on the evaluation results to upgrade the current PDP to conduct the following PDP. The sample was a total of 31 teachers of an educational zone in the Colombo district. Instruments for quantitative data collection were six scales and open-ended questions were used to collect qualitative data. Design Based Research (DBR) approach was made in this study in which both quantitative and qualitative data were collected in the research process. DBR approach is characterized by analysis of the problem domain, design of the solution (intervention), iterative cycles of testing and refining the solution and finally reflecting on the whole process to arrive at design principles and inventing the solution. Intervention of this study was in terms of two professional development programmes on the integration of ITS in instruction. The results of the first intervention are presented in this paper. Analysis of data formed the feedback to design the revised PDP. Proposed revisions were to increase the time allocation of the PDP, provide more hands-on experience, demonstrate ITS-based instructional strategies related to different subject areas and conduct separate PDPs for non-ICT teachers.

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## **INTRODUCTION**

At present, Interactive Touch Screens (ITS) are distributed in the school system in Sri Lanka. In order to make maximum use of ITSs, teachers should know how to integrate it in their instructional process. This requirement could be well addressed through professional development programs (PDP). Rather than designing one PDP, it is more effective to design a framework for PDPs on the use of ITS, so that a PDP suitable for a given context could be developed by any authority expecting to conduct PDPs in this respect.

Studies on the use of ITS in the Sri Lankan school sector are not available due to the recency of its introduction. Therefore, a study into the current use of ITSs and proposition of a framework for productive use of them could ensure the teachers and students the benefit of the vast cost incurred in the acquisition of these hardware, thereby marking it as a worthwhile investment in the school system.

Integration is explicitly different from mere operational use of hardware and software and it is assumed to be a part of teachers' general understanding (Lloyd, 2005) while lack of skills in designing ICT based instruction could be a disadvantage despite the presence of ICT resources and positive attitude towards ICT (Tsai & Chai, 2012).

From the cognitive point of view, for teachers to become effective ICT integrators, Mishra and Koehler (2006) have formulated a framework known as Technological Pedagogical Content Knowledge (TPACK). The TPACK framework which provides useful guidance for teachers to become effective ICT integrators, describes how three broad knowledge bases, knowledge of technology (TK), knowledge of pedagogy (PK) and knowledge of content (CK), interact to create several forms of new knowledge (Mishra & Koehler, 2006).

Numerous studies have shown that use of ITS improves learning processes, specifically where the integration between the teacher's instruction style and the ITSs' potential enables meaningful instruction (Betcher & Lee, 2009). Students have also reported that the use of the

ITS enhances motivation to learn, raises the level of concentration, improves behaviour, and enhances learning because it is 'fun' and innovative (British Educational Communications and Technology Agency, 2008; Cogill, 2002; Hall & Higgins, 2005; Morgan, 2008; Thompson & Flecknoe, 2003).

Thus, above research findings elaborate on how ITS helps in the teaching learning process to enhance student performance as well as teachers' capabilities.

## **OBJECTIVES**

1. Analyse the current usage of ITS among teachers in the school system
2. Design and develop a Professional Development Program (PDP) for teachers on the use of ITS
3. Implement the PDP and evaluate the effect on the teachers.
4. Reflect on the evaluation results to upgrade the current PDP to conduct the following.

## **METHODOLOGY**

The research approach was Designed-Based Research with mixed mode design where both quantitative and qualitative data were collected in the research process. Following are the phases.

### **Method of Data Collection and Analysis of Data**

The problem domain was analysed via a comprehensive literature review on the issues in the use of ITS worldwide, and through discussions conducted with two ICT Directors from Homagama and Sri Jayawardhenapura educational zones, on the current situation of the distribution and the use of ITS in the school system. In fact, the current issues in the integration of the ITS in teachers' instructional process were also inquired. One school visit was made in order to investigate the ground situation of integration. The PDP, a two-day workshop of six hours each, was designed as per the findings of the literature review, discussion with the Directors and the initial observations made on the school visit. The PDP was implemented for 31 selected teachers of the Homagama educational zone.

On the first day, a session was conducted to explain the function of ITS, how it can be integrated into the instructional process, its usage in a Google Classroom and using the OBS software to record a lecture. On the second day, a demonstration of interactive multimedia-based educational software was conducted in order to explain the instructional

design features and the good practices of educational software. Next, a session on the use of Power Point-based authoring software for the development of interactive lessons was conducted. As the teachers did not bring laptops, they were allowed to attempt the tools of the software on the ITS itself.

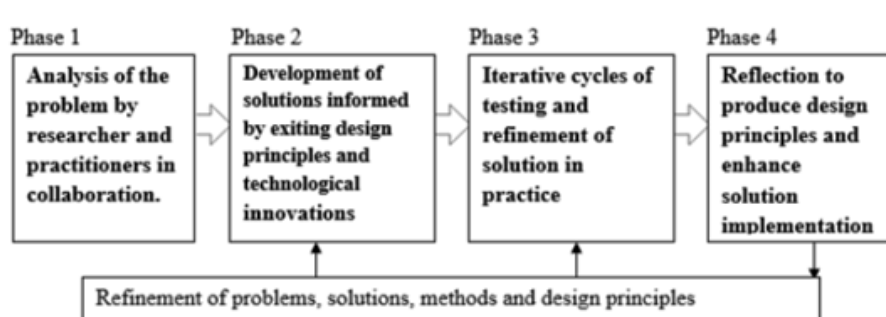


Figure 1. Four Phases of the DBR (Amiel & Reeves, 2008, p. 34)

Before the beginning of the session on ITS, a questionnaire (Q1) was administrated to the participants to capture the demographic data of the participants and a scale (Q2) to measure participants' basic ICT skills required to follow the session (ICT readiness). Another scale (Q3) was also administered at the end of the session to measure the impact of the session on the participants. Before commencing the session on PowerPoint-based authoring software, a scale (Q4) was administrated to the participants to measure participants' initial skills (PowerPoint readiness) in the use of PowerPoint in the development of lesson material. At the end of this session, a scale (Q5) was administered to measure the impact of the session on the participants' use of PowerPoint-based authoring software in instructional material development. Finally, at the end of the PDP, a scale (Q6) was administered to measure the total impact on the participants in the use of ITS in their instructional process. At the end of each session participants' free observations were also collected so as to find out the usefulness of the sessions and suggestions for modifications in future PDPs.

Two correlation coefficients were separately calculated in order to test (1) whether there was any correlation between participants' ICT readiness and the impact of the ITS session on them, and (2) whether there was any

correlation between initial PowerPoint skills and the impact on the use of PowerPoint-based authoring software.

## RESULTS AND DISCUSSION

Analysis of the problem domain through the literature review revealed the lack of sound theoretical base for the integration of ITS in instructional process, the need to address aspects in TPACK framework and the potential of ITS for creative lesson plans. Analysis of the problem domain through initial interviews and a school visit revealed that teachers, who were trained in ITS, can operate the hardware but lacked instructional strategies to integrate ITS in the instruction.

Analysis of the responses to Q1 revealed that 10 ICT teachers and 21 non-ICT teachers participated in the two-day PDP. Except five, 26 participants had some form of ICT training. Fourteen participants were either graduates or had postgraduate qualifications. Their age ranged from 26 to 50 years.

The results of the analysis of the scale Q2 are presented in the Table 1. The mean and standard deviation of the total value and its contributing factors are separately given on the % scale. Only one participant had previous training on ITS.

Analysis of scale Q2 indicates that ICT readiness of non-ICT teachers were strong enough for the successful completion of session 1 in comparison to ICT teachers.

Results of the analysis of the responses to scale Q3 are provided in the Table 2. The total impact and the contributing components of the impact, values of which are converted to % scale, are separately analyzed.

Analysis of the responses to the scale Q3 indicates that the participation in the ITS session has had a tremendous impact on the participants with a small variation.

Analysis of the qualitative data collected on the impression of the participants on the session revealed that the session was successfully conducted. However, they highlighted the need for more hands-on experience. Computation of the correlation coefficient between the participants' ICT readiness and impact of the session (0.021) indicated that the success of the ITS session was not correlated with the participants' ICT readiness.

As improvements for future PDPs, participants suggested preference on separate PDPs for

non-ICT teachers, more hands-on training, and sessions to be conducted at the school level. Practical sessions on image and video processing, how to connect laptops with ITS via a network, sample lessons on ITS integration in instructional process and monitoring the teachers' use of ITS once they have returned to their respective schools were also suggested. Another suggestion was to perform the video recording of the session so that it would help teachers revise their knowledge and benefit teachers who would not have an opportunity to take part in PDPs.

### PowerPoint-based Authoring Software

The results of the analysis of Q4 are presented in the Table 3.

Though the participants' PowerPoint readiness was not excellent, it was strong enough to complete the session successfully. However, their use of PowerPoint in their instructional process was weak, hence it needs improvement.

Table 1. Analysis of ICT Readiness of the Participants for the Session 1.

% Mean of overall ICT readiness and (SD) of all participants			Non-ICT participants			
Hardware	Software	Internet	% Mean total ICT readiness and (SD)	%Mean hardware knowledge (SD)	%Mean software knowledge (SD)	%Mean Internet knowledge (SD)
81(20)	87 (19)	92 (15)	70 (17)	74 (21)	79 (21)	87 (18)

Table 2. Analysis of the Impact of the Session on the Participants of the Session 1

% Mean total impact and (SD)	%Mean positive feeling of the session (SD)	%Mean quality of the session (SD)	%Mean motivation to use ITS (SD)	%Mean technical improvement (SD)	%Mean training condition (SD)
86(11)	85(13)	84(14)	83(14)	83(15)	93(8)

Table 3. Participants' PowerPoint Skills Prior to the Session (PowerPoint Readiness) on PowerPoint-Based Authoring Software

% Mean overall PowerPoint skills (SD)	% Mean basic PowerPoint skills (SD)	%Mean advanced PowerPoint skills (SD)	%Mean use of degree of teacher-centered use of PowerPoint (SD)	%Mean use of degree of student-centered use of PowerPoint (SD)
71(17)	85(19)	64(21)	61(30)	59(30)



Table 4. The Impact of the Session on the Participants' use of PowerPoint-Based Authoring Software in Instructional Material Development

% Mean total impact and (SD)	%Mean positive feeling of the session (SD)	%Mean quality of the session (SD)	%Mean motivation to use ITS (SD)	%Mean technical improvement (SD)	%Mean training condition (SD)
90 (8)	90 (11)	89 (10)	88 (9)	87 (11)	93 (9)

Table 5. Impact Analysis of the Whole PDP on the Participants

% Mean of overall impact (SD)	% Mean of facilitation of teaching (SD)	% Mean of facilitation of learning (Std)	% Mean of opportunity for a variety of instructional strategies (SD)	% Mean of improvement in student active participation (SD)	% Mean of promoting students' collaboration (SD)	% Mean of entertainment quality of ITS (SD)	% Mean of ability to replace blackboard (SD)
85 (10)	87 (10)	87 (13)	87 (13)	84 (15)	87 (13)	84 (14)	71 (22)

The results of the analysis of Q5 are presented in Table 4. According to Table 4, the impact of the session on learning PowerPoint-based authoring software on the participants was immense with a slight variation among them. Computation of the correlation coefficient between the participants' PowerPoint readiness and impact of the session (-0.044) indicated that the success of the learning PowerPoint-based authoring software was not correlated with the participants' PowerPoint readiness.

The analysis of qualitative data collected on the impact of session 2 on the participants revealed that the session was successful but more hands-on experience was required. They had suggested upgrading the software with more instructional strategies, more hands-on sessions, content development sessions, recording of the sessions, subject-wise training and school-based training as improvements to the future PDPs.

The results of the analysis of Q6 are presented in Table 5. The construct measured by this scale (Q6) was the perception of the participants as to the efficacy of ITS in the instructional process. The participants' perception was very encouraging, and it is a very good indication of their motivation to use ITS in instruction. Although the agreement

with that ITS could substitute the blackboard was high, the variation of the opinion was also large indicating that teachers want ITS as an alternative but not as a replacement.

## CONCLUSION

In the design of PDP on its use in instruction both technical and instructional aspects have to be addressed. It has been a major concern of the participants that the length of each session on ITS and authoring software needs to be increased to one day. Further, separate PDPs should be conducted for ICT and non-ICT teachers. The demonstration of sample lessons based on a variety of disciplines on how to integrate them in the instructional process should be included in the future PDPs. More hands-on learning experiences should be provided in the use of OBS, Google Drive in the classroom. Practical sessions should be organized on how to set interaction between ITS and participants' computers via a wireless network, and multimedia processing. Video recordings of future sessions should be carried out. School visits must be made in order to observe participated teachers its integration in order to collect feedback for future PDPs. It is not essential to demand a high initial ICT knowledge and skill from the participants although it is desirable.



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## Attitude of the Students Towards the Usage of Group Activities as a Remedy for Speaking Anxiety

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### ABSTRACT

As literature suggests Second Language (L2) speaking has always been a challenge for students. One of the main issues is the apprehension occurring when a learner is expected to perform in the second language (Gardner and MacIntyre, 1993). As facilitators at the tertiary level, it is vital to create a low-anxiety classroom to aid students with L2 speaking anxiety. This research attempts to investigate the perspective of students towards using group activities to alleviate speaking anxiety in the ESL classroom. The sample group consisted of forty-five Post Advanced Level Students from an intensive course in a private institute. A questionnaire prior to any speaking activity and weekly questionnaires while conducting both group and individual speaking activities were given to this mixed ability group to study their attitude towards L2 speaking for three weeks. The participation, behaviour and responses of the closely monitored sample group were observed and evaluated to meet the intended objectives. Initial questionnaire revealed that majority was afraid of L2 speaking due to several reasons. During the second week there was a slight attitudinal change towards the perception on L2 speaking, but there was a drop in the attendance towards the end of the three weeks. As revealed, group activities have helped the students to make an effort to speak as there were students who did speaking activities for the first time in their life. It was concluded that Group activities can be used effectively to a certain extent, and since students preferred group activities more than individual activities, they can be used to bridge the gap between students and L2 Speaking.

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## INTRODUCTION

One of the biggest challenges faced by the second and foreign language learners is Speech Anxiety (Young, 1991). Over the years researchers like Horwits *et al*, James McCrosky *et al* have been discussing about foreign language anxiety, and new approaches have been explored to aid the foreign language learners with this challenge. One reason can be lack of prominence given to language-specific needs of learners when developing the curriculum (Attanayake, 2020). When facilitating English at both secondary and tertiary levels, it is important for the facilitators to be aware of such approaches to minimize the issues and help the students.

Language anxiety is the fear or apprehension occurring when a learner is expected to perform in the second language or the worry and negative emotional reaction when learning or using a second language (Gardner and MacIntyre, 1989). McCroskey *et al* add to this interpretation, and they highlight the effects of Communication Apprehension. Woodrow (2006) further highlights the debilitating effect anxiety causes in learners' speaking capability. Such speakers tend to avoid communication and as a result, they will lose the opportunity to experience the practice that is required to develop true competence in the language (McCroskey *et al*, 1985). According to Woodrow (2006) oral presentations and performing in front of a class are the most reported stressors for in class situations. Thus, it is vital to explore methods to reduce L2 speech anxiety irrespective of the context to help the students.

Teaching methodologies like Community Language learning can be used to reduce anxiety and to create a supportive environment. On the other hand, researchers have been investigating new remedies to help Speech anxiety. Some major treatment approaches include cognitive-oriented treatments, Systematic desensitization (Wolpe, 1958) and Skills training (Kelly, 1997). Other than these treatments, different methods have been suggested throughout the years to create a low-anxiety classroom.

Language games are one such method. Games can be used to create interest, motivate students, encourage participation, and reduce language anxiety (Saunders *et al*, 1985). As Young (1991) had discussed, having students discuss in small groups or pairs, using relaxation techniques, deep breathing, meditations and music can be used to reduce anxiety in the classroom.

Among these methods, the effective usage of group activities has been discussed (Young, 1992; Neer *et al*, 1991; Pribyl, Keaten and Sakamoto, 2001; Knight *et al*.2016). As observed over the years, there is a reluctance among students to actively and equally participate in group activities, especially the students with speech anxiety do not actively participate in such activities. So as facilitators, it is vital to know the attitude of the students towards the usage of group activities as a remedy for L2 speaking anxiety in order to help them better. Thus, the objective of this research is to investigate the attitude of the students towards the usage of Group Activities as a remedy for Speaking Anxiety.

## METHODOLOGY

To collect data, a sample group of forty-five Post Advanced Level Students who have got registered for the Intensive course to read for a degree were selected. They were from a mixed ability ESL class. This sample group was selected because they were just after their secondary education and were not exposed to tertiary education. Questionnaires and observations were used as the data gathering tool. Initially a questionnaire to study their attitude towards L2 speaking was given. Then within a time span of three weeks both group and individual speaking activities were conducted during their Communication Skills module. Within the three weeks, group activities like role -plays, mini presentations, group discussions and debates were used. On the other hand, individual speaking activities like "Be a celebrity" in which students impersonated one of their favourite celebrities, and giving opinions were conducted. Questionnaires were given at the end of each week to investigate the students' response towards L2 speaking and the use of group activities in speaking. Their

participation, behaviour and the results from the questionnaire which analyzed their anxiety level facilitated in investigating the attitude of the students towards group activities as a remedy to reduce L2 language

anxiety in speaking. Both qualitative and quantitative data were analyzed to conclude the role of group activities in ESL speaking activities.

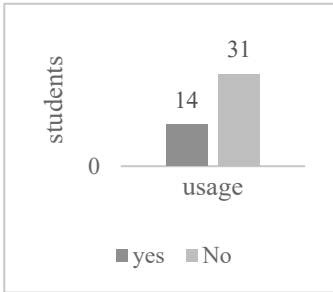


Figure 1. Usage of L2 at Home

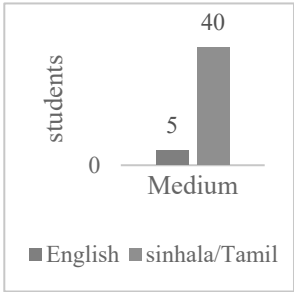


Figure 2. Medium of Communication at School

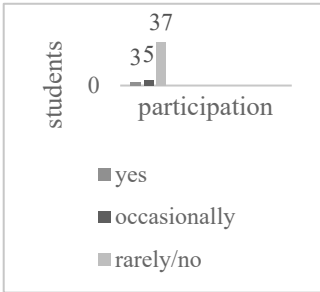


Figure 3. In-Class Participation for Speaking Activities

RESULTS AND DISCUSSION

The results of the quantitative data were analyzed using the percentages of the responses. Initially the background to L2 speaking was investigated by inquiring the usage of English at home, their medium of communication at school, and their participation for in-class speaking activities.

As revealed, only fourteen students said that their parents speak with them in English, and there were five students who have studied in English medium. One important finding is that thirty-seven students have said that they have never or very rarely participated in speaking activities. According to Onwuegbuzie, Bailey and Daley (1991) students who had not followed any foreign language had higher levels of foreign language anxiety than their more language-experienced friends. In Sri Lankan education, though English is considered as a main

subject, their active participation is very low. This can be identified as one factor which adds to the anxiety levels of the students. When analyzing the above charts, it can be realized that the sample group does not have a strong background to L2 speaking. Significantly out of the five, four of them stated that they have situational anxiety. Past survey (Black, 1995) discusses the positive effects of introducing a foreign language to primary school children. The students in the sample group were taught English for almost twelve years, but the majority was afraid of L2 speaking. This brings into light the dire need of helping the students. Qualitative data further revealed that majority of the students had rarely used L2 to communicate in the primary and secondary level. Twenty-six of them said they hardly had in-class speaking activities at school.

At the end of two weeks, students involved in seven group activities. Some revealed that they spoke in English in front of an audience for the very first time. Seven percent of the students stated that speaking is difficult due to linguistic difficulties. At the initial questionnaire 76% of them said that they did not like individual speaking

activities at all. At the end of the second week, they did an individual speaking activity called, “Be a celebrity” which was a prepared, fun speech. Interestingly 54% said they liked this activity, but overall, their preference was for group activities because their teammates have helped and motivated them. At the end of this week, a

drop in the attendance was observed, noticeably on the day of the mini presentation.

Nineteen students out of thirty-one said that they felt confident than before when speaking by the end of three weeks, but still they had symptoms of speech anxiety. When observing the discussions within the group, it was noticed that majority switch to L1 when the facilitator is not around. Their opinion on the group activities has not changed; they preferred group activities. There was a slight difference in their

attitude towards speaking as they said they used L2 for the first time in front of an audience. This highlights the lack of opportunities they have got at school level. As Attanayake (2020) discusses, teaching in South Asian countries are exam –oriented and paper-pencil based. As a result, productive skills are being neglected. So, due to lack of exposure and their attitude, the students have got detached from English speaking, and on the other hand it had added to their L2 speaking anxiety levels.

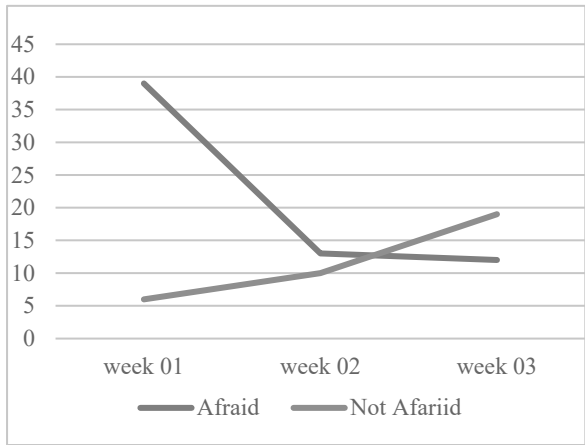


Figure 04. Attitude Towards L2

Table 1. Attitude Towards L2

	Afraid of L2 Speaking	Not Afraid of L2 Speaking
Week 1	39	06
Week 2	13	10
Week 3	12	19

Table 2. Proportion of the Attitude Towards L2

	Afraid of L2 Speaking	Not Afraid of L2 Speaking	Attendance	Proportion	Percentage
Week 1	39	06	45	0.86	86.67%
Week 2	13	10	23	0.56	56.52%
Week 3	12	19	12	0.38	38.71%

According to the quantitative data, a change can be seen in their attitude towards L2 speaking, but towards the end of three weeks there was a drop in the attendance.

When comparing the proportions, it is evident that the number of students who

were afraid of speaking have decreased. As mentioned by the students the group activities in the ESL classroom have helped the students to make an effort to speak as they were supported by everyone.

CONCLUSIONS

The findings of both qualitative and quantitative data proved that using group activities as a remedy to reduce anxiety in

speaking has a positive impact. The students who have never spoken in front of an audience was given the opportunity to make



an effort. It can be concluded that the their initial problem. It was revealed that the students think they cannot speak English. Instead of trying to use L2, they simply find it comfortable to avoid L2 speaking like they did for the mini presentation. There has to be an attitudinal change which should be inculcated from primary and secondary education. If not, the exposure they got for English during their primary and secondary education will be a waste. On the other hand, the students had a positive attitude towards

students have not identified group activities. As it is observed, though they said they like group activities, their participation was low, and some students switch to L1 even when they are given the opportunity to use L2. As found, there is a detachment from L2 speaking due to lack of exposure at school level. So, it can be concluded that group activities can be used effectively to bridge the gap between students and L2 speaking.

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**Law**



## Manufacturer v. Consumer: A Critical Analysis of Sri Lankan Product Liability Law in Respect of Electronic and Electrical Products

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### ABSTRACT

Consumer protection is an area that is being subjected to many recent developments globally. The old notion of *caveat emptor* has been replaced by the modern concept of consumer protection by recognizing it in statutes, cases, and theories. International forum and States are moving towards providing protection to consumers. The buyers of goods and users of products and services are brought under consumer law, and this includes users of all types of goods including software, hardware, literature, music, photograph, motion picture, game, information, data, gas, water and electricity. In this paper, the writer focuses on liability for defective electrical and electronic products. Although the larger area of law relating to product liability is analysed the researcher's focus is limited to the above-mentioned products. The applicable statutes in relation to consumer protection in the law of Sri Lanka are compared and contrasted with the statutes of the UK and South Africa. Theories connected to consumer protection have been taken into consideration. This paper suggests that Sri Lanka needs a consolidated statute to safeguard the rights of consumers.

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## BACKGROUND

The existence of sound laws to impose liability for defective products is a concern for every consumer and likewise regulating product liability is a concern for governments. Electrical products have replaced manual work as they reduce time and energy. Electronic products are not just for personal use, but are used as a means of communication, and they have replaced many other devices.<sup>1</sup> The role that electrical and electronic products play in human life in modern society is not easy to elaborate. An individual, in most situations, uses more than one electronic device from the time he/she wakes up until he/she goes to bed. Usage of electronic products has gained more prominence in the current lockdown situation and every user reasonably expects the product he/she uses to be safe. Defects in electrical and electronic products cannot be ignored as they can cause death, physical injuries, loss of property, loss of invaluable data and consequential economic loss.<sup>2</sup>

It was correctly said that 'Consumers by definition include all of us. They are the largest economic group, affecting and affected by almost every public and private economic decision. Yet they are the only important group whose views are often not heard'.<sup>3</sup> A pressing need for product liability law is, therefore, emphasised in this paper in the interest of all. While accepting that every product that comes to the market should be safe, this paper limits the research to electrical and electronic products for the purpose of narrowing

down the large area and thereby, doing an in-depth research.

Matters concerning the creation and exchange of such products of technology are addressed by the law of property, contracts, and commerce. Instead, Product liability law concerns the consequences of modern technology gone awry-when products, or the interactions between persons and their products, fail.<sup>4</sup> Therefore, it is a legitimate expectation of every consumer that the electrical and electronic products they use are free from latent defects and are safe.

## JUSTIFICATION

The common law of the country, being Roman Dutch Law (RDL), should be the law to deal with defective products in the absence of statutes. In the only product liability case of *Chinta Devi v. Glacio Limited*<sup>5</sup> in Sri Lanka the Court of Appeal did not go into the aspect of the law that should be applied. However, the terminologies used in the case, such as 'action based on tort' and 'breach of the duty of care' were typical to English Law. At the same time, Civil Law Ordinance provides that the law to be administered in all commercial matters (in Ceylon) shall be the same as would be administered in England in the like case, at the corresponding period.<sup>6</sup> This brings the question as to what transactions are commercial transactions. The sale of goods is a commercial transaction, and the liability for a product arising out of a sale, therefore, can be considered as a commercial transaction. Hence the English law becomes the applicable law for latent defects in products that have been bought for consideration by a buyer. Over and above the two major systems of common law, there are other applicable statutes available in Sri Lanka. Provision dealing with merchantable quality and fit for

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<sup>1</sup> Mobile phones have replaced computers, cameras, recorders, wrist watches, alarm clocks, compasses, paper note pads, pens, physical library etc.

<sup>2</sup> Just for illustration, 2 recent incidents are given. One is the death of a family of 4 in 2018 due to the explosion of the mobile phone that was put on charge.

[<https://lifeinsaudi Arabia.net/sri-lankan-family-died-due-to-mobile/>]. The other is the death of one and injuries to two others due to the crash of an elevator from the first floor to the ground floor of the building. [<https://www.newsfirst.lk/2018/12/29/1-dead-and-2-injured-in-a-nightclub-elevator-crash/>]

<sup>3</sup> John F. Kennedy, Speech to Congress, March 15 1962

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<sup>4</sup> David G. Owen, 'The Moral Foundations of Products Liability Law: Toward First Principles', *Notre Dame Law Review*, 1993, p.427 at 429

<sup>5</sup> [1985] 1 SLR 265

<sup>6</sup> Section 3 of Introduction of the Laws of England Act No.5 of 1852

purpose under the Sale of Goods Ordinance<sup>7</sup> and relevant provisions of Consumer Affairs Authority Act<sup>8</sup> become relevant. This brings a victim affected by defects in product that he or she must first argue for the law that should be applied for his/or her case before fighting for the claim.

Another important aspect is the availability of modern versions of statutes in England and South Africa enacted for the protection of consumers.<sup>9</sup> This stimulates to consider that our laws are not providing adequate protection to the affected consumer, and they need reformation.

Hence, the objectives of this paper are to analyse the law in Sri Lanka with regard to the liability for defective electrical and electronic products that cause harm, point out the shortcomings in the law and to recommend a new law that suits the modern society.

## **RESEARCH DESIGN**

This research is purely based on secondary data collected from books, journal articles, and internet sources. In addition, statutes and case law have been used. Although primary data would have been helpful to arrive at most accurate conclusions, given the situation, it was not possible to collect primary data.

The researcher used doctrinal legal research methodology and combined descriptive and analytical approaches to analyse in detail the concepts, statutory provisions, comments of experts and opinion of judges. The idea behind this method is to gather data, select the appropriate ones, categorize those, critically analyse the law; and provide commentary on the sources used to arrive at a finding. The doctrinal methodology best suited the researcher for a critical qualitative analysis. The researcher has also used a comparative legal methodology in order to compare the existing laws of Sri Lanka with

that of England and South Africa. This helped the researcher to arrive at a conclusion that Sri Lankan law desperately needs reformation.

## **RESEARCH PROBLEM**

This research is centered around the problem that, although quite a number of incidents of injuries and damages to property due to latent defects in electrical and electronic products occur in Sri Lanka, the existing legal framework is inadequate to provide safeguards to the consumers.

In addition, Sri Lankan law cannot be equated with the laws of certain foreign jurisdictions. The laws of England and South Africa have been selected in this regard for the purpose of a comparative analysis.

## **RESEARCH QUESTIONS**

When a person is injured due to a defect in an electrical or electronic product such injury may sometimes lead even to death. The questions that are asked are whether it was a manufacturing fault? Was there a warranty? Who were the parties during the chain of distribution and whether they can be held liable on the basis of any duty on their part? Was it a hazardous product, and if so was there a caution notified to the user by whatever way? To what extent the ultimate seller would be liable? Was there a specified standard to manufacture such product and whether such product met all local and international legal requirements in reaching the ultimate user? Who is a consumer? Should it be a strict liability or usual fault-based liability under the Tort Law and breach of contract under Contract Law? What is the role of insurance in this regard? This paper focused on these questions to arrive at a conclusion.

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<sup>7</sup> S.15 of Ordinance No.11 of 1896

<sup>8</sup> S.32(2) of Act No.9 of 2003

<sup>9</sup> Consumer Protection Act 1987 and Consumer Rights Act 2015 of UK; Consumer Protection Act 2008 of South Africa

## THEORETICAL FRAMEWORK

### Morality

Certain authors argue that product liability law involves morality because of the risk created by products. Such authors justify their arguments by stating that the question of compensation to the victims and the safety measures that should be taken to manufacture products involve morality.<sup>10</sup> John Attanasio's ethical approach<sup>11</sup> and Alan Schwartz's theory of consumer sovereignty<sup>12</sup> support this.

### Consumerism

Consumerism is a growing concept. Ancient concept of *caveat emptor* has been disregarded and the development of the law is favouring consumer rights which is a contra premise to *caveat emptor*. Product liability law concerns consumers who are a vulnerable party when compared to the opponent who is usually a wealthy trader/organization.

### Responsibility

Responsibility is a legal obligation and a measure of capacity can be used to decide the extent of accountability of a person. In product liability law the responsibility lies initially with the manufacturer and then on every party coming to the scene during the course of business until it reaches the ultimate consumer. This is correctly referred to as neighbourhood principle in the landmark case of *Donoghue v. Stevenson*.<sup>13</sup> However, the subsequent cases have expanded this principle and responsibility lies on every party in the chain of the 'travel of the product' from the manufacture until it reaches the ultimate user.

### Legitimate Expectation

The concept of legitimate expectation is no more limited to governments and public bodies. It is applied in commercial matters widely.<sup>14</sup> The argument is that it is the legitimate expectation of the user/consumer that the product he/she uses is safe from latent defects.

### Product Liability under Roman Law, Roman Dutch Law and English Law

The researcher argues that liability for defective products is nothing new. Although Roman Law canvassed the concept of *caveat emptor*, historic Roman Law reveals that *Aedilis* as supervisors of the market promulgated certain edicts of *aedilis* concerning the sale of products (slaves and domestic animals) and the liability for defects of the objects sold. *Aedilian* norms were later extended to other things.<sup>15</sup> Theses *aedilian* actions included *Actio redhibitoria* and *Actio quanti minoris* which are directly relevant to product liability. The liability regime was expanded under both RDL and English Law systems. Nevertheless, Sri Lanka has failed to formulate a policy to safeguard consumers when they are affected by electrical and electronic products. Legislative intervention is comparatively inadequate in Sri Lanka to deal with liability for injuries due to defective products.

## ANALYSIS AND FINDINGS

The researcher described the existing legal provisions of Sri Lanka pertaining to product liability, critically evaluated the provisions, analysed the case laws of Sri Lanka, UK and South Africa, and compared the statutory provisions of the comparative jurisdictions with the provisions of Sri Lanka and arrived at a finding that Sri Lankan law, on a comparative basis, lags behind.

<sup>10</sup> David G. Owen, 'The Moral Foundations of Products Liability Law: Toward First Principles', NOTRE DAME LAW REVIEW, 1993, p.427 at 431

<sup>11</sup> John B. Attanasio, 'The Principle of Aggregate Autonomy and the Calabresian Approach to Products Liability', 74 VA. L. Rev. 677 (1988).

<sup>12</sup> Alan Schwartz, 'Proposals for Products Liability Reform: A Theoretical Synthesis', 97 Yale L.J. 353 (1988)

<sup>13</sup> [1932] UKHL 100, SC (HL) 31, AC 562

<sup>14</sup> It was held in *Silva v. Ace Cargo (Pvt) Ltd* HC (Civil) 19-2007 (CO) (Commercial High Court ) that dividend is a legitimate expectation of a shareholder of a company.

<sup>15</sup> Encyclopedic Dictionary of Roman Law, Vol.43, p.448

## CONCLUSIONS & RECOMMENDATIONS

The researcher has arrived at a conclusion that Sri Lankan law needs extensive reformation. Multiple statutes prevailing in the country create confusion to the affected consumer. A consolidated statute that

emphasizes the rights of consumers is necessary. Having a statute separately for electrical and electronic products is not practically feasible. Therefore, a common statute, widely worded to safeguard the consumer for all possible defects is recommended.

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# SICASH

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## Academic Research and Technology Transfer from University to Industry: Prospects, Challenges and the Way Forward for Sri Lanka

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### ABSTRACT

Universities are at the frontier of knowledge, research, innovation and cutting-edge technology. Therefore, converting university research outcome into commercial success has attracted significant attention among policymakers in developed and developing nations alike in recent years. As it is evident, universities around the world are currently embracing a paradigm shift in academic research commercialization, in addition to traditional university mission. Based on the 'Triple Helix' model of innovation, the universities are to create 'academic entrepreneurship.' Relying upon the landmark legislation of the US, commonly known as the 'Bayh-Dole Act' leading universities in many countries have established their own university technology transfer offices (TTOs). The Sri Lankan university system is no exception to this international development. Given the critical and urgent need, the University Grants Commission (UGC) of Sri Lanka has introduced a new legal initiative; namely, the Commission Circular (University Business Linkage) No. 10 of 2016 and guidelines for its implementation. The Circular requires universities to implement an IP Policy at universities, promote the creation of university spin-offs and research cooperation between business and the university, among others. To further this policy objective, all fifteen state universities and a number of non-state sector higher education institutions have established the University Business Linkage (UBL) Cells in compliance with provisions of the said Circular. Therefore, the universities in Sri Lanka have perceived the mandate of teaching, research and creating co-operative extension to provide innovative advantages for the benefit of the society in line with the university mission. In view of the above, this research aims to shed light on and critique the new legal environment created by the UGC Circular for academic research, innovation, protection and commercialization viewed through the lens of a comparative legal research and analysis.

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## BACKGROUND

“A thought which does not result in an action is nothing much and an action which does not proceed from a thought is nothing at all.”

(Georges Bernanos, a French novelist, 1888 1948)

Intellectual property capital of university academia can create valuable commercial innovations. Standing at the frontier of knowledge, university researchers would start successful high technology companies such as Genentech and Google and create valuable intellectual property (hereinafter referred to as ‘IP’) such as the Hepatitis B vaccine and the pain medication Lyrica.<sup>1</sup> In recent years, there has been a rapid increase in technology-based economic development initiatives, focused mainly on stimulating technological entrepreneurship in universities via patenting, licensing, start-up creation, and university-industry partnerships.<sup>2</sup> Relying upon the Patent and Trade Mark Laws Amendment Act 1980 of the United States, commonly known as the ‘Bayh-Dole Act,’ leading universities in many countries have established their own university technology transfer offices (TTOs).

From a societal standpoint, the concept of IP refers to the ideas that result from creative minds in business, industry and academia. A university is an IP goldmine for industrial and business sectors. Like other types of commercially exploitable assets, IP rights in the form of patents, trademarks, copyright, industrial designs, trade secrets and layout designs of integrated circuits can be developed, owned, managed and commercialized to generate a substantial revenue for universities.<sup>3</sup> Perhaps even more importantly, university innovations need to be

## RESEARCH DESIGN

converted into valuable products and services for the benefit of the society. This task can only be accomplished by commercialization of IP emanating from university research and development. From a business perspective, the term ‘commercialization’ can be defined as the process of taking an invention to the market in view of future profits and business growth. To this end, the traditional university system should be turned into an entrepreneurial university and facilitate university-based technology transfer. Against this background, the University Grants Commission (UGC) of Sri Lanka introduced a new legal initiative; namely the Commission Circular (University Business Linkage) No. 10 of 2016 and guidelines for its implementation. However, the impact of the new Circular is yet to be seen as there are many questions than answers which warrant far-reaching legislative reforms in the field of university technology transfer.

## JUSTIFICATION/OBJECTIVE(S)

The researcher was motivated to engage in this research and draft this paper by a clear lack of relevant legal and academic scholarship on the subject when there is a rising tide of opinion in favour of academic entrepreneurship in the country and, at present, the policymakers are deliberating on legislative reform in light of the evolving role of universities in the commercialization of research. Thus, the main objective of this paper is to examine the new legal environment created by the UGC Circular No. 10 of 2016 and critique perceived inadequacies of the said legal norm drawing inspiration and lessons from more sophisticated and advanced jurisdictions.

Most simply, research design is the roadmap that the researcher decides to follow during the journey to find answers to research

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<sup>1</sup> HK Hvide and BF Jones, ‘University Innovation and the Professor's Privilege’ (2018) 108/7 American Economic Review 1860-1898, 1860.

<sup>2</sup> Rosa Grimaldi and others, ‘30 Years after Bayh-Dole: Reassessing Academic Entrepreneurship (2011).

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[dx.doi.org/10.2139/ssrn.1821239](https://doi.org/10.2139/ssrn.1821239)> accessed on 20 August 2020.

<sup>3</sup> WIPO, IP Asset Development and Management: A Key Strategy for Economic Growth (World Intellectual Property Organization, WIPO Publication No. 896E, Geneva 2006) 2.

questions as validly, objectively, accurately and economically as possible.<sup>4</sup>Therefore, the research design of this study consists of the following elements: namely, research problem; hypothesis; questions; methods; theoretical framework.

## **RESEARCH PROBLEM**

Even though the universities around the world are increasingly recognized as important wellsprings of innovative ideas Sri Lanka has not being able to effectively reap benefit from academic research and commercialization during past few decades. As it is evident, commercialization of university innovation and technology transfer from university to industry remain at a marginal level when compared with more advanced economies. In this context, the policymakers of Sri Lanka introduced the University Grants Commission Circular (University Business Linkage) No. 10 of 2016 in order to address this anomaly and facilitate technology transfer and commercialization for economic development. Nevertheless, in spite of the relatively new legal environment for university-based technology transfer universities have to confront a set of legal and policy issues. Therefore, it is imperative to examine this conundrum.

## **RESEARCH QUESTIONS**

The research problem is unpacked into following research questions in order to guide this research: (1) What is the concept of research commercialization and technology transfer from universities? (2) What is the existing legal framework governing university research commercialization in Sri Lanka?; (3) Is the current legal regime adequate or otherwise to deal with emerging trends academic entrepreneurship?; (4) What inspirations and lessons that can be learned from international experiences?; and (5) What recommendations are to be made to improve

the legal landscape on university research commercialization in Sri Lanka?

## **HYPOTHESIS**

The legal environment introduced by the Commission Circular (University Business Linkage) No. 10 of 2016, along with the Guidelines for its implementation, is inadequate to address the emerging issues currently faced by universities when embarking on the journey of academic entrepreneurship by the Sri Lankan universities.

## **METHODOLOGY**

This research is primarily conducted as a library-based critically review of literature. In so doing, primarily and secondary legal sources were used extensively. Moreover, comparative legal research and analysis of the relevant legislative texts of selected jurisdictions, including the US, EU and South Africa relating to promoting technology commercialization is carried out during this research.

## **THEORETICAL FRAMEWORK**

The rationale for legislation facilitating university-based technology transfer is that university ownership and management of IP would accelerate the commercialization of new technologies and promote economic development and entrepreneurial activity.<sup>5</sup>To explain this new paradigm, economic literature offers valuable insights on academic entrepreneurship referring to the 'triple helix model.' A model of development that get together the generation of novelty (represented by the academia), the generation of wealth (companies) and the public mediation (exercised by the government) is the triple helix.<sup>6</sup> In terms of IP rationale, prospect theory and incentive theory can be cited in support of granting ownership of IP rights to universities to facilitate technology

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<sup>4</sup> Rajith Kumar, *Research Methodology* (4th edn Sage Publication, New Delhi, India 2014) 122.

<sup>5</sup> PH Plan and DS Siegel, 'The Effectiveness of University Technology Transfer' (2006) 2/2 Foundation and Trends in Entrepreneurship 77-144, 78.

<sup>6</sup> LoetLeydesdorff, and Martin Meyer, 'Triple Helix Indicators of Knowledge-based Innovation Systems' (2006) 35/10 Research Policy 1441-1449, 1441.

commercialization. The prospect theory advanced by EW Kitch argues that the patent system offers an array of prospects for commercialization technological innovation.<sup>7</sup> Therefore, this research primarily relies on the triple helix model and prospect theory.

## RESULTS AND DISCUSSIONS

The long-established principle of 'publish or perish' governed the realm of academic research for many decades in the world of academia. However, during the late 20<sup>th</sup> century the Western world experienced a dramatic shift from the above-mentioned conventional wisdom. A new norm was created for the commercialization of university developed technology for benefit of the society and its citizen. Ownership of IP of university research outcomes is at the heart of commercialization and technology transfer process. In common law, the right to an invention belong to the inventor and this centuries-old principle was upheld by the US Supreme Court in *Sandford v Roche*.<sup>8</sup> The policy goal behind the concept is to enhance incentives for firms and universities to commercialize university-based technologies.<sup>9</sup> More precisely, by granting ownership of IP generated at the university facilitates licensing and it allowed universities to own the patents arising from government funds and research grants. In this regard, different ownership models have been followed in many jurisdictions; namely, university ownership model, inventor ownership model and university-industry research partnership model. The key objective underpinning these models is to reduce barriers to commercialization as ownership issues of IP can create a stumbling block for university-based technology transfer and

commercialization. The 1980 Bayh-Dole Act, which is considered to be the most far-reaching and successful legislation in the US, introduced a new regime for exploitation of federally funded research by non-governmental entities such as universities.

The purpose of the Act is to promote technology transfer by conferring to universities and other research institutions the ownership of the patent rights emanating from federally funded research. Perhaps most desirably, the impact of the Act is that the ownership of IP rights of university innovations accrues to the university by virtue of the legislation. In consequence, the perceived success of the Bayh-Dole Act has influenced European policymakers to revisit the long-standing tradition of so-called 'professor's privilege.' Under the professor's privilege regime, a university researcher retained blanket rights to his or her invention in countries such as Germany, Austria, Denmark, Finland, and Norway.<sup>10</sup> In search of an alternative approach, the UK universities have adopted Lambert Toolkit providing model contracts and supporting guidelines. Drawing inspirations and best practices from the 1980 Bayh-Dole legislation, policymakers of South Africa too have introduced the Intellectual Property Rights from Publicly Financed Research and Development Act, No. 51 of 2008. The 2008 Act sets out an enabling framework for the protection and commercialization of publicly funded research outcomes.<sup>11</sup>

In analysing the Sri Lankan legal landscape relating technology transfer and commercialization of university innovations, the Universities Act, No. 16 of 1978 (as amended) does not contain any specific legal provision directly applicable to such situations. However, the IP Act of 2003

<sup>7</sup> EW Kitch, 'The Nature and Function of the Patent System' (1977) 20/2 Journal of Law and Economics 265-290, 266.

<sup>8</sup> *Stanford v Roche* (2011) 563 US 776; In this case, the US Supreme Court decided that wording ('agree to assign' v 'hereby assign') of the assignment agreement determines the ownership of patent.

<sup>9</sup> R Grimaldi and others, '30 Years after Bayh-Dole: Reassessing Academic Entrepreneurship' (2011) 40/8 Research Policy 1045-1057, 1054.

<sup>10</sup> HK Hvide and FJ Benjamin, 'University Innovation and the Professor's Privilege' (2018) 108/7 American Economic Review 1860-1898, 1866.

<sup>11</sup> WIPO, *IP Management and the Commercialization of Publicly Funded Research Outcomes in South Africa* (World Intellectual Property Organization, Geneva 2018) 22-23.

stipulates the right to an IP right that has resulted in the performance of a contract of employment shall be deemed to accrue to the employer.<sup>12</sup> It tends to mean that IP developed by university researchers belong to universities by pursuant to the contract of employment. Nevertheless, unlike in other countries, for many decades, university innovation lies idle with no benefit accruing to the university. To remedy this situation the UGC of Sri Lanka introduced the Commission Circular (University Business Linkage) No. 10 of 2016 and guidelines for its implementation. In the implementation of the Circular, all universities have crafted individual IP policies based on the common guidance provided by the World Intellectual Property organization. Under this Circular, the UBL functions as the university technology transfer office (TTO) and it is expected to create institutional bridges between universities and industry. Even though the 2016 UGC Circular introduced a new legal environment, universities across the country face a number of legal and policy challenges.

A careful perusal of the Circular reveals that the new legal environment only provides for the establishment of the UBL Cells in every state university, but it remains silent on IP ownership compared with legislative initiatives of other jurisdictions. Most strikingly, it was revealed during the discussion of UBL Directors that each university has to rely on institutional IP policy to determine any ownership issue whatsoever arises. In most cases, these IP policies have little guidance as to the issue confronted by the university. According to UBL Directors, those private sector entities that collaborate with universities are extremely reluctant to give up their IP ownership in favour of the university. In this regard, the university IP policies need to be re-visited and revised. This situation has compelled university officials and policymakers to seek further clarifications on the way forward. Last but not the least, the lack of awareness and training on university-based technology transfer among the faculty

members poses considerable challenge in the implementation of IP policy of the university.

## **CONCLUSIONS AND RECOMMENDATIONS**

As already stated, universities have become increasingly important wellsprings of innovative ideas. With the introduction of the UBL Circular of 2016 a new legal initiative has been brought in for creating entrepreneurial universities in the Sri Lankan university system. In looking ahead, the University IP and commercialization policies play a major role in this process. In navigating the grey areas mentioned before and universities should revisit and revise existing policies and rules, drawing inspirations and lessons from other more sophisticated jurisdictions. Moving forward, there are many lessons to be learned from the Bayh-Dole Act and other successful legislations. Most desirably, the Universities Act has to be amended and it is imperative for the policymakers foresee insertion of new provisions to deal with new scenarios and emerging trends in the world of technology transfer. In all likelihood, marrying intellectual capital of university academia and entrepreneur experience of business will go a long way towards creating an innovation-driven economy in Sri Lanka. Eventually, registration of more patents and other IP undoubtedly add value to the reputation of the universities in the country taking them to greater heights in world university ranking.

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<sup>12</sup> For example, the IP Act provides by virtue of section 69 (employee invention) and section 14 (4) which deals with 'work for hire' doctrine in Sri Lanka.





## Regulating Responsible Business Practices for Human-Centered SDS: an Analysis of Recent Developments in International Investment Legal Framework of Developing Countries

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### ABSTRACT

To navigate foreign investment for sustainable development, this paper investigates the recent trends in investment treaty practices and the local investment legal frameworks of developing countries to regulate responsible business practices to address community-based obligations - public health, social, human rights and environmental protection. The demand for sustainable development-oriented investment treaties with new legal rules for the promotion of community-based obligations are gaining significant importance to ensure the consistent nexus between human-centered sustainable development strategies (SDS) and investment regulations. In the recent past, though, developing countries have taken potential steps to inculcate such rights, more precise terms are needed to promote 'responsible business practices' while demarcating the role of actors in the field of investment. It argues that one sensible approach for the better management of such obligations in terms of foreign investment would be the practice of bilateral investment treaties (BITs). In this context, this research provides an empirical analysis of recently concluded BITs, selected Model laws and national laws of foreign investment involving developing countries, to examine the extent to which these legal frameworks ensure the community-based obligations through the lens of human-centered SDS to better promote responsible investments.

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## BACKGROUND

The motive behind the location choice favored by the so-called ‘pull factors’ and ‘attraction models’ of host developing countries sometimes conflict with the objective of promotion of responsible investment.<sup>1</sup> The presence of powerful MNCs in developing countries is sometimes categorized as ‘exploitive’ rather than ‘responsible’.<sup>2</sup> Responsible investment is an evolving concept in the field of foreign investment, and is often addressed in the literature to underlining the importance of ‘duty of care’ in achieving the real sense of development that is to ensure every step of business activities comply with best practice approaches. In the present context, responsible investment is considered a ‘must’, not a ‘choice’, thus, the powerful actors of foreign investments should exhibit their commitments towards human-centered SDS and their business activities do not harm the society, human rights or the environment. The need for coherent methodological approaches to review the existing standards of treatment became significant to ensure competing interests of foreign investment, ensures sufficient pool of resources, green capital, guarantees policy commitments and investors/home state support and their accountability.<sup>3</sup> The inclusion of desirable terminologies on responsible investment in the investment laws admit the developing countries as change-makers in accepting and implementing terms on promotion of responsible investment. This would also ensure the equilibrium in standards and the bargaining power in negotiating investment treaties which would also lead the developing countries as active partners in the promotion of responsible investment in the global setting.

<sup>1</sup> Stephen Guisinger, ‘Host-Country Policies to Attract and Control Foreign Investment’ in SanjayaLall (ed), *Transnational Corporations and Economic Development* (Routledge, 1993) 404). See also Chika B Onwuekwwe, ‘Reconciling the Scramble for Foreign Direct Investments and Environmental Prudence – A Developing Country’s Nightmare’ (2006) 7 *Journal World Investment & Trade* 113, 117.

<sup>2</sup> Phillip Stalley, *Foreign Firms, Investment and Environmental Regulation in the People’s Republic of China* (Stanford University Press, 2010) 6.

<sup>3</sup> See generally, TracisioGazzini, ‘Bilateral Investment Treaties and Sustainable Development’ (2014) 15 *The*

## OBJECTIVES

The objective of this research is three-fold. First, the paper examines the role of foreign investment legal framework for sustainable development in developing countries. Secondly, it analyses the treaty language towards the promotion of human-centered SDS including commitment to uphold best business practice approaches to promote community-based obligations through encompassing sustainable development language. Finally, the paper investigates how the recent changes in investment treaty language are practically viable in the existing domestic setting of promotion of sustainable development.

## RESEARCH METHODOLOGY

The methodology for this research is basically a doctoral analysis with an empirical study. It includes recently concluded BITs between 2015 to 2019 of developing countries, recent Model BITs and selected few developing countries’ domestic laws on foreign investment. The research articulates the criteria for sustainable development language to investigate the selected legal framework under three themes - ‘best business practices’; ‘responsible investment’; ‘upholding community-based obligations’. Further, this research also investigates the local structure of legal frameworks of developing countries in order to cope with international sustainable development strategies under the above themes.

## ANALYSIS AND FINDINGS

*Journal of World Investment and Trade* 926–63; Marie-Claire CordonierSeggar, Markus W Gegring and A Newcombe (eds), *Sustainable Development in World Investment Law* (Kluwer Law International, 2011); Pasquale Paziienza, *The Relationship Between FDI and the Natural Environment: Facts, Evidence and Prospect* (Springer, 2014); Andrew Newcombe, ‘Sustainable Development and Investment Treaty Law’ (2007) 8(3) *Journal of World Investment and Trade* 357–408; M Sornarajah, ‘Foreign Investment and International Environmental Law’ in S Lin (ed), *UNEP’s New Way Forward: Environmental Law and Sustainable Development* (UNEP, 1995) 283–97;

The recent BITs concluded after 2015 can be categorized as ‘third generation of investment treaties’ emphasizing sustainable development which is a remarkable shift from the traditional approach of treaty-making. However, still, a few developing countries remain with first or second-generation treaties which focus on protectionist approaches. Besides investment treaties, some countries managed to leverage their own comprehensive domestic foreign investment laws to provide legal certainty and to meet sustainable development norms similar to recent BITs. The recent investment legal frameworks provide a detailed definition of foreign investment, including interpretation of terms, the scope and limitation of investment guarantees and incentives, and spells out the powers and duties of commissions and ministers.<sup>4</sup> Further, domestic foreign investment laws include investor obligations in relation to public health,<sup>5</sup> the environment,<sup>6</sup> labour rights and standards<sup>7</sup> and CSR,<sup>8</sup> and ensures foreign investors comply with domestic legislation.<sup>9</sup> These aspects are crucial for the promotion of responsible investment which leads to human-centered SDS. National foreign

investment laws also pledge to refuse investments that lead to environmental degradation.<sup>10</sup> The Myanmar Investment Law (2016)<sup>11</sup> arts 41 and 89 explicitly refer to prohibited investment business practices that may bring or cause hazardous or poisonous waste<sup>12</sup> or have an enormous impact on the natural environment and ecosystem.<sup>13</sup> One of its objectives is ‘to develop responsible investment businesses which do not cause harm the natural environment and the social environment for the interest of the Union and its citizens’.<sup>14</sup> Moreover, investment incentives schemes of some developing countries have undergone changes based on social and environmental performance, either through priority sectors or incentives condition on the social, or environmental performance of investors. For instance, Brazil, Indonesia, South Africa, Turkey and Mexico are few developing countries that link their incentive scheme to environmental sustainability grounds. However, the surveys conducted by the different organizations indicate the key impediments to the promotion of responsible investment in developing countries, giving foreign investments’ role in achieving human-centered SDS.<sup>15</sup> Accordingly, developing

<sup>4</sup> See *Investment Law No 72 of 2017* (Egypt); *Law on Investment (2014)*, *Law No 67/2014/QH13* (Vietnam); *Law on Investment Promotion (2016)* (Laos); *The Pyidaungsu Hluttaw Law No 40/2016* (Myanmar).

<sup>5</sup> *Investment Law No 72 of 2017* (Egypt) art 15; *The Investment Law No (13) of 2006* (Iraq) art 14.

<sup>6</sup> *Law on Organization of Foreign Capital in Economic Activity (2000)* (Qatar) art 13; *Private Investment Law (2011)* (Timor-Leste) art 27; *Law on Investment Promotion (2016)* (Laos) art 74; *Law Regarding the Promotion of Direct Investment (2013)* (Kuwait) art 34; *Law No 5 of 2007 on Capital Investment* (Indonesia) art 16; *Foreign Investment Act (2014)* (Cuba) art 54; *Investment and Export Promotion Agency Act (2010)* (Gambia) art 56.

<sup>7</sup> *Foreign Investment Act (2014)* (Cuba) art 27; *Investment Law No 72 of 2017* (Egypt) art 15; *Investment and Export Promotion Agency Act (2010)* (Gambia) art 56; *Law on Investment Promotion (2016)* (Laos) art 69; *The Pyidaungsu Hluttaw Law No 40/2016* (Myanmar) art 51.

<sup>8</sup> *Investment Law No 72 of 2017* (Egypt) art 15.

<sup>9</sup> *Law No 5 of 2007 on Capital Investment* (Indonesia) arts 15, 16; *Law on Investment Promotion (2016)* (Laos) art 72; *The Pyidaungsu Hluttaw Law No 40/2016*

(Myanmar) art 65; *Investment Act (2016)*; *Investment Promotion Act, Law No 199 of 2016* (Namibia) s 18; *Protection of Investment Act, Act No 22 of 2015* (South Africa) s 4.

<sup>10</sup> See preamble to the *Protection of Investment Act, Act No 22 of 2015* (South Africa); Preamble to the *Investment Promotion Act (2016)* (Namibia); *Foreign Investment Act (2014)* (Cuba) art 20.

<sup>11</sup> *The Pyidaungsu Hluttaw Law No 40/2016* (Myanmar). *The Law on Investment Promotion (2016)* (Laos) art 34; *The Protection of Investment Act, Act No 22 of 2015* (South Africa) includes the right to regulate, and see s 12.

<sup>12</sup> *The Pyidaungsu Hluttaw Law No 40/2016* (Myanmar) art 41(a).

<sup>13</sup> *Ibid* art 41(e).

<sup>14</sup> *Ibid* art 3(a).

<sup>15</sup> Alina Kudina and Malgorzata Jakubiak, ‘The Motives and Impediments to FDI in the CIS’ (Paper presented at OECD Global Forum on International Investment VII, Paris, 27–28 March 2008); World Bank, ‘Global Investment Competitiveness Report 2017/2018: Foreign Investor Perspectives and Policy Implications’ (Report, World Bank, 2018).

countries should identify their own impediments in promoting responsible investments at domestic level.

The recent BITs showcase numerous smart clauses for sustainable development. A few BITs demarcate the responsibilities of actors by inserting specific words related to the right to regulate, corporate social responsibility, effective use of resources, establishing rule of law, workers' rights, public health and safety while some treaties make seriously formulating ambitious clauses linked to environment, social and human rights protection, economic development and investors right. Similarly, the recent Model BITs demonstrated the changing patterns of investment landscape. Model laws are significant as they have been used as an essential means of establishing acceptable treaty practices among countries.<sup>16</sup> The recent model BITs of the US, Norway, the International Institution for Sustainable Development (IISD) and South African Development Community (SADC) address the norms of sustainable development which pave the way in the promotion of responsible business practices. These Models provide policy spaces to regulate foreign investment through a number of clauses, such as provisions related to the right to regulate, general and specific exemptions or reservations clauses, provisions related to social, human rights and environmental protection and limited application of treatment of standards clauses. The emergence of Model laws has led the creation of a new generation of investment treaties with a balanced approach by encompassing a range of terminologies such as CSR, labour rights, democracy, the rule of law, human rights and fundamental freedom according with international law, emphasizing corporate efforts of investors etc. This would also secure themselves from costly investor-state arbitration. Further, the emerging paradigm

will allow MNCs to invest in sustainable investment projects in host developing countries. At the same time, developing countries should revise their domestic structure to accommodate such investment while enhancing investors' confidence by providing a stable legal environment.

## CONCLUSION

The integrated approach to foreign investment is inevitable for the promotion of human-centered SDS. Though the research identifies the recent developments of foreign investment laws which acknowledge the promotion of responsible investment to a certain extent, some developing countries have not taken significant steps to revise their foreign investment laws or their domestic legal structure to accommodate such investments. This research identified the critical need of reforming foreign investment laws for sharing responsibilities and ensuring global partnership to promote human-centered SDS, domestically as well as internationally. The new BITs and Model laws reflect the view that the traditional or unbalanced BITs no longer suit the world's need, therefore, rigorous revision is needed to uphold community-based obligation which supports responsible business practices in some developing countries. Commenting on the impact of modern BITs of some developing countries still remain infant as they signed the BITs but not yet entered into force. Whatever the case may be, they sought to include provisions related to promoting responsible investment, uphold best business practices and adhere to community-based obligations are remarkable changes of the investment landscape of developing countries. However, the implementation of such provisions depend on the removal of key impediments to the promotion of responsible investment at a domestic level.

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<sup>16</sup> Chester Brown (ed), *Commentaries on Selected Model Investment Treaties* (Oxford University Press, 2013) 2.

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**SICASH**

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## Denial of Justice Claims under the Fair and Equitable Standard: Scope and Limitations

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### ABSTRACT

The cause of action for denial of justice claims lies either on the procedural irregularities of a case or systematic shortcomings of the host state's judicial system which could result in losses for the investor. The evolution of denial of justice claims began in the mid-1990s along with the rise of investor - state arbitration. Within the period of 2000 - 2019, nineteen denial of justice claims have been brought before the ICSID tribunal under the ambit of Fair and Equitable Standard (FET). Among those, the claimant was successful only in three claims. Approximately 84% of the claims were unsuccessful. This raises an interesting question to examine how the principle of denial of justice has been utilized in arbitral awards to afford protection for foreign investors under the FET standard. Pursuant to the arbitral awards analyzed for this study, key aspects that decide the scope and limitation of denial of justice claims are related to the standard to evaluate denial of justice claims, the application of the local remedy rule and the role of the arbitration tribunal.

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## BACKGROUND

The cause of action for denial of justice claims lies either on the procedural irregularities of a case or systematic shortcomings of the host state's judicial system<sup>1</sup> which could result in losses for the investor. Although BITs have increased the avenues that could give rise to multiple causes of action for denial of justice claims, and the numbers of tribunals with the mandates to hear such cases, denial of justice claims gained only a little attention in international investment law between the years post world war II and the early 1990s.<sup>2</sup> The evolution of denial of justice claims began in the mid-1990s along with the rise of investor - state arbitration.<sup>3</sup>

## JUSTIFICATION/OBJECTIVE

Within the period of 2000-2019, nineteen denial of justice claims have been brought before the ICSID tribunal under the ambit of Fair and Equitable Standard (FET). Among those, the claimant was successful only in three claims. Approximately 84% of the claims were unsuccessful. This raises an interesting question to examine how the principle of denial of justice has been utilized in arbitral awards to afford protection for foreign investors under the FET standard. This study proceeds to explore this question in light of the justifications articulated by the recent trends in the formulations of IIAs and arbitral awards. It appears that most of the modern IIAs give specific focus to the element denial of justice within the FET clauses.<sup>4</sup> This provides a strong signal that upon the enforcement of modern IIAs, claims based on denial of justice would

become a repeatedly invoked subject matter in practice. In the same vein, arbitral awards have also given more attention towards developing this element in a manner whereby the host state's right to regulate foreign investments and the investor's right to protection of the said investments are well balanced.

## Research Design: Research Problem; Hypothesis; Questions; Methods; Theoretical Framework; Materials

The study proceeds to rely on the theory of rule of law as the theoretical background. the substantive and procedural dimensions of the rule of law concept<sup>5</sup> ensures that the host state's sovereign right to regulate foreign investment is exercised within the boundaries of legality.

The substantive element of the rule of law concept ensures that the officials who are entrusted with public power do not use those powers arbitrarily.<sup>6</sup> Accordingly, principles of reasonableness, consistency, non-discrimination and transparency have been identified as the core elements of the substantive dimension.<sup>7</sup> The procedural dimension of the rule of law concept deals with principles of due process which ensures, according to customary international law, that the foreign national is given an opportunity to resort to local courts in the event of disputes.<sup>8</sup> Failure to do so would develop into denial of justice under the principles of international

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<sup>1</sup> A. Bjorklund, Supra Note 37 , pp. 812

<sup>2</sup> *ibid*, pp.847

<sup>3</sup> See Jan Paulsson, *Denial of Justice in International Law* (Cambridge University Press, 2005)

<sup>4</sup> UNCTAD (May 2018), 'Recent Developments in the International Investment Regime', *IIA Issues Note, International Investment Agreements*. 2018, UNCTAD publication.

<sup>5</sup> "The concept of the rule of law is related to the idea of exercising public authority subject to legal controls, for the purpose of protecting individuals" - Jeremy Waldron, 'The Concept and Rule of Law', 43 *Georgia*

*Law Review* 1 (2008), pp. 5; For detailed account on the substantive dimension of the rule of law concept see: N. Fuller, *The Morality of Law* (Revised edition, 1969), pp.39,46-91; Procedural dimension: A.V Dicey, *Introduction to the study of the law of the constitution*, (Liberty Classics Edition, 1982) pp 110 -21

<sup>6</sup> S. Chesterman, An International Rule of Law? 56 *American Journal of Comparative Law* (2008), pp. 331, 339, 342

<sup>7</sup> K. J Vandeveld, A Unified Theory of Fair and Equitable Treatment, *International Law and Politics* vol. 43:43 (2010), pp 52.

<sup>8</sup> *ibid*, pp 50.



law.<sup>9</sup> In the ambience of investor – state disputes, the denial of justice claims are based on similar conceptions which proceed on the basis that due processes before the local courts have not been followed.

## ANALYSIS AND FINDINGS

Pursuant to the arbitral awards analysed for this study,<sup>10</sup> key aspects that decide the scope and limitation of denial of justice claims are related to the standard to evaluate denial of justice claims, the application of the local remedy rule and the role of the arbitration tribunal.

### (a) The Standard to Evaluate Denial of Justice Claims

The quest to discover a standard to evaluate the denial of justice claims began with the *Azinian v. Mexico* award.<sup>11</sup> Though it did not specifically focus on formulating a standard, it spared attention to articulate the circumstances in which denial of justice claims would arise.

The *Mondev v. United States* tribunal was the pioneer to pronounce a detailed and coherent standard to evaluate denial of justice claims, under NAFTA.<sup>12</sup> Later, the NAFTA tribunal in *Loewen v. United States* explored the requirement of the standard in detail.<sup>13</sup> The

respondent submitted that the claimant should establish fault on the part of the host state's judicial system and malicious intention/ bad faith to establish discrimination in the local court proceedings<sup>14</sup>.

It is evident that the standard determined by the NAFTA tribunals have been adopted by the ICSID tribunals as well. For example, in *Jan de Nul N.V, Dredging International N.V v. Egypt* case, substantive and procedural denial of justice claims arose out of the acts and omissions of the judicial proceedings of the Islamialia courts.<sup>15</sup> To examine each claim separately, the ICSID tribunal relied on the test established in the *Mondev* case.<sup>16</sup> Further, the cases of *Amto v. Ukraine*<sup>17</sup> and *Liman Caspian Oil v. Kazakhstan*<sup>18</sup> decided under the ECT to follow the Modev standard.

The *Thunderbird* award dealt with denial of justice claims stemming from administrative proceedings.<sup>19</sup> The tribunal emphasised that the requirement of the standard to evaluate denial of justice arising from administrative proceedings is lower than that of the requirement of the judicial proceedings. Other explanations as to how the lower level of the standard was to be determined was brought forward by the case.<sup>20</sup>

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<sup>9</sup> A. Bjorklund, Reconciling State Sovereignty and Investor Protection in Denial of Justice Claims, 45 *VA.J.INT'L. L.* 809 (2005)

<sup>10</sup> Prof. Greenwood in his First opinion to *Loewen* case, claims that there are three different issues to be determined under the denial of justice claims. The first is to determine whether the alleged judicial act could be attributed to the respondent state. Judiciary is one of the organs of the state#. Thus, decisions of the institutions that falls under the purview of the judicial system of a country could be attributed to the state. The international law obliged the state to guarantee a fair trial to the litigants via the national courts of law and failing to do so, would amount to breach of international obligations. Second, is to determine whether the alleged judicial decision had violated the international law principles and finally, it is to determine whether the claimant had satisfied the local remedy rule - See *Loewen* case, Award, paras. 148 & 123.

<sup>11</sup> ICSID Case No. ARB(AF)/97/2, Award (1 November 1999), 39 I.L.M. 537.

<sup>12</sup> (2003) 42 *ILM* 85

<sup>13</sup> (2003) 42 *ILM* 85

<sup>14</sup> *ibid*, para. 130

<sup>15</sup> UNCTAD (May 2018), 'Recent Developments in the International Investment Regime', *IIA Issues Note, International Investment Agreements*. 2018, UNCTAD publication, pg.2 available at < [https://unctad.org/en/PublicationsLibrary/diaepcbinf2018d1\\_en.pdf](https://unctad.org/en/PublicationsLibrary/diaepcbinf2018d1_en.pdf)> accessed 29 June 2020, para. 190

<sup>16</sup> *ibid*, paras. 192 -193

<sup>17</sup> SCC Case No. 080/2005, Award, (26 March 2008), paras. 126 -127

<sup>18</sup> ICSID Case No. ARB/07/14, Excerpts of the Award, (22 June 2010), para. 263

<sup>19</sup> NAFTA/UNCITRAL, Award, 26 January 2006, para. 195

<sup>20</sup> *ibid*, para, 200

In the case of *Bayinder v. Pakistan*<sup>21</sup>, the denial of justice claims alleged that the respondent state had denied opportunities to include the investor in the administration and management of the contract.<sup>22</sup> While accepting the proposition that the administrative nature of acts could create the basis for denial of justice claims, the tribunal said that each of such administrative acts should qualify against a lack of transparency, openness and honesty.<sup>23</sup> Further, the tribunal said that the test needs to be applied specifically to each circumstance.

The foregoing analysis established that the standard articulated in the *Modev* case has uniform application across the denial of justice claims arising from judicial proceedings. In respect of the claims stemming from administrative proceedings, the thrust of the standard remains lowered and it would be decided via the fact pattern of specific cases. In the meantime it is to be noted that the *Mondev* standard is criticised for being vague.<sup>24</sup> It is alleged that the *Modev* standard did not clearly articulate the difference between mere error of the domestic courts and the error that manifests injustice to the investor. These criticisms have led Bjorklund to propose the sequential review as an alternative to the *Modev* standard in 2005.<sup>25</sup> The sequential review approach possess two stages of analysis. The first step focuses on determining whether the alleged judicial practice of the denial of justice claim had violated the national law. If so, in the second step, the alleged judicial practice would be weighted against the applicability of the international law principle in determining the existence of 'denial of justice'.

### The Application of Local Remedy Rule

The phrase exhaustion of local remedies is attached to the customary international rule which is commonly known as 'local remedy rule'. This rule ensures that the investor should have exercised all the local remedial options available to him before seeking justice before an international body.<sup>26</sup> The landmark award related to the application of the local remedy rule was given in *Loewen v. United States*. According to this case, the rationale for limiting the scope of denial of justice claims is based on the idea that the judicial action is a process.<sup>27</sup> When a legal dispute initiates a judicial process, it only comes to an end when the apex court of the last resort gives its verdict. To attribute the state liability for such a judicial action, it is mandatory to complete the entire judicial process.<sup>28</sup>

The 'exhaustion of local remedies' happens when the investor has exhausted all the effective, adequate and reasonably available remedies.<sup>29</sup> This qualification is to ensure that the state is under the obligation not only to present the remedies in abstract but also to ensure the availability of those to the aggrieved parties. It is to be accepted that there would be many practical limitations that would prevent the investor from exercising the local remedies which exist in terms of the municipal law.<sup>30</sup>

The *Loewen* decision makes it clear that the tribunals would look for the whole picture relating to the availability of local remedies when deciding the denial of justice claims. The whole picture would consider the availability of alternative options, effectiveness of those alternative options, and barriers imposed by

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<sup>21</sup> Award, ICSID Case No. ARB/03/29 (27 August 2009)

<sup>22</sup> *ibid*, para. 343

<sup>23</sup> *ibid*, para.344

<sup>24</sup> A. Bjorklund, *Reconciling State Sovereignty and Investor Protection in Denial of Justice Claims*, 45 *VA.J.INT'L. L* 809 (2005) , pp. 813 - 815, 895.

<sup>25</sup> *ibid*, pp. 873- 878

<sup>26</sup> Wallace.D, 'FET and Denial of Justice: *Loewen v. US* and *Chattin v. Mexico*', TDM 2 (2006)

<sup>27</sup> *ibid*, para. 149 and 143

<sup>28</sup> "The responsibility of a State may not be invoked if: (b.) the claim is one to which the rule of exhaustion of local remedies applies and any available and effective local remedy has not been exhausted" - Article 44 of the International Law Commission (ILC) Draft Articles on State Responsibility (2000)

<sup>29</sup> *ibid*. para. 165

<sup>30</sup> *ibid*. para. 167.

the respondent state to prevent the investor from exercising those remedies etc. Since there is no rigid approach with respect to the application of the local remedy rule, the approach taken in *Loewen* is a practical way of approaching the rule which looks at all circumstances of the investment.

The *Jan de Nul* tribunal devoted attention to evaluate the impact of the local remedy rule on denial of justice claims.<sup>31</sup> The confusion whether the said rule should be applied to both – substantive and procedural – claims in the same manner, was resolved. The tribunal had clarified that the rule would have equivalent application to both aspects; except to one category which falls under the procedural aspect of the claim. In general, the rule should not be applied to the claims which are made up because of excessive delays in the national court proceedings. Given the fact that the appeal in the national court was pending while the ICSID tribunal heard this case, the tribunal ruled that the claimants had failed to satisfy the local remedy rule and thus dismissed denial of justice claim on all grounds.

In addition to the acknowledgement of key features identified by precedent tribunals, one more remarkable point has been added by the present tribunal. The local remedy rule would be lifted in circumstances where there are excessive delays in delivering first instance decisions which had made it as unappealable due to the time limit. However, it seems that the upliftment is subjected to the surrounding circumstances. As in the *Jan de Nul* case, the nature of the dispute, conduct of the parties and nature and impact of the manifest injustice of the national court's decision would influence the upliftment decision.

### (c) Role of the Arbitration Tribunal

It is evident that the tribunals show keen interest to stick to the mandate of their role in denial of justice claims. Adopting the approach taken in *Azanian* case<sup>32</sup>, the *Mondev* tribunal said that it cannot take a role equivalent to the Court of Appeal or any other appellate court<sup>33</sup> when handling denial of justice claims. The tribunal said that there is a clear line between seeking justice before international tribunals and seeking international review on the decisions of the national courts.<sup>34</sup> Citing this as a justification, it refused to function as a body that holds revision appellate jurisdiction against the national court's decisions. The *Loewen* award specified that the NAFTA claim cannot be used as a tool to lodge appeals against the national courts' decision. The *Jan de Nul N.V v. Dredging International N.V v. Egypt* tribunal declined to comment about the conduct and mandate of the second panel appointed by the minister of justice. The tribunal cited that it cannot review neither the jurisdictions of national authorities nor the applicable law.<sup>35</sup> The recent tribunal of *Olin Holdings Ltd v. Libya* said that it cannot review merits of the municipal courts. The tribunal was of the opinion that doing so would fall under the mandate of the court of appeal.<sup>36</sup>

### CONCLUSIONS AND RECOMMENDATIONS

The scope of denial of justice claims is influenced by the standard used to evaluate the denial of justice, the application of local remedy rule, and the role of the arbitration tribunal. The standard developed by the *Mondev* tribunal has been applied across. It is quite a surprise to see that the tribunals have not used their discretionary power to develop varying standards to evaluate denial of justice when deciding cases under different formulations of FET clauses. Pursuant to this, there are no fundamental differences among

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<sup>31</sup> *ibid*, para. 255

<sup>32</sup> ICSID Case No. ARB(AF)/11/2, Award, 4 April 2016, para. 99

<sup>33</sup> *ibid*, para. 136

<sup>34</sup> *ibid*, para 138

<sup>35</sup> UNCTAD (May 2018), 'Recent Developments in the International Investment Regime', *IIA Issues Note, International Investment Agreements*. 2018, UNCTAD publication, pg.2 available at < [https://unctad.org/en/PublicationsLibrary/diaepcbinf2018d1\\_en.pdf](https://unctad.org/en/PublicationsLibrary/diaepcbinf2018d1_en.pdf)> accessed 29 June 2020, para. 205

<sup>36</sup> ICSID Case No. UNCT/14/02, Award, 16 March 2017, para. 224

the denial of justice claims which falls under different formulations of the FET clauses. The requirement to exhaust local remedies has become mandatory in the denial of justice claims. Along with this, the tribunals limit themselves from intervening into the national judicial system by clearly adhering to their mandate. This caters to solve the tension between the host state's interest to protect its sovereignty and the investor's right to protection for their investments.



## Online Dispute Resolution (ODR): As an Instrumental Approach for the Settlement of E-Commerce Disputes in Sri Lanka

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### ABSTRACT

The development of IT regime has significantly contributed to the transformation of traditional approaches towards the digitalized regime. Commercial engagements are not an exception in this regard. Growing steadily, e-commerce transactions too give rise to disputes. However, the dispute resolution and redress mechanisms are conducted through the traditional approaches in Sri Lanka. There are numerous drawbacks affecting the effectiveness of the existing system. Demands arise for an alternative dispute settlement approach related to e-commerce that would satisfy the consumers' interest for a speedy, efficient, cheaper and free of encumbrances system. In such a context, this paper explores the benefits of implementing Online Dispute Resolution (ODR). This paper evaluates the lessons of European Union (EU) and considers the system of ODR that will ensure the fundamental right of access to redress and facilitate building of trust in e-commerce transactions thereby contributing to the country's economy.

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## BACKGROUND OF THE STUDY

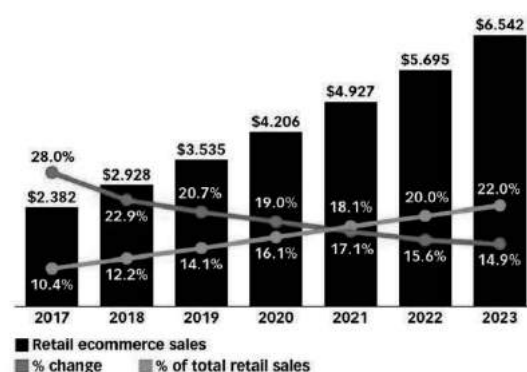
The Development of the IT regime has significantly contributed in the evolution of the world. Sri Lanka is too not an exception in this regard. The Computer literacy is considerably in the upward trend in Sri Lanka, and more particularly in the past decade it has had a dramatic growth. As the Department of Census and Statistics of Sri Lanka provides, the computer literacy of Sri Lanka which was 20.3 percent<sup>1</sup> of the population in 2009, has a rapid growth to 30.1 percent<sup>2</sup> within a decade. The increasing Computer Literacy leads the engagement of the public in different feature platforms of the cyber space such as E-Commerce, Social Media Usages, E-Documents, E-Banking, Education through Digital Spaces and many more.

The IT era has transformed the traditional market into a digital market, and the global business community is rapidly moving among Business-to Business (B2B), Business-to Consumer (B2C) and Consumer- to Consumer (C2C) transactions. The transformation rendered immense benefits for the consumers, as well as traders, such as time saving, reduced transaction costs, increased comfort, quick and continuous access to information, and convenience.<sup>3</sup> which contributed the E-Commerce to become an ideal platform for business transactions. Consumers of E-Commerce have increased steadily since 2010 all over the world. The growth rate has been quite consistent over the last few years, and it is expected to continue in the future too as shown in the figure below (Emarketer, May 2019).

<sup>1</sup> Department of Census and Statistics Sri Lanka(2009) - Computer Literacy Statistics Retrieved: [http://www.statistics.gov.lk/CLS/BuletinComputerLiteracy\\_2009.pdf](http://www.statistics.gov.lk/CLS/BuletinComputerLiteracy_2009.pdf)

<sup>2</sup> Department of Census and Statistics Sri Lanka(2019) - Computer Literacy Statistics Retrieved <http://www.statistics.gov.lk/education/ComputerLiteracy/ComputerLiteracy-2019Q1-Q2-final.pdf>

<sup>3</sup> Abdul Gaffar Khan, 'Electronic Commerce: A Study on Benefits and Challenges in an Emerging Economy', Global Journal of Management and Business Research: B Economics and Commerce Volume 16 Issue 1 Version 1.0 Year 2016, pp.20



(Source: Emarketer, May 2019)

Figure 1: Retail E-Commerce Sales World-Wide (2017-2023)

In Sri Lanka too, E-Commerce has been in the consistent growth. It was reported that Sri Lankan E-Commerce regime had a significant growth of 34% for one year, as at July 2018 (Visa International, July 2018<sup>4</sup>) and the Annual domestic E-Commerce sales value is expected to grow up to US \$400 million by 2022<sup>5</sup>.

However despite the development and the demand for the E-Commerce worldwide, due to the complex nature of the internet, online consumers have suffered serious breaches of their consumer rights in comparison to offline consumers<sup>6</sup>. Even several International Laws<sup>7</sup> stress down the necessity

<sup>4</sup> Daily News, 'Sri Lanka's e-commerce segment records 34% growth' (Daily News.lk, 26 November 2018) <https://www.dailynews.lk/2018/11/26/business/169414/%E2%80%98sri-lanka%E2%80%99s-e-commerce-segmentrecords-34-growth%E2%80%99accessed%20on%209%20June%202020>

<sup>5</sup> Daily News, 'SL e-commerce to hit US\$ 400 mn by 2022', 7 September 2018

<sup>6</sup> B.A.R. Ruwanthika Ariyaratna, 'ARE CONSUMERS SAFE IN ONLINE? A CRITICAL ANALYSIS OF SRI LANKAN LEGAL

REGIME ON ONLINE CONSUMER PROTECTION', The Junior Bar Law Journal (2019)

<sup>7</sup> UNCITRAL Model Law on Electronic Commerce (1996), OECD Recommendation on Consumer protection in ECommerce 2016, UNCTAD. 'Manual on Consumer Protection' (United Nations, 2017)



to provide protection for the Online Consumers in different aspects and guide nations in drafting its legislation in accordance with such standards, the Sri Lankan E-Commerce in practice has failed to deliver the same.

Accordingly, this paper investigates the effectiveness of the dispute resolution and redress mechanism related to the E-Commerce and thereby attempts to suggest the contributory approach of ODR as an apt alternative for Sri Lanka.

## **OBJECTIVES OF THE RESEARCH**

This study aims to suggest the Online Dispute Resolution (ODR) as the instrumental approach for dispute resolution and redress mechanism for the E-Commerce disputes, as an alternative for the traditional practices of dispute resolution in Sri Lanka as the core objective.

Further, the paper intends to,

- i. Identify the effectiveness of the Traditional Dispute Settlement Practice in Sri Lanka.
- ii. Study the legal recognition of the Alternative Dispute Settlement Methods (ADR Methods) in Sri Lanka.
- iii. Analyse the possibility of the legal implementation of the ODR in Sri Lanka.
- iv. Learn the Experiences and Lessons of the ODR in the EU.
- v. Study the other concerns related therein.

## **RESEARCH DESIGN**

### **Research Problem**

Despite the attempts of the Sri Lankan legal arena to strengthen-up the cyber sphere with different pieces of Laws and Regulations, the Electronic Commerce remains as an integral aspect of the cyber sphere which is yet to be flourished. Since the E-Commerce transactions are through the cyber space, the degree of intimacy and extension of e-relationship is far more limited among the parties. Due to its nature of business, numerous consequences of

disputes arise between the consumer and the business trader.

In Sri Lanka, SLCERT (2019) reported 28 Cases of Financial/Email frauds in the last year (SLCERT, 2019). However statistics related to the complaints regarding E-Commerce are hardly found. Yet, the sphere of E-Commerce Dispute Solution should be approached with the utmost attention as the reports suggest. In 2018 Sri Lanka's annual domestic E-Commerce sales value was US\$40 million and expected to hit US\$400 million by 2022 (Roar, 2018). Further, Asia Securities estimates the Sri Lankan online retail market to be a US \$ 450-500 million opportunity over the next five to six years (Asia Securities Research, 2020).

As the core feature of the commercial transactions, every consumer has a fundamental constitutional right to have access to the courts for the purposes of enforcing their rights. In Sri Lanka, in addition to the litigation process, the Consumer Affairs Authority (CAA) and the Alternative Dispute Resolution methods (ADR) contribute to redress the affected parties in commercial transactions, particularly consumers. However the effectiveness of the practices are affected with several significant drawbacks when the disputes are related with e-commerce. The question however is, "Will it be expedient to implement the method of ODR as an alternative for the traditional practices to resolve the E-Commerce disputes in Sri Lanka?"

### **Hypothesis of the Study**

The method of ODR to resolve and redress disputes that arise from E-Commerce transactions will be an expedient alternative for the shortcomings of the traditional practices in the Sri Lankan context.

### **Research Questions**

- i. What is the legal status of E-Commerce and the available Dispute Settlement Practices in Sri Lanka?

- ii. How would the existing traditional settlement practices become effective in disputes related to E-Commerce?
- iii. How would the introduction of the ODR be effective to resolve the E-Commerce Disputes?
- iv. What steps can be taken to introduce ODR in the Sri Lankan Jurisprudence with the experiences of EU?

### **Research Methodology**

The research is a qualitative mode of approach based on the primary and secondary data. Data for this research were collected from Conventions, Treaties, Acts, Resolutions and judicial decisions as the primary sources. As secondary sources data were collected from the books, e-books, statistical reports, journals, scholarly articles, and empirical data available at both library and electronic data-bases.

### **Scope and Limitation of the Research**

The paper limits the scope of the research within the effectiveness of Traditional Dispute practices in the Sri Lankan legal jurisprudence in the disputes related to the E-Commerce and proposes the instrumental approach of ODR as an effective alternative. Thereby the future research may lead to continue the substance to develop the other spheres of research related in the near future.

### **FINDINGS AND ANALYSIS**

Since the rapid growth of the E-Commerce has been identified and recognized by the legal drafters, electronic transactions have been legally recognized as equivalent to the ordinary transactions through the ETA<sup>8</sup>. However, in Sri Lanka the traditional approaches of dispute settlement are being adopted to resolve and redress the disputes among the parties in the context including E-Commerce transactions. Particularly, in order to protect the interests of the consumers, the disputes are resolved through the practice of

- i. litigation,
- ii. Alternative dispute resolution(ADR), and
- iii. The Consumer Affairs Authority (CAA).

Ideally, sale of goods and services through E-Commerce websites operating in Sri Lanka are subjected to the above practices.

However, due to the reasons such as certain pecuniary limitations, time consuming nature of the proceedings, inconvenience, and expenditures, the traditional litigation practice has lost its paramount interest among the parties to settle-down disputes. But as an effective alternative, ADR practices are fairly approached by the parties. Arbitration is the most common ADR method which significantly adheres to resolve disputes related to commercial transactions in the construction industry. Proceedings of arbitration and the award (decision/judgment) of the Arbitrator is binding upon the parties which can be enforced in the same parlance as that of a Court's decree<sup>9</sup>. However, even the time lag issues are significantly rectified by the ADR, where there are numerous other pitfalls which remain unsolved. Currently, two arbitral institutions and/or centers are operative in Sri Lanka – the Sri Lanka National Arbitration Centre and the ICLP. However, both are based in Colombo, therefore, impediments exist in respect of Travelling. Additional expenses remain on par with litigation. The executions of the CAA too sum-up the certain drawbacks to address the matters related to the E-Commerce disputes since the Act<sup>10</sup> does not provide adequate scope of definition for 'Consumer' and the absence of the Online Trade Regulation mechanism. Further, the Jurisdictional issues remain as a significant hazard to resolve the cross-border consumer disputes in all these traditional dispute settlement practices. As the necessity to bridge this lacuna exists, the practice of ODR would be apt to settle down E-Commerce disputes. ODR has been

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<sup>8</sup>Electronic Transactions Act, No. 19 of 2006.

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<sup>9</sup> Arbitration Act No.11 of 1995 which substantially follows the provisions of the UNCITRAL Model Law.

<sup>10</sup> The Consumer Affairs Authority Act No 09 of 2003

emerging in various jurisdictions and would be a more convenient way to deal with the Online Dispute Resolution (ODR) has been defined to mean utilizing information technology to carry out alternative dispute resolution<sup>11</sup>. There are many jurisdictions which have already undertaken the implementation of practices of ODR. Some of them are EU, United States, United Kingdom and New Zealand etc. The EU has a significant background with regard to its ODR platforms which were opened in February 2016. In May 2013, EU passed Regulation 524/2013 for the purpose of establishing ODR platform for the consumer disputes, which undertook the task of establishing, testing, maintaining and funding the ODR platform since June 2013 up to January 2016. EU estimated ODR practice will save consumers 25 billion euros per year. Simply ODR in EU remains as a single junction where consumers and traders who seek for the ADR through the internet can be accessed electronically. 'Online Sales and Service Contracts' are covered through the practice and the platform helps determine suitable ADR entity to settle-down their disputes.

Within just one year, ODR practice throughout the EU nations was considerably effective and was welcomed by the consumers and traders. As by the end of 2017, EU ODR platform hits 1.9M unique visitors and entertained 1/3 of the Complaints were in the nature of cross-border. Further, 300 ADR entities from 26 Member States were accessible through the Platform. Similarly, the traders in the EU from all over the sectors too were interested to comply with the practice as illustrated in the figure below (European Commission, December 2017).

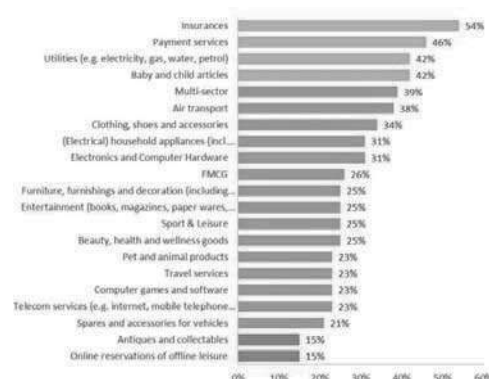
## RECOMMENDATIONS

As the analysis clearly provides the significant benefits of ODR, it is highly recommended to introduce the

<sup>11</sup> Farah C, *Critical analysis of online dispute resolution: optimist, realist and the bewildered*, Computer Telecommunications Law Review, 11(4), 123-128.

disputes related to E-Commerce in Sri Lanka.

Implementation of ODR in to the Sri Lankan context for E-Commerce disputes. ODR would be workable in Sri Lanka especially in a context where a well-balanced statutory framework exist for the resolution of disputes by way of arbitration. In addition, the recognition of the records, documents and signature in the E-form through the ETA and judicial decisions stand to facilitate ODR in Sri Lanka.



(Source: European Commission, December 2017)

Figure 2: Availability of the ODR link per sector

However, Sri Lanka, unlike the EU which is a regional union, is better to initiate the practice of ODR within its national jurisdiction as an introductory measure to settle the disputes which arise from E-Commerce Transactions with the Traders from Sri Lanka. Further, it could be suggested that in Sri Lanka the Arbitration remains as the most commonly used ADR method, the ODR could be initially launched with Arbitration lonely for the first time as to reduce the complexity and background preparations. However the ADR entities should be increased as to redress the disputes in short span of time and they should be well regulated.

Yet, there are numerous additional developments to be flourished in this regard. The Consumer privacy and confidentiality are the utmost important factors which need to be protected with due

care. It is expected that once the Data Protection Bill comes into force these concerns would be addressed. Similarly the ETA, the Consumer Authority Act, and related laws and regulations on ADR (such as the Arbitration Act) need to be amended with flexibility in accordance with the features of the ODR procedure and with the Online Trade regulations. Further, as a key note aspect, the 'Jurisdictional choice' and the 'Clauses and Terms of the Contracts' should be agreed upon by the parties to E-commerce contracts in order to tally with the choice of ODR to hear and determine the

disputes. If not the entire process will be futile.

When advancing with ODR, significant factors such as the Trust, Privacy and Authenticity, Impartiality, Expertise in Technology, Convenience, and Time Frame altogether should be considered as of paramount importance to instigate ODR as an effective alternative choice to Traditional Dispute Settlement Method.

## **CONCLUSION**

Sri Lanka as a developing nation, is yet to develop the economy in various aspects in the upcoming decades. The E-Commerce sphere is going to be one of the influential factors in the near future. However, because of its nature of the business, it is difficult to reduce disputes in the E-Commerce regime, but steps can be taken to resolve those disputes effectively. The ODR is an adoptable alternative practice of dispute settlement in Sri Lanka which would prominently contribute as an effective tool.

Despite numerous risks being involved with the implementation of the ODR, a steadily well-established development over the years like in the EU would help to overcome these hurdles for the establishment and the development process of ODR. Thereby it would contribute to the growth of E-commerce as an effective, efficient, trustworthy platform which would turn as a significant contributor to the economy of the country.



# SICASH

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## Specific Offence of Cyber-Sextortion for Sri Lanka

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### ABSTRACT

With the world rapidly becoming digitalized and the internet being an indispensable part of human life, incidents of cyber harassment including cyber sextortion have also increased. Cyber sextortion often involves a perpetrator threatening to disseminate private sexual images or videos of a victim unless more sexual image/sexual favours, money or other benefit are provided by the victim. This paper analyses the adequacy of current laws in Sri Lanka in comparison with those of Australia in combating cyber sextortion. The analysis reveals that although Sri Lanka lacks specific law on cyber sextortion, some of its existing criminal laws such as the Penal Code provisions on extortion, criminal intimidation, sexual harassment and obscene publications relating to children can be used to a certain extent to prosecute cyber-sextortion. Some provisions of the Cyber Crime Act of 2007, Prohibition of Ragging and Other Forms of Violence in Educational Institutions Act of 1998 and Obscene Publications Ordinance No. 4 of 1927 too can be used to a certain extent for this purpose. Australia, on the other hand, has targeted laws on cyber-sextortion, especially at state level. Analysis of these laws reveal that most of the state laws, except one, are focused on cyber-sextortion which involves threats to distribute sexually explicit images of a victim and are not broad enough to cover forms of cyber-sextortion involving other types of threats. Having mental elements which focus on intent to cause fear or alarm rather than intent to compel the victim to comply with the demands of the perpetrator was also identified as a drawback of these laws. The paper concludes by proposing adoption of a targeted law on cyber sextortion for Sri Lanka and outlining the key elements of a suitable law.

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## INTRODUCTION

Among the many offences committed in the cyber space today, cyber-sextortion has quickly emerged as a growing online phenomenon worldwide.<sup>1</sup> Defined very simply, cyber-sextortion refers to the conduct of threatening to commit some act, generally but not always threatening to release sexually explicit images of a victim, carried out using digital technologies, unless the victim complies with the demands of the perpetrator.<sup>2</sup> It must be noted that the threat could take different forms ranging from a threat to expose sexual images or personal information of a sexual nature to inflict physical harm to victims or someone else. The demand could also take different forms such as a demand for more sexually explicit images/videos, engaging in sexual acts or remaining/getting into a relationship with the perpetrator, monetary or other benefit etc.<sup>3</sup>

Existing research indicates that cyber sextortion is a prevalent and a growing problem worldwide.<sup>4</sup> Existing research further reveals that cyber-sextortion can have devastating effects on the physical well-being, social life and mental health of victims including psychological issues such

as depression, exposure to unwanted sexual advances and harassment, loss of relationships, having to change schools / jobs / residences etc.<sup>5</sup>

Given its prevalence and the seriousness of its impact on victims, cyber-sextortion is a problem that should be tackled through the legal system of a country. In this context, this paper aims to analyze the adequacy of relevant laws in Sri Lanka compared with those of Australia in order to identify any lessons that Sri Lanka can learn from Australia. Australia has been selected for this comparison as most states in Australia have specific laws addressing cyber-sextortion.<sup>6</sup>

This paper consists of four parts. Part One explains the background to and the objectives of the research while Part Two discusses to what extent the existing penal laws in Sri Lanka can be used to prosecute cyber-sextortion. Part Three analyses Australia's laws on cyber-sextortion. Part Four concludes the paper by recommending Sri Lanka to adopt a targeted law on cyber-sextortion and outlining key elements of a suitable law.

## Research Objective and Methodology

The aim of this article is to analyze the

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<sup>1</sup> Roberta Liggett O'Malley and Karen M. Holt, 'Cyber Sextortion: An Exploratory Analysis Of Different Perpetrators Engaging In A Similar Crime' (2020) 1 Journal of Interpersonal Violence.

<sup>2</sup> 'What Is Sextortion? | Federal Bureau Of Investigation' (*Federal Bureau of Investigation*, 2021) <<https://www.fbi.gov/video-repository/newss-what-is-sextortion/view>> accessed 3 December 2020; US Legal, Inc. is one of the oldest and largest US companies which offers a variety of services including legal information, legal products, legal forms, and document preparation and like services; 'Cyber extortion Law And Legal Definition | Us legal, Inc.' (*Definitions.uslegal.com*) <<https://definitions.uslegal.com/c/cyberextortion/>> accessed 4 December 2020.

<sup>3</sup> Anna Brown, 'Sextortion Definition, Sextortion Emails and Help - Cyber Investigations' (*Rexxfield Cyber Investigation Services*, 2021) <<https://www.rexxfield.com/sextortion-definition-sextortion-emails-and-help/>> accessed 5 December 2020.

<sup>4</sup> Anastasia Powell and others, 'Image-Based Sexual Abuse: The Extent, Nature, And Predictors Of Perpetration In A Community Sample Of Australian

Residents' (2019) 92 Computers in Human Behavior accessed 3 December 2020; Maya Oppenheim, 'Scammers Carrying Out Sextortion Cybercrimes During Corona virus' (*The Independent*, 2020) <<https://www.independent.co.uk/news/uk/home-news/sex-scam-email-fraud-phishing-cyber-crime-coronavirus-lockdown-a9480806.html>> accessed 15 January 2021; 'Online Sextortion: A Cybercrime Increasingly Affecting Employees' (*Controlrisks.com*, 2021) accessed 3 December 2021.

<sup>5</sup> Government Equalities Office, 'Hundreds of Victims Of Revenge Porn Seek Support From Helpline' (2015) <<https://www.gov.uk/government/news/hundreds-of-victims-of-revenge-porn-seek-support-from-helpline>> accessed 17 December 2020; Tonya Howard, 'Sextortion: Psychological Effects Experienced And Seeking Help And Reporting Among Emerging Adults' (PhD, Walden University 2019); Janis Wolak and others, 'Sextortion of Minors: Characteristics And Dynamics' (2018) 62 Journal of Adolescent Health.

<sup>6</sup> Despite the activism in India relating to online harassment in general including cyber –sextortion, India does not have specific laws on cyber-sextortion and nor has its existing penal provisions, which are similar to Sri Lanka, have been used to prosecute cyber-sextortion.



adequacy of criminal laws in Sri Lanka in comparison with those of Australia in combating cyber-sextortion and to identify the lessons that Sri Lanka can learn from Australia in designing a suitable targeted law on cyber-sextortion. This study is a library based study involving an analysis of the primary and secondary sources of law in the above-mentioned jurisdictions.

## **SRI LANKAN LEGISLATIVE FRAMEWORK**

Sri Lanka lacks specific laws on cyber-sextortion. In this context, it is pertinent to examine to what extent some of the existing criminal laws in the country can be used to prosecute cyber-sextortion. On a cursory look, it appears that sections 345, 372, 483 and 286A of the *Penal Code* 1883 may be applicable to cyber-sextortion. Section 483 provides that “whoever threatens another with injury to their person, reputation or property etc., with intent to cause alarm or to compel the performance of an illegal act or non-performance of a legal act, commits criminal intimidation”. According to section 43 of the Penal Code, the term ‘injury’ refers to ‘any harm whatsoever illegally caused to any person in body, mind, reputation or property’. Since section 483 criminalizes threatening to injure the person, reputation or property of an individual and since cyber-sextortion also involves threatening various harms to a victim including threats to distribute sensitive images, threats to cause physical harms etc, it can be argued that this section is broad enough to cover any type of cyber sextortion. Although no explicit reference is made to sextortion nor to cyber sextortion, this provision could arguably be applied in cases of cyber sextortion. However, current mens rea element of the section may not be broad enough to cover all types of sextortionists as some sextortionists may not have the intentions mentioned in the section but rather just an intent to compel the victim to comply with their demands.

Section 345 on sexual harassment too can be applied to cases of cyber –sextortion. Section

345 provides that whoever by assault or use of criminal force sexually harasses another or by use of words or actions causes sexual annoyance or harassment to such other person commits the offence of sexual harassment. Since cyber sextortion involves using threats to harass a person such as threats of going public with questionable images, etc., it can be argued that cyber sextortion falls within the purview of this section as well. It is notable, however, that when proving a charge under this provision, the prosecution would have to prove that the threats made by the defendant actually caused harassment to the victim. In cyber-sextortion, the act of threatening itself should be sufficient for the commission of an offence irrespective of the impact of such threat on a victim.

Section 372 of the Penal Code which criminalizes extortion can also be used to prosecute cyber–sextortion to a certain extent. It provides that a person is guilty of extortion where he/she puts another in fear of injury and thus induces the other to deliver any property or valuable security or anything signed or sealed which may be converted into a valuable security. This section, arguably, could cover cases of cyber-sextortion which involve a perpetrator threatening to distribute intimate images/videos of a victim or threatening to harm the victim in any other manner unless the latter pays money or provide any property. However, lack of a definition of the term ‘property’ in the section, casts doubt as to whether intimate images and videos of a victim would constitute property for the purposes of this section. Furthermore, this section would, arguably, not be applicable to certain cases of cyber extortion, namely cases where the demand of a sextortionist comprises of a demand that the victim remains in a relationship with the perpetrator or engages in sexual activities with them.<sup>7</sup>

Section 286A of the Penal Code introduced through the Penal Code (Amendment) Act (No. 22 of 1995) can be regarded as a

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<sup>7</sup> Centre for Policy Alternatives, 'Legal Reform to Combat Sexual and Gender Based Violence' (2020) 25.

provision applicable to cyber-sexortion committed against children. The section criminalizes, *inter alia*, persuading, inducing or coercing any child to pose or model for or appear in any obscene or indecent photograph or film, or selling, distributing or having in possession any such photograph or video. The section further provides that a 'child' means a person under the age of 18 years and 'film' includes any form of video recording. Thus, this section can apply to instances of cyber-sexortion where a sextortionist threatens and coerces a child to provide intimate photos or videos of themselves. It can also capture perpetrators who threaten to distribute intimate photos/videos of children as they would have such photos/videos in their possession, and as possession of such items itself is an offence under this section.

In addition to the above, section 4 of the Computer Crime Act No.24 of 2007 which criminalizes unauthorized access to a computer or any information held in a computer knowing or having reason to believe that he has no lawful authority to secure such access and with intention to commit an offence under any law, can also be used in certain cases of cyber-sexortion, i.e. where the sextortionist has obtained victim's images/information through unauthorized access with the intent of committing criminal intimidation, extortion etc. However, the section cannot be used for prosecuting all cases of cyber-sexortion as the conduct criminalized in this section is unauthorized access to information. Similarly, sections 2 and 3 of the Prohibition of Ragging and Other Forms of Violence in Educational Institutions Act No. 20 of 1998 could also be used for prosecution of cyber-sexortion if it involves students and members of staff at educational institutions falling within the scope of this Act. Section 2 of the Obscene Publications Ordinance No. 4

of 1927 which criminalizes, *inter alia*, making, producing or having in possession for trade purpose/for distribution/for public exhibition, obscene writings, drawings, prints. . . . photographs, cinematographs etc too could arguably be used for prosecuting instances of cyber-sexortion involving threats to distribute sexually explicit images. As the perpetrator in such cases would have sexually explicit/intimate images/videos in their possession for the purpose of distribution or public exhibition, their conduct would fall within the purview of this section.

### AUSTRALIAN LEGAL FRAMEWORK

Unlike Sri Lanka, Australia, both at federal and at state level has laws which are applicable to cyber-sexortion.<sup>8</sup> At the federal level, section 474 of the federal Criminal Code of 1995<sup>9</sup> criminalizes several types of conduct that amount to crimes taking place in virtual platforms. Section 474 (17) provides that a person is guilty of an offence if the person uses a carriage service<sup>10</sup> and he or she does so in a way that reasonable persons would regard as being, menacing, harassing or offensive. As cyber-sexortion can be regarded as using the digital technologies in a menacing way, this section can apply to cyber-sexortion as well.

However, it is the state laws in Australia which are more explicit and are directly applicable to cyber-sexortion. Out of the different state laws, this paper examines in detail the provisions of New South Wales, Northern Territory, Australian Capital Territory and Western Australia as they appear to be relatively clearer and more comprehensive than those of other states.

New South Wales (hereinafter referred to as NSW), Northern Territory (hereinafter referred to as NT) and Australian Capital

<sup>8</sup> See for instance sec 41DB of the Summary Offences Act of 1966 (VIC), section 91R (2) of the Crimes Act 1900 (NSW), section 208AC of the Criminal Code Act 1983(NT), section 72E of the Crimes Act 1900 (ACT), section 26DA of the Summary Offences Act 1953(SA), section 338A of the Criminal Code Act Compilation Act 1913 (WA) and section 192 of its Criminal Code Act 1924 (Tas).

<sup>9</sup> Janis Wolak and others, 'Sextortion of Minors: Characteristics and Dynamics' (2018) 62 Journal of Adolescent Health.

<sup>10</sup> In the federal Criminal Code Act a 'carriage service' is given the same meaning it has in the Telecommunications Act 1997 and means 'a service for carrying communications by means of guided and/or unguided electromagnetic energy.'

Territory (hereinafter referred to as ACT) have almost identical provisions on cyber-sexortion contained respectively in section 91R (2) of the Crimes Act 1900 (NSW)<sup>11</sup>, section 208AC of the Criminal Code Act 1983 (NT)<sup>12</sup> and section 72E of the Crimes Act 1900 (ACT).<sup>13</sup> The essence of these provisions is that a person who threatens to distribute an intimate image of another person without the consent of the other person, with intention to cause that other person to fear that the threat will be carried out, is guilty of an offence. Existence of the image for real and actual fear that the threat would be carried out is immaterial for the commission of the offence. The threat may be made by any conduct, and may be explicit or implicit, and conditional or unconditional. The term “distribute” is defined to include sending, supplying, exhibiting, transmitting or communicating to another person or making available for viewing or access by another person, whether in person or by electronic, digital or any other means.<sup>14</sup> These provisions can clearly capture cyber-sexortionists who threaten to distribute intimate images of a person irrespective of what they demand from the victim. However, cyber-sexortionists who threaten other harms to victims such as physical harms may not fall within the purview of these provisions.

In terms of the requisite *mens rea*, NSW and the NT require intention to cause fear that the threat would be carried out while in ACT the mental element can either be intention or recklessness. Thus, in ACT the offence is broader in scope and is capable of capturing even those sextortionists who may have an intent to gain a benefit or intent to compel compliance by the victims and be indifferent as to whether any fear is caused in the victim.

In Western Australia (hereinafter referred to as WA) section 338A of the Criminal Code Compilation Act 1913<sup>15</sup> provides that any person who makes a threat with intent to

gain a benefit or to cause a detriment to another or to prevent performance of a legal act or to compel the performance of an illegal act, is guilty of a crime. Section 338 defines the term ‘threat’ to include a threat to cause any harm or detriment to any person or property including distribution of intimate images of any person other than the distributor.<sup>16</sup> The term distribute is defined in section 221BC to include a range of ways in which distribution can occur including ‘making the image available for access by electronic or other means’ such as by posting on social media, uploading to websites etc. It is evident that these provisions, read together, can clearly apply to cyber-sexortion cases involving threats of distributing intimate photos as well as threat of other harms. Since the requisite *mens rea* under this section includes intent to gain a benefit it could be argued that this is broad enough to capture all types of cyber-sexortionists as they all would have an intention of gaining some benefit whether in the form of more intimate images, money, sexual favours or otherwise.

## CONCLUSION AND RECOMMENDATIONS

This paper analyzed the adequacy or otherwise of criminal laws in Sri Lanka in comparison of those in Australia in combating cyber-sexortion. The analysis revealed that although Sri Lanka lacks targeted laws on cyber sextortion, some of the existing criminal law, especially, sections 345 (sexual harassment), 372 (extortion), 483 (criminal intimidation) and 286A (Obscene publications relating to children) of the Penal Code can be applied in cases of cyber-sexortion to a certain extent. Out of these sections 483 on criminal intimidation appeared to be the most comprehensive despite some limitations regarding the *mens rea* element. In addition, it was also seen that certain provisions of the Cyber Crime Act of 2007, Prohibition of Ragging and Other Forms of Violence in

<sup>11</sup> Crimes Act 1900 (ACT)

<sup>12</sup> Criminal Code Act 1983 (NT)

<sup>13</sup> Crimes Act 1900, s 72E.

<sup>14</sup> Crimes Act 1900, s 91N; Criminal Code Act 1983, s 208AA.

<sup>15</sup> Criminal Code Act Compilation Act 1913 (WA), s 338A.

<sup>16</sup> *ibid* s 221BA.

Educational Institutions Act of 1998 and Obscene Publications Ordinance No. 4 of 1927 can be applied to cyber-sextortion to a limited extent.

In the case of Australia, it was seen that states have laws which are more explicit and directly relevant to cyber-sextortion. Out of laws in different states, those of New South Wales, Northern Territory, Australian Capital Territory and Western Australia were analyzed in detail. This analysis revealed that the laws of NSW, NT and ACT can apply to cyber sextortion cases involving threats of distributing intimate images, these are incapable of capturing cases involving threats of other harms. Furthermore, it was also seen that the *mens rea* element of the offences of NSW and NT was rather narrow and not capable of capturing certain cyber-sextortionists such as those who are indifferent as to whether any fear was caused in the victim. The relevant law in Western Australia is comprehensive enough to capture cyber-sextortion instances involving not only threats to distribute intimate images/videos but also threats to cause other harms, and the *mens rea* element is also broad enough to capture almost all types of cyber-sextortionists.

Given the limitations of the existing criminal laws of Sri Lanka in capturing all forms of cyber-sextortion, it would be advisable for Sri Lanka to adopt a specific law on cyber-sextortion or to adopt a criminal provision which targets online harassment in general and is broad enough in scope to capture all types of online harassment including cyber-sextortion. If a targeted law on cyber-sextortion is to be adopted, the drafters of such law are recommended to consider the following points. Firstly, the proposed offence should focus on criminalizing the conduct of making a threat to carry out some

act unless the person to whom such threat is directed complies with the demands of the maker of the threat. The threat could include but should not be limited to a threat to distribute intimate images/videos of a victim, to harm the victim or someone related to the victim etc. The demand too could include but should not be limited to demands for sexual favours, for money or a demand to start/remain a relationship with the maker of such threat etc. However, for the conduct to be classified as sextortion, the threat or demand should have a sexual dimension. Secondly, it is recommended to have intention to compel the victim to comply with the demands of the perpetrator as the *mens rea* element of the offence. As was seen in the above discussion of Sri Lankan and Australian law, having intention to cause alarm or fear that the threat will be carried out as a *mens rea* element can have the effect of some sextortionists falling outside the purview of the law. One may argue that intent to compel compliance with a demand is synonymous to an intention to cause alarm. However, it must be noted that there is a qualitative difference between the two, and that intent to cause alarm involves an intent to cause fear/distress whereas an intent to compel compliance is more about pressurizing or forcing someone to do a particular act rather than causing fear or distress. A sextortionist may intend to force someone into compliance without having an intention to cause any fear/distress in the victim. Thirdly, since the offence relates to sextortion carried out using digital technologies explicit reference should be made in the law to the involvement of digital technologies either for making the threat or carrying out the threatened act. Finally, the offence should carry a penalty sufficient to act as a deterrent to potential perpetrators.

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<b>Table of Legislation: Sri Lanka</b>
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## The Covid-19 and Public Law of Sri Lanka

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### ABSTRACT

When the novel corona virus 2019 pandemic hit the countries world over and ours, it was a dreadful scenario as to how we would be handling the crisis and safeguard the lives of people with minimum hardship to the people and maximum benefit to the country. In this study, it is considered whether the government handled the pandemic crisis effectively from the public health perspective and also from the public law perspective, in particular from the standpoint of rule of law. The approach to research is qualitative and library-based. The study shows that the government had necessary laws in place to effectively and efficiently deal with the pandemic from the medical and public health standpoint as well as from the rule of law perspective. However, the study concludes that while the government handled the covid-19 pandemic in a creditable manner from the public health perspective, its score card is dismal looked at from the rule of law perspective.

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## **BACKGROUND**

The corona virus disease 2019 (covid-19) which is declared a global health emergency swept over the countries worldwide like wild fire. It shook, and continues to shake, the human race to its core. This pandemic has been the worst killer and had already taken its toll on the human lives irrespective of their nationality, colour, religion, race, gender, culture, belief, etc. Countries were unprepared to face this killer virus and they attempted to take various actions to deal with this pandemic in order to prevent it from spreading among their populace and to save their people from this deadly decease. The actions taken by countries world over have differed and there had been many trial and error methods adopted by some countries to curtail its spread if not eradicate it from the earth. Almost ten months have gone by, still no country has come up with an efficient and effective vaccine against covid-19; nor has any country discovered or invented any effective medicine to treat those affected. What has been irrefutably and indisputably 'successful' is the outcome of the swift steps taken by the Sri Lanka government to deal with this deadly pandemic. Sri Lanka has been rated amongst a very few countries which have successfully dealt with the pandemic in a remarkably effective manner.

## **JUSTIFICATION/OBJECTIVE**

Be that as it may, the country has witnessed during this period the suspension, imposed by the government, of civil liberties and freedoms of individuals and families when dealing with this pandemic. People were made to stay indoors through the 'imposition of curfew' at times for somewhat prolonged periods of five days at a stretch; some were arrested on the purported ground that they had violated the 'curfew' rules. Some of the measures that the people were made to undergo have not been gone through even during the times when the country witnessed destructive civil war in the recent past. Sri Lanka was under a state of emergency for more than two and half decades until a few years after the end of the civil war. During the time of war the country was almost ruled continuously under a state of emergency and

by emergency regulations proclaimed by the President. There were many occasions where curfews and closure of areas were introduced in the past. But, the country had been brought under a state of emergency during these periods.

## **RESEARCH PROBLEM**

However, there was no proclamation of a state of emergency during the present period of pandemic; nor were there any emergency regulations made by the President to deal with the dangerous virus. Similarly no curfew orders were introduced by the President as enabled by the law. There arise naturally the questions whether the actions taken by the government to curtail the liberties and freedoms of the people during the handling of the covid-19 pandemic are underscored by the law of the land and whether the rule of law was an inevitable casualty at the altar of swift and decisive action to ensure that the pandemic did not take a heavy toll on the lives of the people of this country. These questions represent genuine concerns as the country went through this pandemic in the absence of two important features. One, the Parliament was dissolved prematurely by the President in March though it could have legitimately gone on till September. Two, there was no proclamation of a state of emergency, no emergency regulations to deal with the situation and no order of curfew made by the President under the relevant laws and constitutional provisions.

The main objective of this research is to find out whether the actions of the government in tackling the threat of pandemic, though effective, were consistent with the principles underpinning the rule of law and good governance. It is instructive to find out whether the government 'took the law into its own hands' when dealing with the covid-19 crisis. It is also necessary to evaluate whether it failed to represent good governance when the elected representatives of the prematurely dissolved Parliament were not re-convened so that Parliament could exercise its constitutional functions during the crisis. Interestingly, the President and the government were not accountable and responsible practically and theoretically to

any elected body during this period; if at all the actions of the government could have only been subjected to the scrutiny of the Judiciary. Did these undermine the rule of law and the principles of good governance?

### **Working Hypothesis and Theoretical Framework**

It appears that the rule of law was compromised during the handling of the covid-19 pandemic by the government, although the containing and dealing with the covid-19 pandemic was effective and generally successful. While on one front, viz., the maintenance of public health, it will be evident that the rule of law, in its formal conception and substantive conception, was observed, on the other front, viz., upholding the rule of law, the law of land was ignored in such a grave manner that the constitutionally guaranteed fundamental rights were infringed without valid legal authorization. The theoretical framework is the rule of law as it is understood in the sphere of Public law – both constitutional and administrative law.

### **Factual Matrix**

Before analyzing the legal or constitutional validity or otherwise of actions that transpired during this period, it is desirable to take stock of some of the facts and government's responses that resulted during this period. When the first ever detection of a Chinese tourist was reported in March 2020 the government authorities took steps to isolate the person as well as to contact trace persons who had come in contact with the affected tourist. When it was known that the tourist had gone to various places and mingled with people the contact tracing and isolating of any suspected persons from others were carried out.

These actions were taken by the authorities under the existing laws relating to prevention of contagious diseases. The government used primarily the provisions of the Quarantine and Prevention of Diseases Ordinance, No. 3 of 1897 which was last amended in 1952 and the Public Security Ordinance No. 25 of 1947 which was last amended in 1988. Using these two pieces of legislation and making subordinate legislation under them, the government took decisive and effective steps

to deal with the situation. Some of the steps taken by the government included i) subjecting people to mandatory testing for corona virus, ii) hospitalizing those who were found to be infected, iii) conducting contact tracing, iv) quarantining those who are suspected to have come in contact with corona virus affected persons to designated isolation centres, v) ordering those who might have come in touch with persons who are not proved to have got the virus but who have been suspected to have come in contact with infected persons to self-quarantining in their respective residences and restricting access to those homes from outsiders, vi) issuing public health guidelines such as sanitizing hands and fingers, wearing of face masks, maintaining social distancing, etc., to be followed during this period, vii) locking down geographical areas such as provinces, districts, divisions, towns, villages, etc., viii) preventing social gatherings and public gatherings, ix) closing down buildings and offices, x) stopping transport services in general as well as inter districts and provinces, xi) ordering the closure of shops, restaurants, cinemas and other places where the public gather xii) imposing curfew both island wide and in particular localities, etc.

It is common ground that the government has handled the deadly corona virus pandemic very efficiently and effectively to curtail and contain its deadly effects and spread in the country. From the standpoint of public health, the response of the government has been very successful. Compared with other well-developed countries in the world including our neighbouring country, the dangerous effects of this pandemic are very minimal and the country has been praised for its handling of the covid-19 by the WHO and other bodies. These were accomplished mainly through regulations and directives issued under the Quarantine and Prevention of Diseases Ordinance and the Public Security Ordinance. While the Minister in charge of the subject of health used the provisions of the Quarantine and Prevention of Diseases Ordinance to issue Regulations, the President made use of the provisions of the Public Security Ordinance to issue Orders and Directives.

## ANALYSIS

Notwithstanding the creditable success in containing the covid-19 in the country, the issue is whether the government acted ultra-virus when it made use of the provisions of the Quarantine and Prevention of Diseases Ordinance (QPDO), a law passed in 1897 – almost 125 years ago – and certain provisions of the Public Security Ordinance (PSO) when it decided to handle the dangerous pandemic in the country. A related issue is whether the failure of the government to re-convene the dissolved Parliament when such a dangerous pandemic was threatening to sweep down on the country and when the government decided to take some drastic measures curtailing the liberties and freedoms of the people. These will be looked at accordingly.

The QPDO was enacted with the purpose of making provision for preventing the introduction into the country of the plague and all contagious or infectious diseases and for preventing the spread of such diseases in and outside the country.<sup>1</sup> Towards the achievement of this purpose, the QPDO empowers the Health Minister to make regulations for the prevention of all contagious or infectious diseases being introduced into the country and for the prevention of the spread of such diseases in and outside the country.<sup>2</sup> The QPDO specifically authorizes the Minister to make regulations which provide for, among others, isolating persons having contagious or infectious diseases, for prescribing the mode of burial or cremation of any persons dying of the disease, for removing persons with such disease to hospitals or other places for medical treatment or for their detention.<sup>3</sup>

Many regulations have been made under the QPDO since 1925 on various matters to give effect to the objects of the Ordinance. Some of them have been subsequently amended. The regulations contain 'Interpretation sections' providing interpretation to terms used

therein. The term 'quarantinable disease' is given an interpretation which means 'plague, cholera, smallpox, or yellow fever, or **such other disease as may be declared to be such by the Minister**' by notification in the Gazette<sup>4</sup>.

First of the Regulations made by the Minister of Health under the QPDO after the detection of a tourist having been infected with corona virus was the one made on 20<sup>th</sup> March 2020. By this gazette notification the Minister declared that corona virus disease 2019 (COVID-19) is a quarantinable disease.<sup>5</sup> The Minister amended, by Regulations<sup>6</sup> made on 25<sup>th</sup> March 2020 the terms 'proper authority', 'diseased locality', 'Port Health Officer' found in the existing Regulations. The effect of these amendments is that the Director General of Health Service is declared to be the 'proper authority' in respect of the whole of Sri Lanka and other specific office-bearers are declared to be 'proper authority' in respect of specific areas or establishments. These areas include those of Municipal Councils, Urban Councils, Pradeshiya Sabhas, a port, and an airport, and establishments include any military, naval or air force establishment.

The above steps taken by the Minister of Health are clearly *intra vires* the powers entrusted with her and consistent with the rule of law. However, the Minister's decision to add a new regulation, viz., regulation 61A by Regulations made on 25<sup>th</sup> March 2020 is problematic. Regulation 61A made it mandatory that the corpse of any person who has died or is suspected to have died of covid-19 is cremated. It permits the ashes of the corpse to be handed over to the next of kin. This is in sharp contrast to the original regulation 61 which permitted the burial of the corpse of a person who has died of any disease which is of contagious, infectious or epidemic nature. The new regulation 61A goes against the letter and spirit of the QPDO

<sup>1</sup>Refer to the 'Long Title' to the Quarantine and Prevention of Diseases Ordinance, No 3 of 1894 (QPDO).

<sup>2</sup>S. 2 of QPDO.

<sup>3</sup>S. 3 (1) (g) (i) & (l) of QPDO.

<sup>4</sup>Regulation 1 of Sections 2 & 3 of Quarantine Regulations under the QPDO. [Cap.222]

<sup>5</sup>Extraordinary Gazette No. 2167/18 of the Republic of Sri Lanka. (dated 20. 03. 2020).

<sup>6</sup>Extraordinary Gazette No. 2168/6 of the Republic of Sri Lanka. (dated 25. 03. 2020).

as well. In terms of section 3 (1) (i) of the Ordinance, the Minister's power to make regulations under section 2 includes regulations for 'prescribing the mode of burial or cremation of any person dying of disease'. The QPDO does not exclude burial; neither was it silent on the issue of burial. To the contrary, the QPDO expressly refers to burial as well.<sup>7</sup> As such, it is doubtful whether the new addition – reg. 61A – could survive judicial scrutiny and come out unscathed in the face of judicial grounds testing the validity of subordinate legislation.

The second issue of concern surrounds the 'imposition of curfew' in the country. A curfew was declared in the entire country on some days and in certain parts of the country on certain other days. It is the Public Security Ordinance (PSO) which authorizes the President to order curfew in the entire country or in any part of it. Under section 16 of the PSO authorizes he can declare a curfew where he considers it necessary to do so for the maintenance of public order. Although the country experienced many periods of total curfew running to even a week, there was no order of curfew declared by the President and published in the gazette. No gazette notification to that effect could be found. However, there were Press Notices issued by the Presidential Secretariat,<sup>8</sup> Government Information Department,<sup>9</sup> Ministry of Foreign Affairs<sup>10</sup> informing that a 'Police Curfew' had been declared<sup>11</sup> and in force in the country. There was no reference to any constitutional or legislative provision which underpins the so-called power of the police to declare curfew in the country and thereby restrict the fundamental rights of the freedoms of

movement, assembly, association, among many other freedoms guaranteed by the Constitution.<sup>12</sup>

Neither the PSO nor the Police Ordinance (PO) confers power to the Police to impose curfew in the country or in any part of it. The purported notice of 'Police Curfew' was being imposed is not borne out of any legislative or constitutional authority. It would have been possible if there had been an emergency regulation made by the President authorizing the police to impose 'local' curfew for a limited purpose. There was no emergency regulation made by the President; nor was there a proclamation of a state of emergency by the President, which is a pre-requisite for making emergency regulations. In the circumstances, it is doubtful whether the curfew which enveloped the entire country on many days and some parts of the country on some other days had been shown to have legislative or constitutional leg to stand. The curtailment of fundamental rights and arrests made for the alleged breaches of curfew rules are suspect as to their legal and constitutional validity. They fall foul of the rule of law.<sup>13</sup>

Another issue which has come up for discussion is the failure on the part of the government to have re-convened the dissolved Parliament when a global pandemic threatened the country. The President had the opportunity of summoning the dissolved Parliament to meet had he proclaimed a state of emergency under the PSO. It could be argued that it was not incumbent on the

<sup>7</sup>S. 3 (1) (i) of QPDO.

<sup>8</sup><https://www.presidentsoffice.gov.lk/index.php/2020/03/30/special-announcement-on-curfew/?lang=en> accessed on 03.10.2020.

<sup>9</sup><https://mfa.gov.lk/declaration-of-police-curfew-island-wide/> accessed on 03.10.2020.

<sup>10</sup>Refer to <https://mfa.gov.lk/declaration-of-police-curfew-island-wide/> accessed on 03.10.2020.

<sup>11</sup>Refer to the statement titled 'DECLARATION OF POLICE CURFEW ISLANDWIDE' dated 20.03.2020 and issued by the Acting IGP at <https://mfa.gov.lk/declaration-of-police-curfew-island-wide/>

<sup>12</sup>Refer to Ground View, *Section 16 of Public Security Ordinance on Curfew and Recalling the Parliament*, [HTTPS://GROUNDVIEWS.ORG/2020/05/03/SECTION-16-OF-PUBLIC-SECURITY-ORDINANCE-ON-CURFEW-AND-RECALLING-THE-PARLIAMENT/](https://groundviews.org/2020/05/03/section-16-of-public-security-ordinance-on-curfew-and-recalling-the-parliament/) accessed on 03.10.2020; CPA, 'Curfew in response to COVID-19: Legal Framework and Relevant Questions in Sri Lanka', <https://www.cpalanka.org/curfew-in-response-to-covid-19-legal-framework-and-relevant-questions-in-sri-lanka/> accessed on 03.10.2020.

<sup>13</sup> Letter under the caption 'HRCSL Recommendations on Regularizing the Imposition of Curfew' sent, among others, to the Secretary to the President by the Chairperson of the Human Rights Commission of Sri Lanka dated 08 June 2020. <http://www.hrcsl.lk/wp-content/uploads/2020/02/curfew.HRCSL-recommendation-final.pdf> access on 03. 10. 2020.



President to have done so, as the existing provisions of the law were sufficient enough to deal with the situation which arose. In fact, the administrative authorities were in a position to handle the situation admirably, except the issue of the imposition of the curfew. But with regard to that, the President could have made use of section 16 of the PSO to declare the curfews and avoided violating the rule of law in the country. One does not understand why this was not done!

## **CONCLUSIONS AND RECOMMENDATIONS**

The public health authorities did handle the covid-19 pandemic in a commendable manner to keep it under relative control and safeguard the people of this country from a tragedy of massive scale, compared with other countries. However, one witnesses a regrettable blemish in their achievement in the regulation made by the Minister to mandate the cremation of corpse of persons who died of this virus. This step failed to appreciate and recognize the religious and cultural susceptibilities of certain segments of the Sri Lankan society; in particular when WHO has recognized, and many countries have been following, both methods of dealing with corpses.

With regard to the imposition of prolonged curfews it is not demonstrated that the government made use of available avenues to make the limitation on the freedoms and liberties constitutional and compatible with the rule of law. It took steps which were not underscored by the existing laws. The government could have used the existing laws instead of the unwarranted and extra-legal steps. In the same way it would have been desirable and in line with good governance, if not mandatory as argued by some petitioners in the Supreme Court,<sup>14</sup> had the President reconvened the dissolved Parliament and permitted a consultative and deliberative process, which includes holding the Executive to be responsible and answerable to its actions, with regard to the major public health threat which was faced by the nation.<sup>15</sup>

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<sup>14</sup>Many Fundamental Rights petitions were filed challenging, among other, the validity of dissolution and the failure to reconvene the dissolved Parliament once the three months' period lapsed from the date of dissolution. Having heard the petitioners, intervening parties and the Attorney General, a Divisional Bench consisting of five judges of the Supreme Court did not grant leave to proceed with the petitions. The reasons for the refusal to grant leave by the Supreme Court were not given as a written Order.

<sup>15</sup> This paper does not consider the issue of whether it was constitutional for the President to have kept the Parliament dissolved and run the country without a Parliament beyond a period of three months. That issue requires a separate study and paper on its own.





# SICASH

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## Protecting Human Rights in Pandemic Situations: An Analysis of International Legal Responses in the Context of 'Covid 19' Outbreak

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### ABSTRACT

In the context of domestic and international legal and institutional frameworks on protecting human rights, the responsibility of guaranteeing the rights of people cannot be entirely cast either on the sovereign States or the international community but a shared responsibility of both. However, how to draw the dividing line between the two has been an issue of legal, moral, political and many other forms. This research aims at examining the legal dimension of the paradigm shift of sovereignty that allows the international community to step into the areas once were determined exclusively as internal matters with no international interventions to be done. In this premise, this research particularly wishes to explore the questions of 'why the matters under the purview of the domestic authorities should be taken over by the international community, what legal doctrine/s would support such a move and how to strike a balance between the two parties to harmonize the potential for disputes among the two with special reference to global pandemic situations such as Covid 19 health crisis. Since the research is a doctrinal analysis, qualitative method is used. Key findings expose that the doctrine of Responsibility to Protect (R2P) is a globally accepted legal response in this millennium that provides a legitimate basis to divide the responsibility between two duty bearers. R2P recognizes that the primary responsibility should lie with the national authorities and in the cases of failure of this, the residual responsibility should be taken over by the international community. Although the ambit of this doctrine is to halt specifically designated mass atrocities against human beings, this research argues to adapt it suitably to guarantee the relevant human rights in circumstances where human rights are grossly violated, such as pandemic situations like Covid 19 health crisis, in par with the relevant international standards.

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## **BACKGROUND OF THE RESEARCH**

Almost every country is currently affected by the escalated global pandemic called Covid 19, which is one of the hardest crises faced by the world in the 21<sup>st</sup> century, in different scales. The very nature of Covid 19 virus is that despite the level of the development of countries it generally poses an unprecedented challenge to the human lives and governance mainly due to the inadequacies of resources, commitment, laws, policies, mechanisms and infrastructure to handle the situation. In spite of the efforts taken by the domestic and international stake holders, the virus has severely affected millions of lives and the systems of governance too are crippled due to the widespread nature of the virus. The difficulty to control is more induced by the fact that no vaccine has been successfully found by the time of this research. Due to the gravity of the crisis, so far, no State is fully able to address the pandemic situation effectively without an external support. Even the well-developed countries in the world, including USA, continue to add the highest numbers of Covid 19 patients and deaths. India, the powerful neighbour of Sri Lanka, is adding more cases to the global statistics and the government of India seems not adequately equipped to arrest the situation soon. France, Germany, Italy, Russia, Spain, and Brazil are some other States affected by Covid 19 with less success in controlling the situation. Human security and rights of the subjects under the sovereignty of the affected States are at risk and it is evident that the responsibility cast on the national authorities cannot be homogeneous but heterogeneous in such situations and require the involvement of external partners. The position of USA has been somewhat hostile towards the involvement of the World Health Organization (WHO). The way that the USA objected against the involvement of such global actors who provide the necessary assistance for people supplementary to the responsibility of the sovereign authority of affected States, required the world to revisit the issues of international interventions in order to shoulder the human catastrophic situations. In this backdrop, the need to share the responsibility among the sovereign

authorities and the international community has become indispensable. The need to shift the traditionally crafted paradigms to new directions is inevitable in global pandemic situations, particularly to protect the rights of people, in the light of relevant international human rights standards. The contemporary pandemic situation has pushed the world to think of a compromise between the responsibility to protect rights and security of people without unduly undermining the traditional well-established roles between the sovereign States and the international community. Hence, some legal responses emerged to make a balance between the conflicting interests due to this paradigm shift. However, the challenges posed by it require to be addressed without leaving painful scars on the world that may throw the civilizations to centuries back if escalates to unlawful and uncontrollable courses of action.

## **JUSTIFICATION AND OBJECTIVE**

In the above setting, the research examines a legal response introduced to share the responsibility among the sovereign States and the international community to protect human rights and human security, namely, the doctrine of the 'Responsibility to Protect (R2P/RtoP)', which offers a platform to divvy the responsibility with minimum harm on the established international legal principles governing the right to self-determination of peoples, State sovereignty, international obligations and scrutiny. Therefore, the research analyses the aptness of the 'Responsibility to Protect' in addressing the Covid 19 pandemic by sharing the responsibility among the two actors by allowing no space to abuse the paradigm shift.

## **Research Design**

This qualitative research, which does a doctrinal analysis, particularly examines secondary data. The legal dimension of the paradigm shift of sovereignty from rights to a responsibility and then to a shared responsibility with the international community is the underlying current of this research, which examines the questions 'why

the matters under the purview of the domestic authorities should be taken over by the international community, what legal doctrine/s would support such a move and how to strike a balance between the two parties to harmonize the potential for disputes among the two.

## THEORETICAL FRAMEWORK

Legality of interventions by the international community on domestic affairs of a sovereign State has been subjected to many debates over the years. The United Nations Charter requires member States to refrain in their international relations from the threat or use of force against the territorial integrity or political independence of any State. The relevant provisions of the UN Charter depict *prima facie* the reluctance of the organisation to permit interventions to the domestic affairs of a sovereign State. Article 2 in general emphasizes the obligation of the UN and its members to act in accordance with the principles included therein. Article 2(1) recapitulates the principle of sovereign equality of all its Members and the need to preserve it. The principal rule on the non-intervention to affairs of a sovereign State is contained in Article 2(4) of the Charter, which makes armed interventions on territorial integrity and political independence of States. This provision is subjected to diverse opinions cast by scholars either as conclusive and not subjected to any limitations or exceptions or due to the exceptions provided in the pursuing Articles of the same text, as not imposing an absolute prohibition.<sup>1</sup> The members of the UN agreed to be members bound by a set of common standards and legal provisions and to permit international scrutiny of their behaviour by consenting to many international obligations such as treaties and customary law. Article 2(7) extends the prohibition against international

interventions to the United Nations itself too, but subject to the pursuing articles on right to self-defense and collective security. Hence, the organs of the UN also should respect essentially internal matters under the purview sovereign States. This provision confirms the strong intention of the founders of the Charter on strictly limiting interventions or use of force against another sovereign State. However, there is no specific criterion for determining the underlying meanings of the phrase 'matters which are essentially within the domestic jurisdiction of any State'. Since there is no precise authoritative definition or list of acts as to what matters should be considered as essentially within the domestic jurisdiction of any State, it leaves for a case-by-case determination based on the facts of each case. In the absence of a definition or a criterion to decide, it can be implied that this provision does not prohibit all actions and decisions of the UN on matters inside territorial boundaries of a State. The matters falling within the scope of Charter VII of the Charter are understood with no doubt as permissible for the organisation. Similarly, if 'an international concern' could be invoked from a matter, under the purview of a sovereign State traditionally known as purely domestic, based on its impact on international peace, security and stability the UN should be able to take appropriate actions to halt or prevent such activities by a sovereign State. Another matter relating to the interpretation of Article 2(7) is that who has the authority to decide whether a matter is 'essentially within the domestic jurisdiction of a State'. This uncertainty has paved the way for two different viewpoints; some argue that it should be decided by the State subject to the act of intervention and the contrary opinion held by others is that the organs of the UN in the exercise of their individual functions should have the competent authority for such determinations.

Several doctrinal responses have been were crafted in the journey of finding sustainable responses to strike a balance between the need for intervention and the protection of State sovereignty. Among those most notable and acceptable one has been the doctrine of Responsibility to Protect. The report

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<sup>1</sup> Article 51 of the UN Charter provides that; *Nothing in the present Charter shall impair the inherent right of individual or collective self-defence if an armed attack occurs against a Member of the United Nations, until the Security Council has taken measures necessary to maintain international peace and security.* Chapter VII of the Charter provides authority to the UN Security Council to use several forms of interventions ranging from non-military to military interventions

produced by the International Commission on Intervention and State Sovereignty (ICISS) in 2001 introduced the innovative concept of 'the responsibility to protect, as a doctrinal response to define the obligations of States to prevent and respond to mass human rights catastrophes. This doctrine divides the responsibility among the sovereign State and the international community by highlighting the primary responsibility as it rests on the State which experiences the human catastrophic situations. If the State in distress fails to discharge the expected role of responsibility to its own people, international community shoulders the residual responsibility.<sup>2</sup> The Report clarified the shared responsibility should of the two duty bearers; the sovereign State and the international community under three tiers: responsibility to prevent, responsibility to react and responsibility to rebuild.<sup>3</sup> R2P should begin with preventive measures. As it is not easy to prevent human catastrophes in many occasions. Therefore, R2P requires the duty bearers to move to the next tire, the responsibility to react, should the prevention gets fail. Reactions may begin with less coercive measures such as sanctions and international prosecution and as necessitate to move to military intervention in extreme cases. This doctrinal response was able to attract the world attention, particularly the UN. The UN Secretary-General commissioned a High-Level Panel to examine the threats, challenges and change facing the Security Council and released its report titled 'A More Secure World: Our Shared Responsibility.'<sup>4</sup> The adoption of the concept by this panel indicates the momentum occurred in endorsing the newly crafted notion of R2P. In 2005 World Summit of the General Assembly on the occasion of the sixtieth anniversary of the founding of the United Nations in 2005 the notion of R2P was adopted unanimously and documented in the 'World Summit

Outcome Document (WSOD) of 2005'. However, at this Summit the scope of the R2P notion was limited to four international crimes, namely to genocide, war crimes, ethnic cleansing and crimes against humanity in the paragraph 138 of the WSOD and urged the collective responsibility of the international community in such catastrophic situations and to take appropriate actions, ranging from diplomatic, humanitarian and other peaceful means, and the actions in accordance with Chapter VI and VIII of the Charter, to protect the vulnerable populations from these designated crimes in accordance with three pillar approach added to the original concept.

## ANALYSIS AND FINDINGS

Key findings expose that the doctrine of responsibility to protect is a globally accepted legal response in this millennium, crafted to provide a legitimate basis to divide the responsibility as it recognizes two duty bearers in human catastrophic situations, in case the sovereign States prove fail in protecting the rights and security of people under their jurisdictions. However, the scope of the R2P was subsequently limited to designated mass atrocities to prevent potential abuses to exert strategic purposes by external parties. However, this research argues that despite the deficits of R2P in cases where the national authorities prove unable to take timely and decisive measures in cases where the populations are at the verge of gross violations of their rights and human security is in danger. If so, the international community should be allowed to provide supplementary actions as appropriate to prevent or end the sufferings of the people at such risk.

## CONCLUSIONS AND RECOMMENDATIONS

The legal dimension of the paradigm shift of sovereignty from rights to a responsibility and then to a shared responsibility with the international community is explained by the doctrine of responsibility to protect. Although its legality was questioned at a time with the adoption of the doctrine at the World Summit of the UN General Assembly of 2005, it is now widely recognized as a legal concept that the

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<sup>2</sup> See the Core Principles of R2P, ICISS Report, The Responsibility to Protect, p.xi

<sup>3</sup> Ibid

<sup>4</sup> A More Secure World: Our Shared Responsibility. Report of the Secretary-General's High-Level Panel on Threats, Challenges and Change (New York: United Nations, 2004), UN Doc. A/59/565, 2 December 2004, p. 85

UN Member State should adhere to. The ambit of this doctrine is limited at the World Summit of 2005 to halt specifically designated mass atrocities against human beings. However, it is argued that the scope of the doctrine should be extended to human catastrophic situations posed by both human made and natural disasters and other heinous atrocities in which either national authorities do not have the capacity to handle by their own or in the cases where they are the violators of human rights or/and human security and are not willing to take appropriate actions. Hence, this research concludes by proposing that the doctrine of R2P should be adapted suitably to guarantee

the relevant human rights in specific circumstances, such as pandemic situations like Covid 19 health crisis, in par with the relevant international standards. Having witnessed the seriousness of Covid 19 disaster, the world should accept the reality that in cases where the capacity of the sovereign States is exceeded and unable to effectively address the catastrophes, they should not let the population be affected by hanging on the obsolete principles based on absolute rights of sovereignty. On the other hand, the interventionist efforts of the residual duty bearers, the international community, should prove as absolutely genuine and non-abusive.

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## Victim-Friendliness of the Personal Injury Law in Sri Lanka: A Critical Analysis

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### ABSTRACT

A legal regime which is insensitive to socio-economic impact of its application on the community over the time, is not sustained. Such laws are abrogated by the society by ignoring them. Personal injury law is also facing the same problem in Sri Lanka, even though the laws applied are multifaceted in nature. The main argument which is brought against this calamity is that it is not victim-friendly due to several reasons. In fact, victim-friendliness is not a standard in law. Finding a legal definition to recognise the elements of victim- friendliness is problematic. However, it is understood that 'user-friendliness' is similar to the concept of victim-friendliness in context. It is further examined that the concept is evolving in the area of Criminal law. The blow-out is apparent in South African countries and India in view of victim's right to access to justice. Using the main features of a user friendly regime, New Zealand has introduced a new legal model to govern personal injury victims. This study examines whether the same concept can be used to enhance the rights of the victims of personal injury, for obtaining an adequate compensation in Sri Lanka, in comparative perspective with New Zealand.

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## INTRODUCTION

Personal injury victims are a special category of people who have been attracted special attention of the law makers because they are physically and psychologically vulnerable due to their injuries. Permanent or partial disability may be the immediate effect of these injuries. A serious personal injury may affect the family of a victim as a unit. Also, it may affect the society at large in various means, if the matter is not attended in a correct manner. Victims may be suffering from lifetime physical difficulties due to ignorance of their own, as well as acts or omissions of others. Bread winners, parents and guardians, widows and widowers, children and other dependents, intended spouses are among the victims. Once it is observed that,

*In the case of a road traffic injury, in addition to the direct financial burden on the family in the form of medical expenses, a less visible, nevertheless considerable, loss also occurs. The debilitation of a working individual causes loss of productivity, especially if he is the breadwinner. The family then suffers a major financial setback. The cost incurred due to the family members taking time off work to care for the injured also can't be ignored. All these expenses add up to a considerable amount of money and resources. This ultimately burdens the society as a whole.<sup>1</sup>*

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<sup>1</sup>SD Dharmaratne, AU Jayatilleke & AC Jayatilleke, Road traffic crashes, injury and fatality trends in Sri Lanka:1938–2013 (Bull World Health Organ, 93(9) 2015) pp 640–647.

<<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4581645/>>; An article

based on this research is found at <<http://www.dailymirror.lk/article/Preventing-accidents-Authorities-need-to-tighten-their-seat-belts-134350.html>> accessed on 14.03.2019; Further, Dr. Mahipala stated about 80,000 road accidents occur in Sri Lanka annually and average 6-8 persons die per day from road accidents. The Health Ministry spends between Rs. one million to ten million to treat road accident victims and the annual budget exceeds Rs. 3.5 billion. A major road accident occurs in Sri Lanka every 10 minutes. – Daily mirror, 2012. See more at:

The role of the State is important in this point. The State is the main provider of social welfare under specific guidelines to ensure social protection. The State spends millions of monies to treat people in government-based hospitals around the country. <sup>2</sup> Data is not available for the expenses spent by the State for the recovery of injuries for every accident. A welfare State cannot ignore any victim for the mere fact that the accidents are caused without fault on the part of anybody and there is no offender. There can be no party who can be responsible, but the State treats the victim of injury equally. However, demanding social services from the State itself, is questioned due to its other responsibilities.

The socio-economic impact that the accidents brings to a family and society does not vary the impact connected to fault and non- fault of the doer. It is very serious, painful and far beyond thinking. The issue is how to address legal implications of the problem on a rational basis.

### Redressing Personal Injury Victims in Sri Lanka; The Set Up:

The legal arrangement of redressing personal injury victims in Sri Lanka, is multifaceted. The main action for damages is, the *Aquilian* action which is founded on Roman Dutch law principles with a blend of several English law concepts as the case may be. Other than that, this is supplemented with two judicial alternatives, to name, Criminal action and Fundamental Rights Action. Both the actions do not guarantee compensation *per se*, for the real damage occurred to the victims. Those are rather functioned to entrust rights against public safety, and assure basic rights are guaranteed under the Constitution. Compensating the victims are a secondary

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<[http:// www.dailymirror.lk/21469/laws-coming-to-protect-thirdparty-victims#sthash.KK760umy.d p u f](http://www.dailymirror.lk/21469/laws-coming-to-protect-thirdparty-victims#sthash.KK760umy.d p u f)>

<sup>2</sup>For example, national health services are provided free of charge, medical assistance, self-employment, retirement schemes and Day Centers for needy can be shown.

aspect of it. However, in the Criminal justice system, victims of criminal injuries are compensated through a recently introduced statute subject to upper limits.<sup>3</sup> The ability to sue the same person for damages for future losses in a personal injury case is ignored, whereby the victims are unaware of the civil procedure and the time bar. Therefore, it has no connection with the cases filed in the Civil law court, and they are out of the scope of the Act.

The other methods of recovery of damages in personal injury law are Insurance and Social security mechanisms. The general idea of the concept of insurance is transferring the financial burden of the risk to a third party. In fact, this is recognized as a popular market instrument which is available in case of damage or loss due to its multiple roles, though twofold *per se* as First Party Insurance and Liability Insurance. The former activates as a lifetime policy that holds the coverage of protection over specific loss or damage or illness or death in exchange for a periodic payment. However, those who can afford the damage against future loss have the potential of affording such a policy in a community and the remedy is not ensured and generalized to all. The latter, liability insurance or third-party insurance is compulsory in some critical areas of application of law as is in the Motor Traffic Act.<sup>4</sup> More or less in other areas it is selective though, insurance is popular because the insured is protected from being held responsible for the other party's damages. There are different types of liability insurance policies available in the market, however, in reality, to make an insurance company liable, it is required to prove fault on the part of the insured (the defendant) in the normal process of the court, i.e.; a road traffic case. If not, victim compensation is not *per se* guaranteed under the compulsory scheme of insurance.

Instead, social security provides for a safety net for the people and involves several schemes introduced by the governments from time to time. For instance, pension schemes introduced by governments, tax reductions, grant of loans with low interests or without interests. This solution is highly used in developed countries in the modern world, but the system has not been properly established here to date.

In consequence, the Sri Lankan legal system for recovery of damages for personal injury is complex in its application. Inadequacy of the victim's knowledge about the system and the substantial principles, and the knowledge and the attitude of the persons involved in the area and procedural barriers are the fundamental questions which could be raised in this point. Thus, it is doubtful whether such a system addresses the real issue of personal injury compensation in a friendly and effective manner.

### **What Constitutes 'Victim-Friendliness' in a Personal Injury Case?**

Victims need to return to a normal life that he/she had before the incident. It is not an easy task. Caring of victims is totally dependent on the financial capability of the family; if not, the victim will be a burden to the family. The danger involved in a personal injury case may vary. The recovery period of each case may also be differed. The cases of permanent bodily impairment are more serious than death. Thus, depending on the relevance, the victims and the close associates need some financial and psychological support from an external source unless it is sorted out internally.

In an environment where the adversarial system prevails, the system of compensation is not very much supportive to the victims to come out of the agony with less barricades. Thus, victims may be doubled victimised when they opt for litigation. It is clear therefore that the present system is not victim friendly in promoting access to justice and or a feasible remedy.

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<sup>3</sup>Assistance to and Protection of Victims of Crime and Witnesses Act, No. 4 of 2015.

<sup>4</sup> Motor Traffic Act of 1951, s 99-100.

'Victim-friendliness' is a concept which derives through public law to mean 'user-friendly' system in general. It does not make a standard in law to judge whether any system is accessible by the victims. Free dictionary defines the victim in different contexts and states that *one who is harmed by or made to suffer under a circumstances or condition*.<sup>5</sup> On the other hand, friendliness is a quality of being good or friendly. Merriam Webster<sup>6</sup> defines the term 'friendliness' as, *the quality of being suited to particular needs, concerns, users, etc inter alia*. These definitions, though they appear in normal kinds of situations, could help to set a standard to judge the efficacy of a system.

Victim-friendliness and user-friendliness are similar concepts which are evolving in the modern world. User-friendly devices and applications are now spoken of. Such concepts are in the early stage of evolution, and their increased use in negotiation contracts and other legal documents will have to be evaluated and even defined by case law or statute law in future. Ultimately, whether some remedies are victim friendly or some devices are user friendly have to be determined by policymakers, legislatures and courts of laws in future.

Although it may be difficult to find a definition for the concept, it is well-known and articulated in the context of crimes, particularly victims who are coming within vulnerable categories, such as children or persons suffering from mental incapacity. Examples can be found in Zimbabwe, South Africa and India.<sup>7</sup>

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<sup>5</sup><https://www.thefreedictionary.com/victim> accessed on 15th July 2020.

<sup>6</sup><https://www.merriam-webster.com/dictionary/friendliness> accessed on 15th July 2020.

<sup>7</sup>Dr Anne-Maree Farrell, Ms Sarah Devaney and Ms Amber Dar, Interim Report, Scottish Government Social Research, School of Law, University of Manchester, 2010; Towards Victim Friendly Responses and Procedures for Prosecuting Rape a Study of Pre-Trial and Trial Stages of Rape Prosecutions in Delhi (Jan 2014-Mar 2015); Webster Chihambakwe, An Assessment of the

Basically, victim-friendliness is meant to be relaxing of procedural barriers of litigation. It is apparent that the above-mentioned jurisdictions referred to victim friendly court systems which prevents victims' access to justice. This is very true in the circumstances in which victimised children and women go into courts amidst public eye. Even if they are physically strong enough to access to court, psychological helplessness prevents them seeking legal remedies. However, the situation is very different in a civil case because victims may psychologically fit but unable to access the court physically because the structure of the court does not allow them to enter the premises where justice is done.

Therefore, it can be argued that a victim friendly legal system should provide them a scheme in which the victims are encouraged to seek legal remedies, supporting them with required guidelines and facilities with adequate compensation including interim payments where necessary. Such a regime better enables the victims as the users of the system in seeking adequate compensation with confidence and trust.

### **New Zealand: A Comparative Model**

Some legal systems adopt that liability should be transmitted in case of accidents. The reason for this change was none other than the legendary work of the Royal Commission of New Zealand in 1967.<sup>8</sup> Based on this report the New Zealand Parliament passed the Accident Compensation Act unanimously, in 1972.<sup>9</sup> This is not to argue that the

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Effectiveness of the Victim Friendly Legal System in Zimbabwe: A case Study of Harare, Metropolitan Province.

<sup>8</sup>The Royal Commission was established to examine the workers' compensation scheme but found it "essential to examine the social implications of all hazards which face the work force, whether at work or during the remaining hours of the day."

<sup>9</sup>See, Peter McKenzie, The Compensation Scheme No One Asked For: The Origins of ACC in New Zealand (34 VUWLR 2003) p193. Ailsa Duffy, The Common-Law Response to the Accident Compensation Scheme (34 VUWLR 2003) p367;

Woodhouse report is the supreme report published on accident compensation. However, Woodhouse report is the best document which could be used as a creation for making a victim friendly regime in the contemporary legal world.

Among the objectives for establishing a comprehensive compensation system in the post-World War II scenario, the report emphasized that;

'People have begun to recognise that the accidents regularly befalling numbers of their fellow citizens are due not so much to human error as to the complicated and uneasy environment which everybody tolerates for its apparent advantages. The risks are the risks of social progress, and if there are instinctive feelings at work today in this general area they are not concerned with the greater or lesser faults of individuals, but with the wider responsibility of the whole community.'<sup>10</sup>

The report was not a mere document but happened to be an in-depth social – legal finding into a matter of accidental damages and its aftermath. Commenting on the above Richard Gaskin states in his writing,

'From this bedrock notion Woodhouse derived several corollaries: the centrality of injury prevention and rehabilitation (missing from existing tort law), the need to compensate all losses (missing from current social welfare practices), procedural fairness and cost-efficiency.'<sup>11</sup>

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Terence G. Ison, *Changes to the Accident Compensation System: An International Perspective* (Osgoode Hall Law School of York University, 1993) pp 25-44.

<sup>10</sup> New Zealand Royal Commission of Inquiry into Compensation for Personal Injury Compensation for Personal Injury in New Zealand: Report of the Royal Commission of Inquiry [herein after referred to as Woodhouse Report], (Government Printer, December 1967) at para 89.

<sup>11</sup> Richard Gaskins, *The Enigma of Community Responsibility: Ethical Reflections on Accident Compensation* (46 VUWLR, 2015) p 790.

This raises very important concerns over the applicability of a comprehensive system of compensation in any country.

Rehabilitation and full compensation (all losses) are the basic attractions one would consider, though injury prevention is a distinct objective of tort law. Procedural fairness and cost efficiency are at the heart of the discussion of personal injury victims whereas delict/tort actions are costly and time consuming. The Woodhouse Commission found that the report was created on five basic principles, Community Responsibility, Comprehensive Entitlement, Complete Rehabilitation, Real Compensation and Administrative Efficiency.<sup>12</sup>

One may question why emphasises were paved on the Woodhouse report which was released in 1967. To date, almost all the legal regimes fully or partly referred to and studied the report before moving on to a new regime.<sup>13</sup> They have used the said principles as standards for making a victim friendly legal regime that could be used to set as guidelines in Sri Lankan context also.

## CONCLUSION

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<sup>12</sup> Edward J Lemons, *The Woodhouse Report: Relegated to the Archives?* (McGill Law Journal, Vol. 19, No. 2, 1973) p 195.

<sup>13</sup> i.e. *Law society of South Africa and others vs. minister for transport and road accident fund* case cct 38/10 [2010] zacc 25. Further, the compensation for occupational injuries and diseases act (coida) of 1993 (as amended 1997) and William J Gaine, no-fault compensation systems, experience elsewhere suggests it is time for the UK to introduce a pilot scheme, *bmj*. 2003 May 10; 326(7397): 997–998, Paul C. Weiler, the case for no-fault medical liability, 52 Md. L. Rev. 908 (1993) available at: <http://digitalcommons.law.umaryland.edu/mlr/vol52/iss4/4> visited on 28.08.2020; Jeffrey O'Connell, tort versus no-fault: compensation and injury prevention, [https://doi.org/10.1016/0001-4575\(87\)90018-2](https://doi.org/10.1016/0001-4575(87)90018-2), visited on 28.08.2020

The area of personal injury needs urgent attention of the policy makers as the existing system of injury prevention and compensation is not victim friendly. The present system does not encourage the victims to seek legal remedies through courts due to its inherent lacunas. In the meantime, other systems of compensation such as insurance, based on private market endanger the trustworthiness of the system of compensation letting down the claims depending on the profit-making tasks of the insurance companies. Thus, it is

significant to make a change in the substantive law, shifting the liability from fault to non-fault in personal injury cases and establish a separate establishment under a statute for victims' protection. In doing so, the concept of Victim-friendliness needs to be extended to civil wrongs such as in Criminal law, particularly personal injury situation which gives rise to serious societal problems mainly because both criminal and civil wrongs are violations of the law which require redress irrespective of fault.





## Contractarian Approach in Protecting Trade Secrets in An Employment Context

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### ABSTRACT

Today, we live in a knowledge-based society where everything is valued upon knowledge. Trade secrets in this knowledge-based economy amount to capital although there is insufficient protection for them compared to other intellectual property rights. In a typical scenario, an employer believes that the comprehensive employment contract which includes non-disclosure and non-competition clauses would be the best way to protect their trade secrets from employees. However, these restraint of trade clauses may prejudicially affect employees' right to have employment options. As such, this paper proposes that the courts should be able to equally concern the rights of employers in protecting trade secrets and the rights of employees in terms of their right to employability.

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## BACKGROUND

In the knowledge-based economy, intellectual assets such as trade secrets have a profound impact on the success of business. Economists argue that the rights associated with trade secrets provide its owner an important advantage and leverage over other competitors.<sup>1</sup> As an effective protection tool, trade secrets regimes are sufficiently broad to encapsulate a large array of industrial and commercial information. That is mainly because any relatively secret information which contains a potential commercial value and subjects to reasonable steps to protect secrecy is eligible for the protection under the trade secrets regime. Nonetheless, the unique characteristic of trade secret protection is that it is easier to lose than any other form of intellectual property rights. Business firms increasingly rely on contractual obligations or restraint of trade clauses to protect their trade secrets and treat such agreements as effective instruments to prevent their employees walking away with vital product know-how to rival organizations.

### Objective of the study

This paper examines the issue of using restrictive covenants in protecting trade secrets. It explores whether such restraint of trade agreements are valid in the Sri Lankan context and how they impact on the rights of the employees. This paper emphasises the fact that law should endeavour to strike a proper balance between the competing but equally important employers' interests in the protection of trade secrets and employees' interests in continuing their profession free from unreasonable restraints.

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<sup>1</sup> A Mitchell, 'The jurisdictional basis of trade secret actions: Economic and doctrinal considerations' (1997) 8 Australian Intellectual Property Journal 134, 136.

## RESEARCH DESIGN

By adopting a black-letter law approach, this paper reaches its conclusion through a doctrinal analysis of existing statutes, cases law and scholarly work. It mainly examines how trade secrets can be protected through a contract law approach and to what extent such an approach may impact on the rights of employees.

## ANALYSIS

### Protecting Trade Secrets in an Employment Context

Despite the increasing significance and utility of trade secrets, they are highly vulnerable due to the threats posed by employees, international corporate espionage and hackers.<sup>2</sup> In any event, employers have to reveal their trade secrets at least to their employees in the course of their employment while expecting that employees should not use trade secrets for their own benefit or for the benefit of a competitor of the employer, even after leaving employment. In reality, employees can become the biggest threat to the protection of trade secrets.<sup>3</sup> This is mainly because employees can easily access and misappropriate a trade secret since they know how and where confidential information is stored. They may have even contributed to development of that information. As stated by Caenegem, "the law surrounding the post-employment phase is perhaps the most significant part of the law of trade secrets and it certainly

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<sup>2</sup> Jennifer Brant and Sebastian Lohse, 'Trade Secrets: Tools for Innovation and Collaboration - Research Paper 3', International Chamber of Commerce (2014) 4.

<sup>3</sup> Robert G. Bone, 'A New Look at Trade Secret Law: Doctrine in Search of Justification', (1998) 86 California Law Review 241.

attracts a great proportion of the litigation in trade secrets cases.”<sup>4</sup>

### **Contractarian Framework for Protecting Trade Secrets**

Legal approaches of protecting trade secrets spreads in a vibrant spectrum starting from intellectual property law, law of contract, equity and to unfair competition. This is mainly because *Trade Related Intellectual Property Rights (TRIPS) Agreement* leaves a room for member countries to adopt their own standards of protection, including breach of confidence, breach of contract, and unfair competition.<sup>5</sup> In the Sri Lankan context, trade secrets are protected under a TRIPS-complaint legislation – Intellectual Property Act, No. 36 of 2003.<sup>6</sup> As is the case of TRIPS Agreement, Sri Lankan IP Act also provides that the common law rights are not restricted by the provisions of the IP Act.<sup>7</sup> As such, still there is a room for application of contractarian or equitable approaches of protecting trade secrets.

Contractarian approach of protecting trade secrets is highlighted in the employment context against the backdrop that the modern employment relationships arise from a valid contract, irrespective of whether it is written or not. Therefore, employers view the contract as a way to ensure the contractual parties honour the duty of preserving confidentiality of information. These contractual measures are commonly known as ‘restrictive

covenants’ or ‘restraint of trade covenants’, by which contractual parties agree “to give up some freedom which he [or she] would otherwise have had.”<sup>8</sup>

In general, these restraints may include non-disclosures, non-competitions and non-solicitations.<sup>9</sup> Non-disclosure agreements prohibit employees from disclosing and using trade secrets in an unauthorised manner during and at the end of the employment. Non-solicitation agreements prevent employees from soliciting the customers of the ex-employer for his or her own benefit or for the benefit of a competitor after leaving the ex-employer. In a broader context, non-competition agreements prohibit ex-employees’ ability to compete with the employer by joining a rival of the ex-employer or by starting his or her own competing business.

In the trade secrets regime, these covenants may be considered as a way to incentivise investing “in the development of knowledge [trade secrets] with some certainty that it will not fall immediately into the hands of a competitor if the employee leave.”<sup>10</sup> In other words, these restraints intend to control and limit the wide circulation of firm-specific information and knowledge. Employers consider that having an express written term in an employment contract may be an effective way of informing employees about their confidentiality obligation and protecting confidential information from current and ex-employees. Restrictive covenants, such as non-competes, are increasingly popular among businesses.

Whereas restrictive covenants are considered to be a popular method of protecting employers’ trade secrets, such

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<sup>4</sup> William van Caenegem, *Trade Secrets and Intellectual Property: Breach of confidence, Misappropriation and Unfair Competition* (Walter Kluwer, Netherlands, 2014) 223

<sup>5</sup>Article 39 (2) of the TRIPS Agreement ties the protection of trade secrets with the protection against unfair competition by virtue of Article 10bis of the *Paris Convention*. See also footnote 10 of the TRIPS Agreement.

<sup>6</sup>See Section 160 (6) of the Intellectual Property Act, No. 36 of 2003.

<sup>7</sup>Section 160 (9) of the Intellectual Property Act, No. 36 of 2003.

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<sup>8</sup>*Eso Petroleum Co Ltd v Harper’s Garage (Stourport) Ltd* [1968] AC 269, 298 [emphasis added]

<sup>9</sup>*Linder v Murdock’s Garage*, (1959) 83 CLR 628, 633.

<sup>10</sup>Christopher Arup, Chris Dent, John Howe and William Van Caenegem, ‘Restraint of Trade: The Legal Practice’ (2013) 36 (1) UNSW Law Journal 1, 3. [emphasis added]

covenants cannot be automatically enforced by an employer. This is because the common law holds that restraint of trade clauses are *prima facie* void as contrary to public policy, since it considers the likelihood of reducing competition and freedom of trade. This rule was enunciated by Lord Macnaghten in *Nordenfelt v Maxim Nordenfelt Guns & Ammunition Co Ltd*<sup>11</sup> in 1894. This approach has been followed by the Sri Lankan judges for a century through judgements such as *Krishnan Chetty v Kandasamy*<sup>12</sup>; *Hentley Garments Ltd v J.S.A. Fernando*<sup>13</sup>; *Finlay Rentokil (Ceylon) Ltd. v A. Vivekananthan*<sup>14</sup> and *Coats Thread Lanka (Pvt) Ltd v Samarasundara*.<sup>15</sup>

According to the *Nordenfelt* test, restrictive covenants will be enforced if they are reasonable between the parties (employer and employee) and in the public interest. This can be regarded as a balance of “two competing policy considerations: the policy of freedom of contract and enforcing contractual obligations, and the policy of preserving freedom of trade from unreasonable contractual restrictions.”<sup>16</sup> In other words, the common law endeavours to strike a balance on an employer’s interest in protecting trade secrets and an employee’s interests in protecting their labour rights. However, for some practical reasons such restrictive covenants may bring a negative impact on employees.

### Implications of Restrictive Covenants on Employees

One of the implications of restrictive covenants may be their impact on employee rights and freedoms. Contractual restrictions, such as non-compete, may impede employees’ right to employment options or employee mobility. In a broader

sense, free employability is a key factor in modern economies where high velocity of labour is emphasised. Legal-economic literature analyses this phenomenon through endogenous economic growth theory and suggests that there is a positive correlation between knowledge spill-over and economic development.<sup>17</sup>

If an employee is tied up by employability restrictions, he or she may have three options: (1) to remain with their current employer; (2) not work at all for the stipulated period; or (3) to detour the career so as not violating the non-compete. In any case, such measures prejudicially effect on the rights of the employee at least during the restrictive period where the employee is not compensated for not allowing him or her to work.

Even though restrictive covenants, such as non-compete, are enforced to the extent they are reasonable,<sup>18</sup> it is doubtful whether the judicial approaches are completely favourable towards employee rights and freedoms. Also, if trade secrets related information is regarded as a proprietary right of an employer, employees may be denied owning their knowledge and skills gained through the employment. That is because trade secrets of an employer and general stock of knowledge of an employee are invariably combined and difficult to separate. In such a context, restricting the use of trade secrets by an employer in turn may impact on the right to own and use of the employment-related-knowledge and skills of an employee.

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<sup>11</sup> [1894] AC 535, 565.

<sup>12</sup> (1924) 3 T.C.L.R 21

<sup>13</sup> (1980) 2 Sri L R 145

<sup>14</sup> (1995) 2 Sri L R 346

<sup>15</sup> (2010) 2 Sri L R 1.

<sup>16</sup> Lindy Willmott, Sharon Christensen, Des Butler, Bill Dixon, *Contract Law* (Oxford University Press Sydney, 5<sup>th</sup> ed, 2018) [18.35].

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<sup>17</sup> Luis A. Rivera-Batiz and Paul M. Romer, ‘Economic Integration and Endogenous Growth’ (1991) 106 (2) The Quarterly Journal of Economics 531, 551; Paul M. Romer, ‘Endogenous Technological Change’ (1990) 98 (5) The Journal of Political Economy 72, S 99.

<sup>18</sup> See for eg, English common law: *Nordenfelt v Maxim Nordenfelt Guns & Ammunition Co Ltd* [1894] AC 535, 565; *Herbert Morris Ltd v Saxelby* [1916] 1 AC 688, 706, 707; Sri Lanka: *Finlay Rentokil (Ceylon) Ltd. v A. Vivekananthan* (1995) 2 Sri L R 346, 349.

In any case, these contractual restrictions implemented through the employment contract may not be interpreted as voluntarily assumed by an employee.<sup>19</sup> That is because typically an employment contract is offered in a boilerplate format and employees are often asked to sign on the contract as a 'take-it-or-leave' condition.<sup>20</sup> Moreover, the employment relationship is, in general, recognised as "the paradigmatic example of inequality of bargaining power in contract law."<sup>21</sup> The power asymmetry between an employer and an employee may heavily influence the existence and the character of restrictive covenants such non-disclosures and non-competes.<sup>22</sup>

## **CONCLUSION**

Even though it is true that the issue of misappropriation of trade secrets by employees has caused serious concerns for business world, it does not necessarily mean that a country should undervalue employees' interests. As such, Sri Lanka may focus adopting a rights-based approach in protecting trade secrets. Accordingly, the courts may refrain from enforcing restrictive covenants which restrict employees' right to earn a living or in the case where courts are unable to demarcate trade secrets from employee-know how. In that way, the courts may adopt a more balanced approach which equally concerns both employers' and employees' rights.

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<sup>19</sup>See Rachel Arnow-Richman, 'Cubewrap Contracts and Worker Mobility: The Dilution of Employee Bargaining Power via Standard From Noncompetes' (2006) Michigan State Law Review, 963, 963.

<sup>20</sup>OrlyLobel, 'Enforceability TBD: From Status to Contract in Intellectual Property Law' (2016) 96 Boston University Law Review 869, 880.

<sup>21</sup> Rachel Arnow-Richman, 'Cubewrap Contracts and Worker Mobility: The Dilution of Employee Bargaining Power via Standard From Noncompetes' (2006) Michigan State Law Review, 963, 963.

<sup>22</sup> Viva R. Moffat, 'The wrong Tool For the Job: The IP Problem with Noncompetition Agreements' (2010) 52 William and Mary Law Review 873, 885.

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## Compromising Health to Gain Wealth: A Legal Response to Adverse Health Effects of Night Work

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*Compromising Health to Gain Wealth: A Legal Response to Adverse Health Effects of Night Work.*

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### ABSTRACT

Although night work has responded to a variety of social, technical, and economic reasons, it has adversely affected the health, safety, and work-life balance of such night workers. Thus, this article aims to explore the hiatus in the Sri Lankan law in devising effective legal measures responding to such health issues encountered by night workers due to their engagement at an irregular work time. This research is conducted as a literature review based on secondary sources approaching both qualitative and quantitative methods. The International Labour Organisation (ILO) and its recommendations provide for an effective mechanism for an organised night working culture in response to the health effects of such working community. However, Sri Lanka, not being a signatory to those conventions failed to address the issue through legislative measures. Further, the delinquency of statistics and medical research on the health status of night workers in Sri Lanka also worsened the situation. Thus, the author attempts to draw a constitutional justification to delineate the fundamental duty of the state to address the said issue and recommends suitable strategies and mechanisms to truncate the adverse health effects to those workers by drawing examples from initiatives taken by the European Union especially from Spain.

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## BACKGROUND

The structural evolutions in the working pattern since the industrial revolution to the technological era have lifted the living standards of the people considerably, while on the other hand, have adversely affected the health of workers by increasing the threat of adverse effects from several health-related issues compared to the past. The night work or night shift is one of such fundamental changes or evolution adopted as a working culture of the twenty-first century due to 'globalisation'. Although night work also existed in ancient civilisations, it became widespread once 'improved artificial lighting' instigated.

Night work is a performance of work at a time when people would normally sleep. This can either be a non-shift night work, which is by nature, has to be performed at night or night shift, where the working time of the workers succeed one another at different times of the day in which workers will also be required to work for certain hours per week at night too. Depending on the nature of the work, the workers may perform night work regularly or periodically or on a temporary short-term basis. Recently, the expanding needs like ensuring the functioning of social utilities, reaching the productive and economic demands, developing the leisure sector etc., cultivated a dramatic expansion in outsourcing the business processes through providing 'technology-enabled services' which resulted in enabling the multitude of remote work arrangements.

## OBJECTIVES

This research aims to explore the gap in Sri Lankan law relating to health-related rights of night workers. In order to devise effective preventive strategies, it is important to study workplace stressors that cause and increase the risk of adverse health effects that affect both night workers themselves as well as the people surrounded by them. The author also aims to recommend systematic legal measures to uplift the health and wellbeing of such night workers by drawing examples from selected other jurisdictions.

## RESEARCH METHODOLOGY

This research is conducted as a literature review based on secondary sources. The research attempts to address the research question by way of a combination of both qualitative and quantitative research methods, and it is carried out in an exploratory manner. This article also touches the medico-legal perspective to understand the health issues of night and night shift workers.

## RESEARCH PROBLEM AND QUESTIONS

Although few Acts enacted by the Parliament of Sri Lanka incorporate definitions for the term 'night worker' based on the objectives and context of such labour legislation, it has failed to devise effective preventive measures for health issues encountered specifically by the night workers due to irregular work time. Therefore, this research attempts to investigate the International Labour.

Organisation's contribution to the specific questions addressed herein; analyse and evaluate to what extent such contributions are incorporated into Sri Lanka's legal context, and; how European Union (EU) Directives and Spain (despite the directives issued by the EU addresses the issue through local legislative measures) address the issue effectively.

## HYPOTHESIS

The author believed that the initiation of regulations of night work and shift work through legal measures would control and minimise the adverse health effects caused due to irregular working hours.

## THEORETICAL FRAMEWORK

The author attempts to analyse the findings based on international labour rights, especially spotlight on the rights of night workers and night shift workers. The recommendations are supported by the constitutionally recognised fundamental duties of the State and the concept of dualism. The author also draws the concept of labour exploitation to justify the fundamental argument of this article, which is based on the

responsibility of the State to protect the labour force from such labour exploitations. As the subject matter of health falls under the Provincial Council list to the ninth schedule under the Thirteenth Amendment to the Constitution of Sri Lanka, the legal response addresses the issues related with the devolution as well.

## FINDINGS AND RESULTS

According to the statistical data, there is a rapid increase in the number of night workers in the last few years. Nevertheless, the night work has responded to a variety of social, technical and economic reasons; it also adversely impacted on worker's health, safety and work-life balance which is incompatible with the biological rhythms of the human body and social structure especially to an Asian country like Sri Lanka. Recent research identifies the following as the leading health issues among night workers and night shift workers who have the maximum probability of rapidly being affected by the same compared to the daytime workers.

- Reduction in quality and quantity of sleep.
- Widespread complaints of "fatigue".
- Anxiety, depression, and increased neuroticism.
- Increasing evidence of adverse cardiovascular effects.
- Possible increase in gastrointestinal disorders.
- Increased risk of spontaneous abortion, low birth weight, and prematurity.

As a result of the increment in the number of night workers, the International Labour Organisation (ILO) adopted international standards on night work aiming to protect the vulnerable categories of night workers, in particular, the young persons and women in the industry. The Night Work (Women) Convention (Revised) 1948 (No. 89), Convention concerning the Night Work of Young Persons Employed in Industry 1921, Night Work of Young Persons (Non-Industrial Occupations) Convention 1946, and Night Work (Bakeries) Convention deal with the revision of the definition of the term 'night

work' and does not, in particular, deal with the health effects of the same. Moreover, Sri Lanka is not a signatory to the above-said conventions. The Night Work of Young Persons (Industry) Convention (Revised), 1948 (No. 90) where Sri Lanka is a signatory, classifies and defines the term 'night work' in the context of young person's considering the factors that are harmful, prejudicial, or dangerous to them. However, no specific provision is provided for measures to ensure health while engaging in night works or night shift works.

C171 – The Night Work Convention, 1990 is the convention ab initio recognised the need for a separate law to deal with the health and wellbeing of the night workers. This convention prescribes a regular health assessment; access to medical advice on work-related health concerns; access to first-aid facilities and quick accessibility to further treatment in case of emergency; an option to transfer to a similar job where possible, and other employment benefits if the worker is found unfit for the night work for the health-related reasons; alternatives to night work for women workers during pregnancy and for a period following childbirth; the rate of compensation that accounts for the peculiar nature of night work; access to appropriate social services; and adequate consultation with workers' representatives on matters relevant to night workers. However, the detailed protection mechanisms are not comprehended in the convention itself. Instead, such mechanisms are listed out and demonstrated under the recommendations – that does not have an enforcement mechanism- to the respective ILO Conventions. Moreover, inasmuch as Sri Lanka is also not a signatory to this Convention, it does not have an obligation to enforce the convention by passing a legislative enactment responding to the same.

Current status of the law's response to the night workers, in general, is debilitating and in light of health and safety of the same remains tacit in Sri Lanka. The Regulation 3, 6 & 7 of the Shop and Office Employees Act of 1954 and sec.67 of the Factories Ordinance 45 of 1942 of Sri Lanka deal with the overtime pay for the workers who

contributed beyond the stipulated working hours. However, the law remains silent on premium payment for night workers. Moreover, these laws deal with the recognition of gender equality, definition of the terms related to night work and classification of working hours for night workers according to their age group. The prevailing laws also failed to respond to the diversity of night works currently existing in Sri Lanka. Even though no attempts are recorded in collecting specific statistics estimating the health issues of night workers in Sri Lanka, the sample data collection and overall medical research conducted in western countries to identify such health effects, prove not only the existence of adverse health effects but also a collapse in the basic structure of the society – the family – as well. Therefore, it can be concluded that no specific provisions were provided to deal with the health and wellbeing of the night workers, specifically or alone in Sri Lanka.

## **RECOMMENDATIONS AND CONCLUSION**

The State has the obligation under the supreme law of the country – the constitution – to promote the international peace, security and co-operation, and the establishment of just and equitable international economic and social order and should endeavour to foster respect for international law and treaty obligations in dealing among nations under Article 27(15). However, Sri Lanka is not a signatory to the C171, which specifically deals with the health of night workers; thus, it is not under the obligation to incorporate those measures into the local legislative enactments. However, Article 27(7) read together with Article 27(13) of the Constitution provides that it is the fundamental duty of the State to eliminate the disparity and the exploitation of man by man or by State and promote with special care and interests of children and youth, so as to ensure their full development, physical, mental, moral, religious and social, and protect them from exploitation and discrimination. Thus, it can be concluded that the State is under the fundamental duty to regulate the night or night shift work in response to the health-related issues encountered by them.

As already discussed above, the night does not only adversely affect the health of the workers but also collapse the basic structure of the society. Article 27(12) also provides that the State has the duty to recognise and protect the family as the basic unit of the society. Thus, the State should also cultivate strategies for work-life balance in order to prevent the collapse of such a basic unit of society.

Having said that, Spain is following a mechanism to address most of the issues related to night work by way of collective agreements as to cultivate responses based on the nature of each employment. Several legislations and implementing structures are also established to achieve the objective of preserving the health of such night workers in Spain. On the other hand, the European Union initiated an obligation on the part of employers of such institutions under Principle 9 of the European Pillar of Social Rights to maintain the work-life balance of the workers by providing the right to parents and people with caring responsibilities to claim suitable leave, flexible working arrangements and access to care services. European Union directives also provide provisions on the definition for nightshift, length of shifts, flexibility and control of scheduling the working time, and pays attention on preserving the health issues of such workers as well. Thus, the ILO Conventions and recommendations to such conventions, measures initiated by the European Union and few external mechanisms like coordinating correlated authorities to the mainstream would be a proper guide to initiate regulations to preserve the health and wellbeing of the night workers in Sri Lanka.

Moreover, the subject matter of health is a devolved subject under the 13<sup>th</sup> Amendment to the Constitution of Sri Lanka; thus, each Provincial Council could enact a statute based on and responding to the nature of the night work existing therein. Furthermore, the paucity of statistical data analysis undertaken so far to analyse the health issues of the night workers in Sri Lanka is also another delinquency which delays the law's response to this issue. The failure of the

State to ratify the C.171 is also can be counted as an additional disappointment on the law's response. Thus, the author urges the importance of a speedy initiation of

regulatory mechanisms to prevent night workers exploitation considering adverse health issues encountered by those employees as a result of night work.

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# **Psychology & Nursing**





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## Depressive Symptoms, Social Anxiety and Aggression as Predictors of Cyber bullying Perpetration in Adulthood

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### ABSTRACT

The present study aimed to investigate whether depressive symptoms, social anxiety, and aggression were significant predictors of cyber bullying perpetration on Facebook in adulthood. A cross-sectional, non-experimental study was conducted using 168 Sri Lankan Face book users between the ages 21 and 60. Participants were recruited through convenience sampling method. Data were collected exclusively online using a structured questionnaire. The study variables cyber bullying, depressive symptoms, social anxiety, and aggression were assessed using the self-reports, Prevalence of Face book Bullying Scale, Centre for Epidemiologic Studies Depression Scale (CES-D-10), Interaction Anxiousness Scale, and Brief Aggression Questionnaire respectively. Data were analysed using the statistical techniques Spearman correlation and multiple regression analysis. Results of the Spearman correlation analysis revealed that depressive symptoms and aggression were significantly and positively related to cyber bullying perpetration, while there was no significant relationship between social anxiety and cyber bullying perpetration. Results of the multiple regression analysis revealed that depressive symptoms and aggression were significant predictors of cyber bullying perpetration, while social anxiety did not significantly predict cyber bullying perpetration. The findings of the present study highlight the importance of addressing the psychological and behavioural health issues of the perpetrators using appropriate interventions in order to reduce the occurrence of cyber bullying. This study also emphasizes the importance of reporting incidents of cyber bullying and taking necessary legal actions against the perpetrators.

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## INTRODUCTION

The rapid growth of social media over the course of the past decade has substantially changed the nature of everyday social interactions. At present, interacting in cyberspace has become an integral activity embedded in the daily routines and lifestyle habits of all individuals, irrespective of age, gender, or social status. Spurred by the popularity of social media, a novel form of communication, online communication, has evolved replacing the traditional means of communication. As a consequence of this transformation in communication, the phenomenon of cyberbullying has emerged as a growing social concern, replacing traditional bullying.

Smith et al. (2008:376) define cyberbullying as “an aggressive, intentional act carried out by a group or individual using electronic forms of contact, repeatedly and over time against a victim who cannot easily defend him/herself”. Similarly, Patchin and Hinduja (2006:152) define cyberbullying as “willful and repeated harm inflicted through the medium of electronic text”. However, some researchers argue that intentionality, repetition, and power imbalance should not necessarily be present in cyberbullying, unlike in face-to-face bullying (Law et al. 2012; Slonje, Smith, and Frisen 2013; Ybarra et al. 2011). Hence, the above definitions remain debatable to date.

Cyberbullying is no longer a novel concept, and this phenomenon has been subjected to the rigorous scholarly investigation over the past decade. However, majority of the extant literature has been primarily focused on cyberbullying that occurs among adolescents, high school students, and university students. There is a distinct lack of research on cyberbullying that occurs in adulthood. Although cyberbullying that occurs among adults within the specific context of the workplace has been investigated previously (Coyne et al. 2017; Snyman and Loh 2015; Vranjes et al. 2017), research into general cyberbullying (i.e. context-free) in adulthood is extremely limited (Kowalski, Toth, and Morgan 2017).

Furthermore, despite the worldwide efforts to investigate the phenomenon of cyberbullying, research on cyberbullying that occurs exclusively through Facebook is extremely limited (Kokkinos, Baltzidis, and Xynogala 2016). According to the most recent statistical reports, Facebook is ranked as the number one most popular social network worldwide. Statistical reports reveal that it has reached 2.23 billion monthly active users and 1.47 billion daily active users by the second quarter of 2018 (Facebook 2018). Hence, lack of research on cyberbullying that occurs exclusively through Facebook can be recognized as a significant gap in the extant body of literature.

A critical analysis of the past literature reveals that much of the studies have been focused on the psychological impact of cyberbullying perpetration and victimization, while research on psychological predictors of cyberbullying perpetration is sparse (Schenk, Fremouw, and Keelan 2013; Schenck and Fremouw 2012). This shows that very little scholarly attention has been given to the psychological determinants of cyberbullying perpetration, whereas much importance has been given to the consequences of cyberbullying perpetration and victimization. This reveals another significant gap in the extant cyberbullying literature.

Moreover, majority of the research on cyberbullying reveal associations between personality traits and cyberbullying behaviour, while only a few studies have investigated the relationship between an individual's psychological and behavioural characteristics (e.g. depressive symptoms, social anxiety, aggression) and cyberbullying (Ayas and Deniz 2014; Kokkinos, Antoniadou and Markos 2014). However, these limited numbers of studies also have focused on adolescents, not adults. Hence, to date, there is a distinct lack of empirical evidence to support that psychological and behavioural characteristics such as depressive symptoms, social anxiety and aggression are associated with cyberbullying. Also, this limited body of research investigates depressive symptoms, social anxiety and aggression, as consequences of cyberbullying victimization,

not as predictors of cyberbullying perpetration (Gámez-Guadix et al. 2013).

Finally, a number of efforts have been taken by researchers worldwide, including in Asian countries like Indonesia (Safaria 2016), Singapore (Kwan and Skoric 2013), Malaysia (Balakrishnan 2018), China (Chu et al. 2018), Korea (Lee and Shin 2017), and India (Negi 2016; Sharma et al. 2017), to investigate the phenomenon of cyberbullying. However, to date, research attempts to investigate cyberbullying in Sri Lanka are unknown.

The above justification points out the gap in the extant cyberbullying literature, and hence, provides the rationale for the present study. The primary aim of the present study is to investigate whether depressive symptoms, social anxiety, and aggression are significant predictors of cyberbullying perpetration on Facebook in adulthood. Additionally, the present study has two main objectives; to assess the average levels of depressive symptoms, social anxiety, and aggression in the study sample, and to examine whether depressive symptoms, social anxiety, and aggression are significantly associated with cyberbullying perpetration in adulthood. Thus, the present study seeks to answer the following research question.

“Are depressive symptoms, social anxiety, and aggression significant predictors of cyberbullying perpetration on Facebook in adulthood?”

Hence, the present study proposes the following hypotheses.

- H1: Depressive symptoms will be positively related to cyberbullying perpetration
- H2: Social anxiety will be positively related to cyberbullying perpetration
- H3: Aggression will be positively related to cyberbullying perpetration

## **METHODOLOGY**

The study adopted a cross-sectional, non-experimental, and a quantitative research design. The study sample consisted of 168 Sri Lankan adults between the ages 21-60 ( $N =$

168). Participants were recruited through convenience sampling. Proficiency in English and being active Facebook users were the requirements to take part in the survey. Individuals who were diagnosed with any physical or mental illness (clinical population) at the time of the survey were excluded from the study. Majority (88%) of the respondents belonged to the age group 21-30, and more than half of the respondents were females (60%). The highest level of education received by majority of the respondents (40%) was undergraduate degree or equivalent professional qualification. Majority of the respondents were full-time students (45%).

Data were collected through an online survey using a structured questionnaire, through self-report measures. Cyberbullying perpetration on Facebook was assessed using the 18-item Prevalence of Facebook Bullying Scale (Kwan and Skoric 2013; Cronbach's  $\alpha = .86$ ). Respondents had to indicate the number of times that they have engaged in specific cyberbullying behaviours during the past month, on a scale ranging from 0 to 5, where 0 = never and 5 = more than 10 times. Respondents' prevalence of depressive symptoms during the past week was assessed using the 10-item Center for Epidemiologic Studies Depression Scale - CES-D-10 (Andresen et al. 1994; Cronbach's  $\alpha = .86$ ). This scale is a revised and short version of the original 20-item Center for Epidemiologic Studies Depression Scale (Radloff 1977) and used for general population. Responses were given on a 4-point Likert-scale ranging from 0 to 3, where 0 = rarely or none of the time (less than 1 day) and 3 = most or all of the time (5-7 days). Social anxiety was assessed using the 15-item Interaction Anxiousness Scale - IAS (Leary 1983; Cronbach's  $\alpha = .93$ ). Responses were given on a 5-point Likert-scale, where 1 = not at all characteristic of me and 5 = extremely characteristic of me. Aggression was assessed using the 12-item Brief Aggression Questionnaire - BAQ (Webster et al. 2013; Cronbach's  $\alpha = .83$ ). This scale is an alternative short form the 29-item Buss-Perry Aggression Questionnaire (Buss and Perry 1992). Responses were given on a 5-point Likert-scale, where 1 = extremely uncharacteristic of me and

5 = extremely characteristic of me. The 10-item Marlow-Crowne Social Desirability Scale - M-C SDS (Strahan and Gerbasi 1972; Cronbach's  $\alpha = .89$ ) was used to assess participants' social desirability in responding. This is a short version of the original 33-item M-C SDS (Crowne and Marlow 1960). In addition to the above-mentioned scales, a demographic questionnaire was used to gather the background information of the respondents.

A structured online questionnaire was created using Google forms and the web link for the survey questionnaire was distributed via Facebook. Initially, participants had to provide their consent to take part, and debriefing was done once they had completed the survey. The ethical approval for the present study was obtained from the Ethics Board of the Colombo Institute of Research and Psychology.

The statistical analysis of data was performed using IBM SPSS Statistics 20

software. The assumption of normality was checked for each of the study variables using the Kolmogorov-Smirnov test and Shapiro-Wilk test. As the assumption of normality was violated, Spearman correlation coefficient was computed to assess the degree and the direction of relationship between the study variables. A multiple regression analysis was run to determine the proportion of the variance in the outcome variable that can be explained by the predictor variables and the control variables. The assumptions of regression were tested prior to the regression analysis. All the demographic variables were used as the control variables when running the multiple regression analysis, to control for their potential effects on the outcome variable. In addition, a reliability analysis for each of the study variables was conducted.

Table 1: Means (M), Standard Deviations (SD), the Minimum (Min), and the Maximum (Max) Scores of the Study Variables

Variable	M	SD	Min	Max
Cyberbullying	4.61	6.27	0	59
Depressive Symptoms	7.69	4.81	0	27
Social Anxiety	39.18	8.69	19	65
Aggression	34.10	7.87	12	57

## RESULTS

The descriptive statistics of the study variables are indicated in the Table 1 above.

As indicated in the Table 1, the engagement in cyberbullying perpetration in the study sample was extremely low ( $M = 4.61$ ,  $SD = 6.27$ ). The scores ranged from 0-90. Only 0.6% scored high for cyberbullying perpetration. As a whole, the respondents were not depressed as the mean score was below 10 ( $M = 7.69$ ,  $SD = 4.81$ ). The scores ranged from 0 to 30. However, more than quarter of the sample (28%) scored high for depressive symptoms. Respondents scored less for social anxiety as a whole ( $M = 39.18$ ,

$SD = 8.69$ ). The scores ranged from 15 to 75. However, nearly quarter (23%) of the respondents scored high for social anxiety. As a whole, the sample scored low for aggression ( $M = 34.10$ ,  $SD = 7.87$ ). The scores ranged from 12 to 60. However, nearly half (46%) of the respondents scored high for aggression.

As indicated in Table 2, there was a significant positive relationship between depressive symptoms and cyberbullying perpetration ( $r_s(166) = .30$ ,  $p < .001$ ), as well as aggression and cyberbullying perpetration ( $r_s(166) = .29$ ,  $p < .001$ ). Therefore, H1 and H3 were supported. However, there was no significant relationship between social anxiety and

cyberbullying perpetration, as the correlation was weak positive ( $r_s(166) = .06, p = .445$ ). Therefore, H2 was not supported. Cyberbullying, depressive symptoms, social anxiety, and aggression yielded Cronbach's  $\alpha$  .83, .74, .81, and .76 respectively.

The regression model (predictor variables and control variables) accounted for 23% of the variance in cyberbullying perpetration ( $R^2 = .23, F(7, 160) = 6.84, p < .001$ ). Furthermore, the results revealed that depressive symptoms ( $\beta = .31, t(160) = 4.23, p < .001$ ) and aggression ( $\beta = .16, t(160) = 2.17, p = .031$ ) significantly predicted cyberbullying perpetration, while social anxiety did not significantly predict cyberbullying

perpetration ( $\beta = -.04, t(160) = -.52, p = .607$ ) at 95% confidence level (Table 3).

However, it should be highlighted that, when the regression model controlled for participants' social desirability, only depressive symptoms significantly predicted cyberbullying perpetration ( $\beta = .30, t(159) = 4.0, p < .001$ ) at 95% confidence level. This shows that when participants' social desirability in responding was taken into account, aggression had no effect on cyberbullying perpetration ( $\beta = .13, t(159) = 1.72, p = .087$ ). However, still the proportion of variance in cyberbullying perpetration explained by the regression model remained statistically significant ( $R^2 = .24, F(8, 159) = 6.13, p < .001$ ).

Table 2: The Correlation Matrix for the Study Variables

		1	2	3	4
1	Cyberbullying	(.83)			
2	Depressive Symptoms	.30*	(.74)		
3	Social Anxiety	.06	.24*	(.81)	
4	Aggression	.29*	.30*	.14	(.76)

Note: The parentheses along the diagonal display the Cronbach's  $\alpha$  of the study variables.

\*  $p < .01$

Table 3: Coefficients of Regression

Model <sup>a</sup>		Unstandardized Coefficients		Standardized Coefficients	<i>t</i>	Sig.
		B	Std. Error	Beta		
1	(Constant)	9.517	2.562		3.715	.000
	Age	-.977	.783	-.120	-1.248	.214
	Gender	-3.442	.971	-.270	-3.545	.001
	Education Level	.628	.521	.097	1.206	.230
	Employment	-.055	.491	-.011	-.112	.911
2	(Constant)	1.590	3.607		.441	.660
	Age	-.350	.741	-.043	-.472	.638
	Gender	-3.589	.913	-.281	-3.931	.000
	Education Level	.931	.486	.143	1.914	.057
	Employment	-.068	.455	-.014	-.150	.881
	SumDS	.409	.097	.314	4.229	.000
	SumSA	-.027	.053	-.038	-.516	.607
	SumAGG	.128	.059	.160	2.170	.031

Note: DS = Depressive Symptoms, SA = Social Anxiety, AGG = Aggression

<sup>a</sup> Dependent Variable: Cyberbullying

## DISCUSSION

**Hypothesis 1** predicted that depressive symptoms would be positively related to cyberbullying perpetration. As expected, the findings revealed that there was a significant positive relationship between depressive symptoms and cyberbullying perpetration, supporting H1. This finding is consistent with majority of the research findings (Schenk, Fremouw, and Keelan 2013; Selkie et al. 2015). Also, the results of the multiple regression analysis revealed that depressive symptoms significantly predicted cyberbullying perpetration, supporting the finding of Hill et al. (2017). However, it should be highlighted that these previous studies examined the phenomenon of cyberbullying perpetration in specific contexts, and their study samples were different to the present study.

**Hypothesis 2** predicted that social anxiety would be positively related to cyberbullying perpetration. The results indicated a weak positive correlation between social anxiety and cyberbullying perpetration, but however this relationship was not significant. Therefore, H2 was not supported. This finding is contradictory to the research finding of Kokkinos, Antoniadou, and Markos (2014), where they found a significant positive relationship between social anxiety and cyberbullying perpetration. Also, social anxiety did not significantly predict cyberbullying perpetration. A possible logical explanation for these contradictory findings may be, that unlike in adolescence, in adulthood there are other significant predictors of cyberbullying perpetration than social anxiety. For an example, the need to belong and the fear of social rejection are intense during adolescence, and as individuals mature, they are less concerned about such needs. Thus, engaging in online harassment as a means of overcoming feelings of insecurity, or in other words, social anxiety, may not be common during adulthood. However, further research is required to confirm this, as this is only a logical explanation in the researcher's point of view, and not a theoretical explanation.

On the other hand, majority of the past literature reviewed above reveal associations between social anxiety and cyberbullying victimization (Ayas and Deniz 2014; Chu et al. 2018). These researchers argue that socially anxious individuals are more likely to be victims of cyberbullying, as they appear vulnerable due to social withdrawal. This could be one reason why the above research hypothesis was not supported, as it was not based on sufficient empirical evidence. Also, as aforementioned, social anxiety is a broad term, and there are various types. The present study assessed only one aspect of social anxiety, which is interaction anxiety (Leary 1983). This could be another reason why the above finding of the present study is contradictory to the research finding of Kokkinos, Antoniadou, and Markos (2014).

**Hypothesis 3** predicted that aggression would be positively related to cyberbullying perpetration. As predicted, there was a significant positive relationship between aggression and cyberbullying. Therefore, H3 was supported. This result is coherent with the research findings of Calvete et al. (2010) and, Savage and Tokunaga (2017). Furthermore, the findings revealed that aggression significantly predicted cyberbullying perpetration, when not controlled for participants' social desirability in responding. This finding is consistent with the research findings of You and Lim (2016). However, it should be noted that in these researches, the study sample was adolescents.

Interestingly, aggression did not significantly predict cyberbullying perpetration, when participants' social desirability in responding was taken into account and controlled in the regression model. This shows that the participants have responded in a socially desirable manner, and the social desirability bias had a significant effect on the outcome.

In contrary to the researchers' expectations, the engagement in cyberbullying perpetration in the study sample was extremely low. A possible reason for this could be the effect of demographic variables,



which could have acted as the confounding variables in the study.

The present study has several notable strengths. Although self-report measures were used to collect data, a scale which has demonstrated high reliability and validity in previous researches was used to control for social desirability bias. Also, all the scales used to assess the study variables yielded reliability coefficients greater than .70.

The most notable limitation of the present study is the lack of population validity. The study sample was clearly disproportionate, as 88% of the respondents belonged to the age group 21-30. However, it should be emphasized that the study sample was not significantly gender-biased, as the percentages of males (40%) and females (60%) who responded to the survey were reasonably proportionate. Collecting data exclusively online can be recognised as another limitation of this research.

Findings of this research reveal that cyberbullying perpetrators show psychological health issues such as depressive symptoms, as well as behavioural health issues such as aggression. Thus, it is crucial to address these underlying issues with appropriate assessment and treatment in order to minimize the occurrence of this behaviour in future. Most importantly, necessary steps should be taken to educate the Facebook users to effectively use this social networking site, instead of using it as a tool to harass another. Also, it should be brought to attention that, online harassment is against the law, and hence, both the victims and witnesses of cyberbullying should be encouraged to report such incidents. Law enforcement should play a more active role in enacting cybercrime legislation and revising the existing Computer Crime Act.

The present study provides the framework for future research inquiry on cyberbullying. Replication is essential to gain a deeper

understanding of the phenomenon of cyberbullying and future research should address the limitations of the present study. It is advisable to use both an online survey and a traditional paper and pencil method survey in data collection. Furthermore, it would be interesting to find out whether cyberbully perpetrators are once traditional bullies who have migrated to an electronic platform to accomplish their intentions, or whether they have never engaged in traditional bullying. On the other hand, it would be interesting to investigate whether these adults were bullies during their adolescence as well. In addition, it is useful to study whether there are differences in engagement in cyberbullying in terms of gender and level of education, as the present study did not focus on the effects of any demographic characteristics on cyberbullying perpetration. Also, it might be useful to take into consideration factors which might prevent an individual from engaging in cyberbullying such as the subjective evaluation of the potential risks of engaging in cyberbullying, and the ability to exercise self-control over the behavioral intention and social norms. Finally, it is crucial to use a sample representative of the general adult population in future studies, in order to draw accurate conclusions.

## **CONCLUSION**

Findings of the present study reveal that depressive symptoms and aggression are significantly related to and predict cyberbullying perpetration in adulthood. These findings emphasize the importance of addressing the psychological and behavioural health issues of adults with appropriate interventions, as a means of reducing the occurrence of cyberbullying, which is a growing social concern.

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## Exploring Parents' and Teachers' Attitudes and Expectations Regarding Inclusive Education in Colombo

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### ABSTRACT

The study aimed to explore teachers' attitudes and parents' expectations regarding inclusive education. In total 8 participants were interviewed regarding their attitudes and expectations of inclusive education. 4 participants were mainstreamed teachers that have a child or children with special educational needs present in the classroom and 4 participants were parents that have a child with a diagnosis that requires special educational needs, attends school and is in a mainstreamed classroom, while receiving extra help at school. The results were analyzed using Thematic Analysis. Data analysis highlighted four themes: Improved Communication, Adequate Resources and Support, Education and Awareness and Roles of Schools. It was evident that there are multiple gaps that need to be bridged as there is a significant discrepancy between how the education of students with special needs should be approached and how students are being approached. Parents expectations of teachers and schools are clearly stated, and teachers showed promising characteristics to change neutral or negative attitude toward inclusive education if their expectations are met. As inclusive education is a fairly new practice, the study aimed to determine common attitudes and expectations between parents and teachers in order to help the development of inclusive education in Colombo. Future implications of the study are discussed.

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## **INTRODUCTION**

Inclusive educational practices have been accepted globally since 1980, and has since become a standard practice in certain regions (Lindsay, 2007). Some prominent difficulties children with disabilities face are: having a limited level of comprehension, speech delay, weak motor skills, poor ability in reasoning, not being on par with their peers in physical activity and behavioural issues (Gerschel, 2003; Odom & Wolery, 2003). The No Child Left Behind Act of 2002 takes into consideration that each child has a different style of learning. It encourages education systems to make minor amendments to the curriculum and access arrangements during exams, for children that cannot cope with the general syllabus (Lage, Platt, & Treglia, 2000). Vygotsky's social learning theory of *dysontogenesis* (1978) stresses that resources and processes made available to typically developing children should be available for atypically developing children as well, to contribute toward both cognitive and social development of every child (Lumadi, 2013). Therefore, exposure to social situations is a key ingredient of development, as social skills are favoured when mainstreaming, more than academic progress alone (Pinar, 2013).

While positive attitude in teachers toward children with special needs and the inclusive education system is of vital importance, research suggests that teachers generally have a negative or neutral attitude toward inclusive teaching (De Boer, Pijl, & Minnaert, 2011; Murray, 2009; Salovitta, 2018). The need to modify the curriculum for a child with special needs, feeling unprepared to accommodate students with special needs while simultaneously catering to a classroom of typical children and the insufficient support and resources to cater to both children are some of the reasons for this negative attitude (Sharma, & Nuttal, 2016; Chiner & Cardona, 2013; Hunter-Johnson, Newton, & Cambridge-Johnson, 2014).

Parents too have a vital role in the inclusion movement, as the entire mainstreaming process would depend on their attitudes and expectations of the child (Francis, Fuchs, Johnson, Gordon, & Grant, 2016). Maintaining

a healthy and good rapport with the school staff have shown to play a significant part the school's successful continuation of inclusive teaching and a better outcome for the children (Hornby, & Witte, 2010). Overall, the parents felt that the school staff did not understand their requirements and did not possess qualities that ensured their child would be taken care of, and they expected more personalized programmes (Martinez, Conroy, & Cerreto, 2012; Tobin et al., 2012). Parents' concerns were echoed in a study conducted in Sri Lanka examined the levels of awareness of and exposure teachers had to children with special educational needs. The results indicated that 80% of academic staff were not aware of the policies and different methods of teaching children with extra needs and did not have the relevant training and education (Dissanayake, 2016). A main reported issue in the inclusive education system is the quality of communication between parents and teachers (Soodak, & Erwin, 2000). Both parents and teachers believe effective communication would resolve challenges, as one of the main challenges faced are the attitudinal aspects of both parents and teachers (Pivik, McComas, & Laflamme, 2002).

While studies in different regions have shown the need to develop a better understanding between parents and teachers for the positive growth of inclusive education (Brackenreed, 2011; Hornby, & Witte, 2010), there is a lack of research in this field in Sri Lanka. Therefore, this research aims to answer the question: What common ground do parents and teachers have in their expectations and attitudes toward inclusive education?, through the explorations of common expectations and attitudes of parents and teachers, to create a common platform to develop the inclusive education system in schools in Colombo.

## **METHODOLOGY**

### **Study Design**

This study used a qualitative approach, where a semi-structured interview was used to gather data on parents' and teachers' attitudes and expectations regarding inclusive education system.



### **Participants**

The study consisted of 8 participants (4 teachers and 4 parents). While no preference was given to participants' age, gender or ethnicity, all those who participated in the study were female. Two parents were stay-at-home mothers, and the other two parents were working mothers. Parents were required to have a child or children with special needs that attend a typical school and are in mainstreamed classes but received support from the learning support unit. The children were required to have a clinical diagnosis. All teachers had over 5 years of teaching experience. The teachers were required to have experience in accommodating children with special needs in a typical classroom setting in a school in Colombo. Only class teachers were included, while subject teachers were excluded to avoid misinterpretation of results as their experiences and challenges would differ.

### **Sampling Method**

A criterion purposive sampling method was used for the study as it allows the researcher to manage the choice of individuals included in the study that are most suitable for participating in the research (Barbour, 2001).

### **Study Instruments**

Data for the present study were obtained with the use of semi-structured interviews, as this method allows for flexibility and gathering of rich data (Dominci & Guzzo, 2010). Some of the questions that teachers were asked were: "What are the challenges you have faced by having a child with special needs in your classroom?" and "What do you think are the advantages and benefits in including different type of children in one classroom?". Some of the questions the parents were asked were: "What do you expect from your child that is being mainstreamed?", and "What do you think would help develop the existing inclusive education system in Colombo?". The questions used for the current study were guided by existing literature interested in exploring parents' expectations of and teachers attitudes toward inclusive education (Flewit & Nind, 2007; McGhie,

Irvine, Loreman, Cizman, & Lupart, 2013; Vanderpuye, 2013).

### **Procedure**

Upon receiving permission from the school, the researchers approached the academic staff, and parents that met the criteria for being a participant in the research. Once the researchers had confirmed participants and they were briefed on the study and ethical considerations, their written informed consent was obtained. The researcher met with the participants individually for approximately an hour each. The interviews were audio-recorded with the participants' consent. At the end of the interview, the participants were debriefed and given the researchers' contact numbers in case the participant wanted to withdraw from the study within the specified period.

### **Data Analysis**

Thematic analysis was chosen to analyse the data, as the study was interested in finding common themes between the groups, and this analysis helps the researcher explore the codes and themes uniquely through the visual representation of the thematic map (Vaismoradi, Turunen, & Bondas, 2013). The data was read, coded and given labels. Next, themes and sub-themes were identified and later elaborated in the context of the data and literature.

## **RESULTS**

Four themes were identified with the use of thematic analysis, which each theme having two to three sub-themes. A thematic map is given below for a clearer representation of the study's themes and sub-themes.

As shown in Figure 1 above, the four main themes drawn from the data from the participants were, improved communication, extra materials and support, education and awareness, and the roles of schools. The themes derived from the analysis included both parents' attitude and teachers' expectations in the subthemes. Parents had the attitude that the current level of communication between parents and teachers are insufficient and leads to the parents not being up-to-date with the child's progress and negatively affects their



level of involvement in the child's academics. Similarly, teachers agreed that more frequent meetings during school hours would benefit the child. While teachers expected extra support such as shadow teachers and suitable resources in the second theme, parents said that they were more in favour of individual attention and a personalized approach toward their child. In theme three, teachers expected parents of typically and atypically developing children to have more knowledge on special educational needs as it would make the inclusive approach a more pleasant experience for teachers, students and parents; where as parents believed that the root cause of children

with special educational needs not being treated fairly is due to the lack of teacher knowledge and experience. The final theme indicated that teachers expected other teachers to be more accepting and understanding of students with special needs, and parents agreed that teachers need to change their negative attitude when accommodating children that require extra support. They further expected teachers to maintain proper records, as they believed teachers do not put in enough effort to maintain the child's daily records, and expected teachers to not only focus on academics but also help children become more self-sufficient.

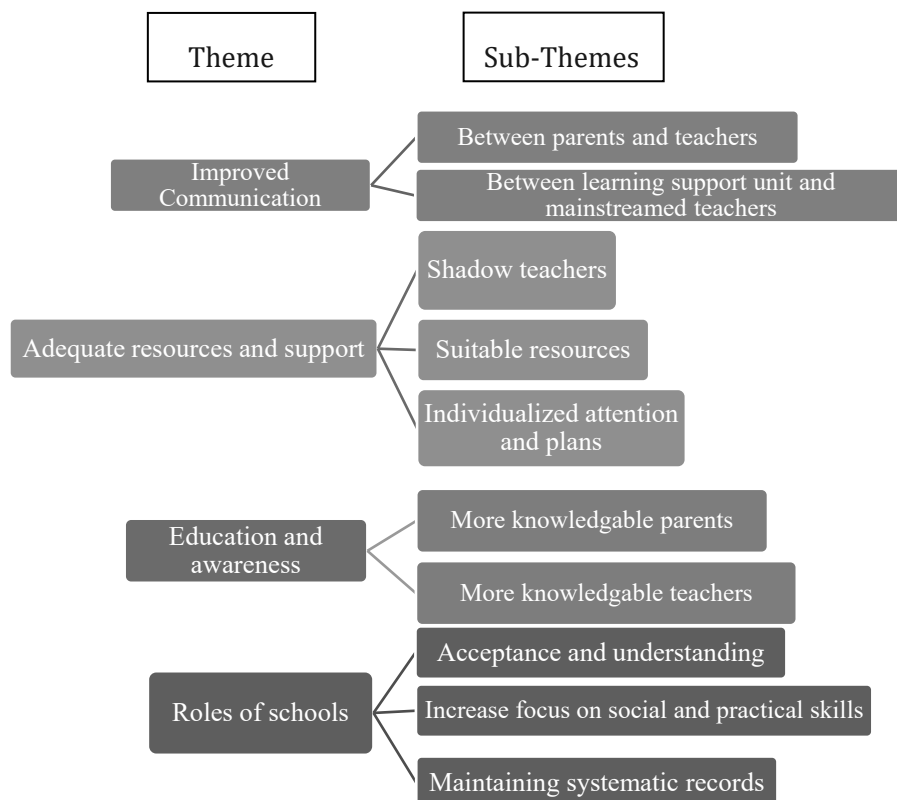


Figure 1: Thematic of Parent Expectations of and Teacher Attitude toward Inclusive Education in Colombo

## DISCUSSION

The first theme maintains that both parents and teachers believe that the current level of communication between the individuals is not sufficient, especially when catering to a child with a diagnosis that requires extra support. This result is consistent with previous findings, where parents stated that levels of communication between parents and teachers need to improve (Pivik et al., 2002; Soodak &

Erwin, 2000). However, according to past research, it was also expressed that communication between the two individuals needs to be limited as certain parents do not have boundaries when contacting the teacher, and disrespect the teacher's privacy (Ellis, Lock, Lummis, 2015). The need for better communication between the learning support unit teacher and mainstreamed teacher, too is consistent with previous research. A lack of collaboration between teachers led to multiple challenges, especially concerning one teacher

receiving more power and recognition, while the other teacher's methods and successes were not appreciated (Hamilton-Jones & Vail, 2014). It is suggested that frequent collaborative meetings are organized between the mainstreamed teachers and special educational needs teachers to plan accordingly on what needs to be done by each individual throughout the week (Dove & Honigsfeld, 2010).

The second theme was in line with previous research, where the needed mean of support for class teachers that handle an entire classroom of students was emphasized, as the shadow teacher gives the student the extra individual explanation and motivation, resulting in optimal learning (Padmadewi & Artini, 2017). Additionally, previous research states that using resources such as extra visual aid, sound clips, and sensory toys have contributed to enhance learning for children with learning disabilities, as this worked as a tool of attracting the student to different learning mechanisms (Colomo-Palacios, Paniagua-Martín, García-Crespo, & Ruiz-Mezcua, 2010). Parents preferred if the child receives an individualized attention and approach that caters specifically to the child's needs, even in the mainstreamed classroom, which is in line with previous research (Dervin, 2010). However, previous research too suggests that support and reinforcement at home contributes to enhanced learning skills, and highlights the importance of parents' involvement in the child's learning process (Anders et al., 2011; Anders et al., 2012).

According to the third theme, parents and teachers both believed that the other individual needs to have adequate knowledge on what special educational needs and their expected role. This is consistent with previous findings, as the importance of parental and teacher awareness is stated as important factors in ensuring the effective educational experience of children with special needs (Star & Foy, 2012). Parents that had a better understanding on their child's diagnosis and disability were more satisfied and appreciated the teachers' efforts (Star & Foy, 2012). Teachers having prior knowledge on the

disabilities responsible for specific academic or social impairment have been more successful in ensuring the progress of the students' development (Wong & Kasari, 2012). The findings indicate the importance of teacher knowledge and exposure to special educational needs before embracing teaching as a full-time career.

The fourth theme too was reflected in existing literature, where having more understanding and accepting academic staff had a significant positive impact on children with special educational needs (Coe, Aloisi, Higgins, & Major, 2014; Gablinske, 2014). However, research also states that in most cases even the most understanding teachers are unable to deliver to their potential due to the lack of time and increased workload, thereby, giving parents a negative impression of the teachers and the school (Ahmmed, Sharma, & Deppeler, 2012; Florian, 2012). Past research indicates when parents showed desirability toward an improved social life for their child the children have shown overall progress in academics and behavioural change (Durlak, Weissberg, & Pachan, 2010; Pinar, 2013). Previous studies as well state that teachers lack the skill of maintaining records throughout the academic term, and state that teachers must be more methodical and plan with sufficient material (Shaw, Pedersen, Cooley, & Callingham, 2013). The minority of teachers that showed the maintenance of systematic records had better problem-solving skills and were more efficient (Shaw, Pedersen, Cooley, & Callingham, 2013). Therefore, indicating the importance of effective record keeping by teachers throughout the academic year.

As the teachers' attitudes reflect a current context where their needs are not met, the participants' expectations suggested that neutral or negative attitudes can change if their requests are fulfilled. The study would have been richer in information, had the researcher briefed the participants on what inclusive education was before the interview, as many were unfamiliar with the terms and had to be asked different questions that may have diluted the data. Nevertheless, the study extensively gives insight to what gaps need to be bridged concerning the current inclusive

education system; there by contributing to research, as it creates awareness on further improvements to the current system, particularly in a developing country hesitant to change traditional teaching methods. In order for inclusive education to be successful in Colombo, schools can start by accommodating shadow teachers and extra resources in classrooms and have awareness and skills-training programmes on special educational needs for teachers and parents, as these were concerns echoed throughout the data. It is recommended that future researchers take into consideration the implications mentioned and conduct further studies to understand how inclusive education and needed changes for inclusive education to become a more established practice, especially in developing countries.

## CONCLUSION

Parents' attitudes of the current inclusive education system and teachers' expectations

of what can be done to improve inclusive education in Colombo is highlighted in the present study. Though the study shed lights on an important aspect of special education, it is not very generalizable in the field of research as the study was conducted in one school. However, the use of a qualitative approach and thematic analysis enabled the researchers to gather information more in depth, giving a deep understanding on where parents stand with their past and present experience, and what can be done toward improving the current system from the educator's perspective. Although the study gathered common ideas of both parents and teachers to help understand the gaps that need to be filled in order for inclusive education to both progress and prosper in Colombo, further research need to be conducted in order to confirm what steps need to be taken to make changes in the education system, and to evaluate if the current suggestions can contribute to a positive change.

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# SICASH

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## The Relationship between Individuals' Social Networks and Satisfaction with Life: The Mediating Role of Loneliness

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### ABSTRACT

Humans are social beings, pre-programmed to form connections even before birth. Every individual has a set of connections with a group of people, through whom the need to socially connect with others is satisfied. A failure to satisfy these needs can have detrimental effects on an individual. Commonly known phenomena such as social isolation can be perceived as feelings of loneliness in the absence of adequate social connections. Despite the understanding that loneliness is typically prevalent in the elderly population, recent surveys show that young adults are lonelier than any other age group despite having the highest amount of social connections. Yet a limited number of research has been conducted to date on loneliness among young adults. Therefore, this study aimed to investigate whether loneliness was influenced by social network characteristics, and, in turn, could predict satisfaction with life (SWL). Data was collected using a survey disseminated among young adults aged 19-24. Using a sample of 194 participants, results revealed that the relationships between two out of four structural characteristics (*average closeness* and *frequency of interaction*) and SWL were significantly mediated by loneliness, while the other two (*network size* and *network density*) were not. The relationship between the functional network characteristic of perceived social support and SWL was also significantly mediated by loneliness. The paper concludes with a brief discussion of the limitations and implications of these findings.

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## INTRODUCTION

Social connections play a major role in determining satisfaction with life (Neto & Barros, 2003) as individuals, on average, spend almost 80% of the time awake interacting with others (Cacioppo et al., 2009, p. 977). Everyone has a social network that comprises of a group of people through which they satisfy social needs (Dominguez-Fuentes & Hombrados-Mendieta, 2012; Papadopoulos et al., 2014). A deficit in these social relationships is perceived as loneliness (Neto & Barros, 2003, p. 352; Perlman & Peplau, 1981).

The Mental Health Foundation showed that loneliness is becoming more of a problem among young adults (Gil, 2014), and that 36% of individuals aged 18-36 worry about feeling lonely (Griffin, 2010). BBC Radio 4 also revealed that 40% of individuals between the ages of 16-24 felt lonely 'often' or 'almost all the time' compared to 29% from the elderly group (BBC, 2018). Moreover, the Office for National Statistics (ONS) data show that 9.8% of young British people were lonely 'often' and the cause was attributed to various life challenges that could present opportunities for social exclusion (ONS, 2018b). These findings are surprising as young people generally have the highest degree of social connections (Simmons, 2018).

Despite the slightly alarming prevalence of loneliness among young adults (Gil, 2014; ONS, 2018a), only a handful of studies have investigated this phenomenon in the young adult population. Given the close link between social networks and loneliness (Berg & McQuinn 1989; Green et al., 2001; Stokes, 1985), this study set out to investigate the mediating role of loneliness in the relationship between social network characteristics and satisfaction with life (SWL) among the young adult population in Sri Lanka, who as per WHO (2007) are aged between 19 and 24.

Ashida and Heaney (2008) distinguished social networks in terms of structural and functional characteristics. Structural characteristics include dimensions such as the network size, density, frequency of

interaction, and the perceived closeness within a social network. Functional characteristics portray how an individual would benefit through the network and how support is provided within the network. Social connectedness, social support, and cognitive support are some functional Characteristics (Ashida & Heaney, 2008, p. 873; Israel, 1985).

This study first hypothesized that structural network characteristics, including *size, density, frequency of interaction*, and *perceived closeness* will be related to loneliness as the latter occurs in the absence of important or meaningful interpersonal relationships (Neto & Barros, 2003; Perlman & Peplau, 1981, 1984). Research has shown that factors such as the number of close friends (Stokes, 1985) and frequency of telephone contact (Mellor et al., 2008) are strongly associated with reduced levels of loneliness.

*H1: There is a relationship between structural network characteristics (network size, the density of network, frequency of interaction and closeness to individuals) and loneliness.*

Social support is one of the main functional characteristics of a social network (Mitchell & Trickett, 1980). It is one of the resources that are exchanged in goodwill between individuals in a social network. Research shows that perceived social support (PSS) increases a sense of belongingness (Baumeister & Leary, 1995), thus decreasing loneliness (Kang et al., 2018; Mahon et al., 1998). Thus, it is hypothesized that:

*H2: There is a relationship between functional network characteristics (perceived social support) and loneliness.*

SWL is the overall quality of an individual's life based on his/her criteria (Schin and Johnson 1978), and loneliness has been found to be an important indicator of SWL (Bozorgpour & Salimi, 2012; Kapikiran, 2012; Mellor et al., 2008). A number of studies show that loneliness contributes to dissatisfaction with life (Cacioppo & Hawkley 2003; Fees et

al., 1999; Savikko et al. 2005; Theeke 2009). Thus, it is hypothesized that:

*H3: There is a relationship between loneliness and satisfaction with life.*

The above discussion highlights the likelihood that structural and functional network characteristics will influence loneliness, which in turn can influence SWL. For example, Kang et al. (2018) found that loneliness mediated the relationship between PSS and quality of life

*H4: Loneliness will mediate the relationship between structural and functional characteristics of social networks and satisfaction with life.*

## METHODOLOGY

The current study adopted a quantitative, non-experimental, and cross-sectional study design. Using convenience sampling, Sri Lankan young adults aged 19-24 (WHO, 2007) and proficient in English were selected. A total of 208 responses were received, out of which the useable sample size was 194. Data was collected via a structured questionnaire using Google Forms.

Structural network characteristics were measured based on Green et al. (2001) and Green et al. (1996). First, **network size (NS)** was measured by asking participants to name up to 10 individuals with whom they interact on a frequent basis. Then, a rating (1 = Not close at all to 9 = Very close) was given to each of the 10 individuals, and a mean score was calculated to determine **perceived closeness** within the network. Next, based on the extent to which the 10 individuals knew one another, **network density (ND)** was measured by dividing the actual number of connections by the total number of possible connections in the network. Lastly, a frequency of contact rating (1 = Never to 5 = Every time) was given to each of the 10 individuals in the network, and a mean score was calculated to determine **frequency of interaction (FOI)**. **Perceived social support** was measured using the PSS scale (Zimet et al., 1988), **loneliness** through the UCLA Loneliness Scale (Russell, 1996), and satisfaction with life through the SWL Scale by Diener et al. (1985).

Multiple regression analyses were performed to determine mediation using the PROCESS macro for SPSS Version 3.3 released in 2019 by Hayes (2012). The study adhered to the ethical guidelines of the British Psychological Society (BPS) and Coventry University.

Table 01: Descriptive Statistics, Correlations and Reliability Coefficients (n=194)

	NS	ND	FOI	AC	PSS	L	SWL
Mean	6.93	.6308	3.713	7.551	5.61	44.66	23.03
Standard Deviation	(2.915)	(.2461)	(.675)	(1.051)	(.937)	(9.275)	(6.274)
NS							
ND	-.481**						
FOI	-.244**	.189**					
AC	-.201**	.265**	.496**				
PSS	.096	.055	.318**	.422**	(.884)		
L	-.075	-.044	-.198**	-.322**	-.613**	(.911)	
SWL	.109*	-.019	.061	.150*	.324**	-.452**	(.830)

Note: n = 194, \*  $p < .10$  \*\*  $p < .05$ ; Reliability estimates for the scales used are stated within parentheses along the diagonal; NS = Network Size; ND = Network Density; FOI = Frequency of Interaction; AC = Average Closeness; PSS = Perceived Social Support; L = Loneliness; SWL = Satisfaction with Life.

RESULTS AND DISCUSSION

The table above indicates the means, standard deviations, correlations, and reliability coefficients of the study variables.

Hypothesis Testing

The simple mediation model, which comprised the network characteristics as the predictor variable, loneliness as the mediating

variable, and SWL as the outcome variable was assessed using 5000 bootstrap samples (Hayes, 2012; Preacher & Hayes, 2008a, 2008b). Demographic factors such as age, gender, marital status, employment status, whether participants lived with parents, and whether they had siblings were controlled for during the analysis. The model was assessed five times for each of the four structural characteristics and functional characteristic of PSS as the predictor variable.

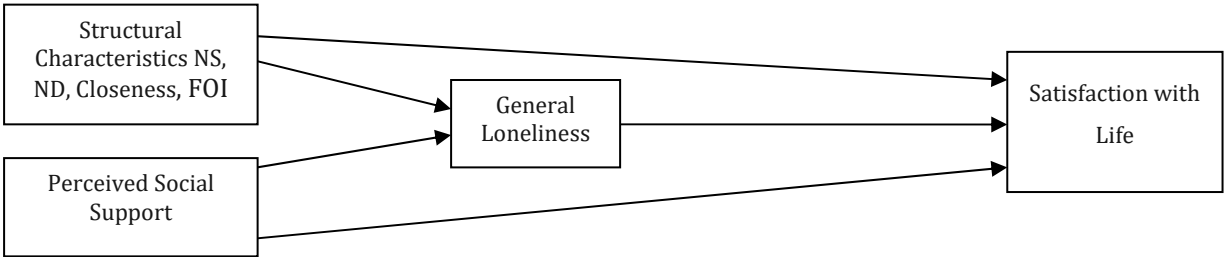


Figure 1: Network Size (NS)

NS was not significantly related to loneliness ( $\beta = -.072, t = -.999, p = .318$ ), although loneliness was significantly related to SWL ( $\beta = -.4792, t = -.7.4309, p < .001$ ). Since one of the two paths constituting the mediation effect was not significant, loneliness did not significantly mediate the relationship between NS and SWL (*Std. Indirect effect* = .034, *SE* = .035). Results showed that the bootstrap confidence interval (CI) included zero (-.0333, .1076) indicating that the indirect path is not significant. However, NS was positively and directly related to SWL, although at the 90% confidence level ( $\beta = .115, t = 1.794, p = .074$ ).

Network Density (ND)

ND was not significantly related to loneliness ( $\beta = -.055, t = -.757, p = .450$ ), while loneliness was significantly related to SWL ( $\beta = -.4887, t = -7.5284, p < .001$ ). Again, since one of the two paths constituting the mediation was not significant, loneliness did not significantly mediate the relationship between ND and SWL (*Std. Indirect effect* = -.027, *SE* = .035). Results showed that the bootstrap CI included zero (-.0145, .0980), indicating that the indirect effect is not significant. NS, ND are

quantitative characteristics and are more focussed on identifying different elements that make up an individual's social network (Ashida and Heaney 2008). Therefore, it gives less emphasis on the belongingness/emotional aspects of providing support within the social network thus supporting the above findings.

Average Closeness (AC)

AC was significantly and negatively related to loneliness ( $\beta = -.398, t = -5.873, p < .001$ ). In turn, loneliness was significantly and negatively related to SWL ( $\beta = -.484, t = -6.854, p < .001$ ). As both paths constituting the mediation effect were significant, loneliness significantly mediates the relationship between AC and SWL (*Std. Indirect effect* = -.193, *SE* = .043). The bootstrap CI did not include zero (.1128, .2825), indicating that the indirect effect is statistically significant. This indirect effect is considered to be a full mediation as the direct path from AC to SWL was not significant in the presence of the mediator ( $\beta = .008, t = .1179, p = .906$ ).

### **Frequency of Interaction (FOI)**

FOI was significantly and negatively related to loneliness ( $\beta = -.183, t = -2.486, p = .014$ ). In turn, loneliness was significantly and negatively related to SWL ( $\beta = -.486, t = -7.373, p < .001$ ). As both paths constituting the mediation effect was significant, loneliness significantly mediates the relationship between FOI and SWL (*Std. Indirect effect* = .088, *SE* = .038). The bootstrap CI did not include zero (.0167, .1637), indicating that the indirect effect was significant. This mediation effect too is a full mediation as the direct path from FOI and SWL was not significant in the presence of the mediator ( $\beta = .008, t = .123, p > .902$ ). Although AC and FOI are structural characteristics, they showed significant relations to loneliness as their features contribute towards the individualistic experience of belongingness. The belongingness hypothesis highlights humans' need to form and maintain long-lasting and meaningful relationships (Baumeister & Leary, 1995, p. 497), explaining why limited perceptions of closeness and less frequent interaction could lead to greater experiences of loneliness, which is closely in line with Mellor et al. (2008) who found that loneliness mediated between belongingness and SWL. The results also showed that loneliness was significantly related to SWL, which closely parallel findings in the existing literature that loneliness contributes to dissatisfaction with life (Cacioppo & Hawkley, 2003; Fees et al., 1999; Savikko et al., 2005; Theeke, 2009).

### **Perceived Social Support (PSS)**

PSS was significantly and negatively related to loneliness ( $\beta = -.673, t = -12.291, p < .001$ ). In turn, loneliness was significantly and negatively related to SWL ( $\beta = -.434, t = -4.979, p < .001$ ). As both parts constituting the mediation effect was significant, loneliness significantly mediates the relationship between PSS and SWL (*Std. Indirect effect* = .292, *SE* = .062). The bootstrap CI did not include zero (.1699, .4116), indicating that the indirect path was significant. This mediation effect is considered to be a full mediation as the direct

path from PSS to SWL was not significant in the presence of the mediator ( $\beta = .080, t = .911, p = .363$ ). According to past research, functional characteristics have shown direct relations to loneliness (Kang et al. 2018). This finding further illustrates how these qualitative dimensions of a social network play an important role in predicting the level of loneliness and in turn SWL (Ashida and Heaney 2008: 873; Israel 1985).

### **Summary of Findings and Limitations of the Study**

Given that only AC and FOI out of the four structural network characteristics were significantly related to loneliness, Hypothesis 1 received partial support. Hypothesis 2 was supported as PSS was significantly related to loneliness, and Hypothesis 3 was also supported as loneliness was significantly related to SWL in all five mediation models. However, Hypothesis 4 received partial support as loneliness only mediated the relationships between AC, FOI, PSS, and SWL.

However, these findings need to be considered in light of the study's limitations. First, the sampling method was convenience sampling, and 70% of the sample consisted of students, who may have different characteristics from young adults. Random sampling will have aided in the selection of an unbiased sample, thereby providing more generalisable results. Second, the measures of social network characteristics were adopted from Green et al. (1996) and Green et al. (2001), who placed limits on the minimum and a maximum number of network members as 3 and 10 individuals, respectively. This may have restricted an accurate depiction of the participants' social networks. Third, although the scales adopted to measure PSS and loneliness showed high reliability, participants' responses may have been affected by social desirability bias. Fourth, most of the participants had siblings and lived with parents, but this study did not compare their experience of loneliness with those who had no siblings and/or lived apart from their parents. Fifth, the majority of the student sample could have been busy with work and may not have had time to



experience a deficit in their relationships. However, we believe that in line with the definition of loneliness, as the absence of meaningful interpersonal relationships, it is possible that despite being engaged in studies/employment, a young adult may still feel lonely as they may lack adequate connections with others that are supportive and meaningful.

## CONCLUSION

Overall, results demonstrated that two of the four structural network characteristics (FOI, Closeness) were significantly related to loneliness. PSS was also significantly related

to loneliness. Recent studies have highlighted various ways in which human interaction has been negatively impacted through socializing online (Leung, 2011; Pittman & Reich, 2016). It is likely that social network characteristics can be adversely impacted by online interactions (Phu and Gow, 2019; Sahin, 2012), which may lead to the young adult population experiencing loneliness to a much greater or qualitatively different extent. Therefore, it is critical and timely that future research on social networks and loneliness of young adults, and how this relationship could be moderated by expanding online social interactions, be undertaken.

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## An Interpretative Phenomenological Analysis on Factors Affecting Organizational Commitment by HR Managers of Private Sector Service Industries

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### ABSTRACT

Organizational commitment and its link to various other constructs in organizations has been widely discussed in the Western context. However, the Sri Lankan context is less researched therefore, the present study examines the relationship between organizational commitment and contributing factors of organizational commitment within private sector service industries as perceived by five HR managers from private sector service industries in Sri Lanka. The research has adopted Interpretative Phenomenological Analysis (IPA) approach to conduct the research. Five Human Resource managers were interviewed using semi structured interviews for the qualitative analysis to explore the factors affecting organizational commitment. The qualitative data revealed three superordinate themes of Contributions to organizational commitment by the employer, employee, and peers. The research suggests an existing need to study the perception of organizational commitment with relevance to employees intensively due to conclusions obtained. Moreover, the study has proven that organizational commitment is being influenced by more than the individual characteristics of an employee. The present study emphasis the need for in depth studies in defining and perception organizational commitment within the Sri Lanka cultural context.

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## **INTRODUCTION**

The traditional concept of lifetime employment in one organization has become almost non-existent with the fluidity of modern-day work culture. Loyalty towards an organization has proven to be decreasing and replaced by transitory relationships with shared responsibilities and mutual benefits; changing concept of loyalty in employees is subjected to individual as well as cultural differences. Therefore, identifying the underlying mechanisms of loyalty has been studied over the years within various cultural settings. Research has found that decrease in loyalty has a positive correlation with decrease in organizational commitment (Neal and Hesketh, 2001). The emerging pattern of changing the organization/employer frequently has provided reasons for decreased relationship between the employee and the employer.

The notion of a psychological contract between the employee and the employer is being identified as a vital component of the relationship between the two parties. Changes in psychological contract may create an environment where employees may depict reduced commitment towards employment. (Hart and Cooper, 2001). Therefore, perception of an individual needs to be studied with relevance their attribution. Besides organizational culture: organizational climate depicts the way in which individual's attachment to experience they attain from work. The influence of organizational climate and culture can be directed towards the thought process of individuals in the workforce. Therefore, the current research attempts to explore the link between the way employees attribute their capacities and their levels of organizational commitment.

Occupational well-being is another facet in organizational settings which would have a direct impact towards the commitment of employees (Dhondt, Pot and Kraan, 2014). Organizational commitment has been identified to depict a positive association with organizational outcomes such as occupational well-being, job performance, job involvement and organizational citizenship behaviour (Clausen and Borg, 2010). Moreover,

occupational well-being is strongly linked to affective organizational commitment than the other two components of commitment within an organization due to the attachment towards his or her organization (Clausen and Borg, 2010). Further, organizational commitment has an important constituent with individual well-being as well as individual's ability to deal with stress, and strains of contemporary work life (Clausen and Borg, 2010).

Research suggests that importance of identifying antecedents of turnover intentions as an effective way of reducing actual employee turnover (O'Donnell et al., 2012). Organizational commitment is believed to be one of the antecedent factors of employee turnover. The interest over organizational commitment has been largely stimulated due to evidence in the research literature of commitment being a reason of reduced turnover and increased performance (Cohen, 1993). Extra effort exerted by the committed employees towards the organization especially in developing countries has been proven by the co-existing relationship between organizational commitment dimensions and turnover intentions of employees (O'Donnell et al., 2012)

## **Organizational Commitment**

Organizational Commitment has been defined as the acceptance of organizational values and the willingness to put in effort for the organization and the desire to remain with the organization (Gallie and White, 1993 cited in Nijhof, Margriet, Beukh of 1998). For the current study, the researcher will be adopting the Organizational Commitment model proposed by Allen and Meyer (1991). The model introduced by Meyer and Allen in 1990 focuses on attitudinal as well as behavioral approaches and the complementary relationship of the above two variables in levels of commitment (Allen and Meyer 1990). Meyer and Allen refer to organizational commitment as a mind-set of psychological state which reflects the desire, a need or an obligation which maintain the relationship of membership of an employee towards an organization (Allen and Meyer, 1990). The three-component model



introduced by Meyer and Allen comprises of Affective, Continuance and Normative commitment (Meyer and Allen, 1991). Affective commitment represents the emotional attachment to identification with an involvement with the organization; continuance commitment is based on costs that the employee associates with leaving the organization; normative commitment is the employee's feeling of obligation to remain in the organization (Allen and Meyer, 1990). Even though commitment has been categorized into two aspects; respectively task and organizational commitment, it has been proven individual perspectives matter in terms of assessing organizational commitment than task commitment (Nijhof, Jong, Beukh of 1998). Hence, the need to understand the underlying mechanisms which influence Organizational commitment has been stated in research.

Recent research has focused on organizational commitment due to rapid changes in organizational dynamic in 21<sup>st</sup> century. Research has depicted a link between organizational change and organizational commitment. Herscovitch and Meyer (2002) have evaluated a multidimensional conceptualization of commitment to change. The research emphasizes on the different forms of commitment components and the utilization of the components to predict employee behavior to organizational change (Herscovitch and Meyer, 2002).

Most of the recent studies indicate a positive relationship between perceived organizational support and affective and normative commitment. Research have further mentioned a moderating effect of internal locus of control with relevance to work autonomy (Aube, Rousseau and Morin, 2007). Commitment to change within the organization and the link between locus of control was established by Chen and Wang in 2007 high normative and affective commitment have association with internal work locus of control (Chang and Wang 2007; Munir and Sajid, 2010). Locus of control as a moderator in job satisfaction and

organizational commitment has been proven by Chhabra (2013) and Syahputra (2014).

Qualitative research carried out by Lesabea and Nkosi (2007) on employees 'perspective on organizational commitment has further stated the need for inspection on the facts that effect organizational commitment; the information gathered throughout the study proves the fact that locus of control may have a certain level of influence over organizational commitment (Lesabea and Nkosi, 2007).

The importance of OC has been conveyed in the above content with the use of past literature. Further, considering the cultural differences; Spector et al in 2004 have suggested the need for an approach towards a less culturally bias conceptualization. The present research attempts to initiate an understanding of existing themes which may not have been investigated so far in a diverse cultural background like Sri Lanka. The need to conduct a study in Sri Lankan context was identified since most studies done on organizational psychology are western based. Therefore, with relevance to Asian cultural context the need for such studies is accentuated.

The objective of the study was to provide in depth of knowledge of the factors influencing Organizational Commitment irrespective of any parameters. The importance of understanding the contributions to organizational commitment within private sector service industries and identifying emerging themes with relevance to the above would be addressed by the second objective of the study. Therefore, would provide all-inclusive knowledge with relevance to Organizational Commitment.

Organizational Commitment has been subjected to various interpretations over the years. The need to explore Organizational Commitment in different context has been specified in many recent researches due to variations in the results obtained in diverse geographical and cultural contexts. The current study is an attempt to bridge the



existing research gaps in research conducted on Organizational Commitment.

### **Research Questions Qualitative Inquiry**

The research question for the qualitative phase of the study is formulated with the purpose of exploring further into organizational commitment as most of the previous research lacks qualitative analysis on organizational commitment.

### **Main Research Questions**

What are the contributing factors to organizational commitment in terms of Human resource managers' perspective in private sector service industries?

The research question has been framed with the focus of collecting information that is more relevant to Sri Lankan context specifically through Human resource Managers.

### **Sub Research Questions**

What are the aspects within an organization which would increase organizational commitment of the employee? And

What is the impact of individual differences to organizational commitment in various work settings?

## **METHODOLOGY**

### **Research Design**

The current study adopted a qualitative data collection method with the use of semi structured interviews to obtain data. Data has been analyzed using IPA in order to explore emerging themes from the interviews. Participants were Human Resource Managers and Human resource management executives with minimum of three years of experience. Five individuals from educational, bank, travel and tourism, information technology and event management organizations

working at private sector service industries were recruited using purposive sampling. The research question has been framed with the focus of collecting information that is more relevant to Sri Lankan context specifically through Human Resource Managers. Participant were briefed about the focus of the study and were handed over participant information sheet and the consent form prior to the interview. A pre-planned pilot tested protocol was used for interviews.

Data gathered through interviews were transcribed, coded, categorized, thematically analysed and peer reviewed. Analysis of data was conducted with the use of Interpretative Phenomenological Analysis (IPA). Validation was secured through triangulation of data. The respondents were given a copy of the interview to enhance data validity.

## **RESULTS**

The study focused on identifying the contributing factors to organizational commitment in private sector service industries via interviewing Human resource managers from educational (P1), bank (P2), travel and tourism (P3), information technology (P4) and event management (P4). The verbatim transcripts were extracted from the interviews carried out with five participants from private sector service industries. Significant themes were categorized and were clustered into 4 superordinate themes and number of subordinate themes with relevance to the meanings associated with the discussed concepts by the participants.

The focus laid on various aspects of organizational commitment as well as various definitions found on organizational commitment in different disciplines are identified with the aid of the data gathered. The significance of the identified themes will be further explored in the discussion section along with the quantitative data analysis.

Table 1: Subordinate Themes Clustered under Superordinate Themes.

Superordinate Theme	Subordinate Themes
Contributions to Organizational Commitment by the Employer	<ul style="list-style-type: none"> <li>• Flexibility to work offered by the organization</li> <li>• Support from the employer as an influential factor to levels of organizational commitment</li> <li>• Job descriptions contributing to monotony at work and dealing with it</li> <li>• Recognition offered by the employer as a reinforce of self-efficacy leading to increased levels of organizational commitment</li> <li>• Trust laid on employees by the management leading to fluctuating levels of organizational commitment</li> <li>• Motivation contributing to levels of organizational commitment</li> </ul>
Contributions to Organizational Commitment by Peers	<ul style="list-style-type: none"> <li>• Individual attitudes affecting the group and vice versa</li> <li>• Support offered by peer groups influencing organizational commitment</li> </ul>
Contributions to Organizational Commitment by the Employee Characteristics	<ul style="list-style-type: none"> <li>• Professional qualification for increased commitment</li> <li>• Individual differences as a baseline factor accounting for commitment</li> <li>• Desire to thrive in the field they work</li> </ul>

### **Work Life Flexibility**

Human Resource managers in various industries emphasized on work life flexibility can be found under many instances. Flexibility is explained under many categories such as leave, off days, professional development opportunities offered by the employer. The effect of flexibility draws parallel to work as well as personal life matters. According to the data found in the interviews, interviewees especially in the educational and bank sector do make demands in terms of management being empathetic and understanding towards their work and life commitments in return of employee commitment towards the organization. Apart from the positive components of flexibility the negative effects such as high expectations from the organization have been identified by the HR managers as a facilitator for less commitment towards the organization.

### **Support Offered by the Employee**

Support laid by the employers within the work setting in terms of carrier development, in completing tasks, in acquiring new knowledge, to initiate new ideas are some of the important aspects which were put forward by the HR managers. Further, the notion of a supportive management was identified as an influential component in increased

commitment due to the emotional attachment being created with the organization. Emotional attachment was mentioned as an underlying reason which would enhance commitment towards an organization.

### **Job Description**

Depending on the individualistic nature of the employee, the need to have a matching job description was highlighted by the HR managers. Monotony at work being an initial factor to decreased levels of organizational commitment was emphasized in several ways.

### **Affects Towards Self-Efficacy**

Employee's self-efficacy is a personal belief of which would affect organizational commitment according to the HR managers. The idea of being able to carry out a task in appropriate situations and the realization of organization reinforcing the abilities supplies the employee with the assurance of self-efficacy.

### **Trust Assured by the Employee**

Along with self-efficacy the trust laid on the employee by the organization has been commented as another factor that may influence fluctuation in levels of commitment. Importance of both parties maintaining trust with relevance to work

and other promises made were empathized as well. Breaching the trust leads to complications in organizational commitment.

### **Individual Attitudes Affecting the Group and Vice Versa**

Pleasant work environment created as a result of friendly peer interaction is being highlighted by the participants. Especially the important feelings such as belongingness, acceptance and being a part of a team are emphasized as crucial components in organizational commitment.

### **Support Offered by the Peer Groups**

Further the acceptance offered by the peer group would enhance the commitment of the employee to achieving the targets set by the organization. According to the data gathered even though the employees do not depend largely upon peer interaction in certain private sector service companies educational and bank sector HR managers pointed out peer support or conflicts as a main reason for transfer requests made by employees.

### **Professional Qualifications**

As mentioned above professional qualification has been identified as a component which provides a sense of security to an individual within the organization. Then manner in which the organization reinforces employees to gain further qualification makes room for increased levels of commitment. Healthy completion among the employee in terms of the being professionally competent is another aspect mentioned especially by bank and education sector HR managers.

### **Individual Differences**

Individual differences found in the work force has been pointed out as a baseline factor accounting for commitment by the HR managers in private sector industries. The difference in attribution styles specifically focusing on personal development more compared to development of the organization. Further, various personality types found within the organization according to the HR managers depict different levels of commitment towards the

organization as well as towards the job description irrespective of the company they work. Along with the different personality types the modes of communication has been mentioned as another component which would affect work ethics of the employee all though a direct link could not be established between organizational commitment and various modes of communication of the employee.

Definition of commitment and the interpretation of commitment varies from one individual to the other, data gathered shed light into the fact that the sense of commitment would be limited depending on the individuals' notion of commitment as well. Therefore, HR manager's emphasis on the sense of commitment being varied from individual to individual as well as the influence of cultural background on the sense of commitment are some of the aspects being highlighted through the study.

## **DISCUSSION**

The present study, a qualitative exploration conducted to understand the contributing factors to organizational commitment via interviewing HR managers in five private sector service industries. In depth analysis of data has provided three superordinate themes which are:

1. Contribution to organizational commitment by the employer
2. Contributions to organizational commitment by the peers
3. Contributions to organizational commitment by the employee

The three superordinate themes stand supportive to many components which can be found in the past literature. Commitment being defined depending on the context of the organization is one such differentiation which could be seen via the data gathered through the study.

The finding of the qualitative study of the research suggested that organizational commitment can be influenced due to

flexibility at work in terms of leave, organizational policies and work hours etc. Lesabe and Nkosi (2007) have proved the importance of compensation and nature of work as important aspects within an organization of which would facilitate organizational commitment. Support provided by the employer has been considered as another factor which would enhance commitment of an employee. Support can be considered as a component of psychological contract which was discussed in the introduction of the research. Employer and employee understanding have been proven to strengthen the organizational commitment of the employee. Approachability of the management, professional opportunities such as workshops, conferences are considered as aid provided to enhance professional development of the workforce.

Employee engagement (Nguyen, Mai, and Nguyen, 2014) is proven to be vital to commitment-based-organizations. From the data gathered through the qualitative study it can be confirmed that strategies and policies of the organization would influence commitment of the employee. Especially in the bank sector, employee engagement as well as strategies and policies are being mentioned as main human resource components contributing to organizational commitment (Nguyen, Mai, and Nguyen, 2014). Being able to engage in higher levels of organizational citizenship behaviour can be considered parallel to the ability of intrinsically satisfying tasks employees could engage at work (Lesabe and Nkosi, 2007). Nature of work as well as job description can result in job satisfaction according to research most recently conducted by Zhou et al. (2014). Hence, the mention of job description at work as a contributor to organizational commitment can be justified. Less instances of monotony, acceptance of innovative ideas is some of the mentioned components identified in the present research which would make the work characteristics lead towards job satisfaction.

Motivational aspects at work such as work environment, training programs and

incentives were some of the identified areas as influential key facets to self-efficacy (Dhondt, Pot and Karaan, 2014). Participation in the workplace has been identified as a relative dimension in organizational well-being of the individual (Dhondt, Pot and Karaan, 2014).

Individual differences such as attribution and personality were mentioned as contributing factors to organizational commitment. Moreover, the influence of internal and external locus of control on affective and normative commitment were depicted in the quantitative analysis. A link between intrinsic motivation and internal locus of control may exist according to qualitative data. Since the relationship of organizational commitment and motivation has been established by previous literature present research indicates possibility of an existing relationship in the above two components within the target population studied in the Sri Lankan context. The nature of which peer influence contributes to organizational commitment is an emerged theme identified in the present study. The dynamics of which peer relationships and its influence in employee's notion of pleasant work environment has been emphasized through participant information.

## **CONCLUSION**

The present research has focused on the objectives of exploring the contributing factors of organizational commitment within various organizational backgrounds.

Present research provides many managerial implications of which could be utilized specially to improve organizational commitment of the employees in the following situations. The organizational commitment with reference to other personality differences as well as attribution styles of the employees need to be identified. The utilization of work locus of control in motivating an employee with affective commitment and to foster employee participation in goal setting are some of the strategies which management could implement considering the finding of the present study.

Even though the contributions to organizational commitment have been studied under HR manager's perspective, the need for in depth analysis with reference to employee perspective can be considered a component to be studied in future research. In addition, given the fact that commitment may change depending on other factors such as change in the organization also need to be studied within the same context and beyond to obtain an understanding of the cultural influence that

may occur in organizational commitment (Chen and Wang, 2007).

Present study can be considered as an initiative for research on Organizational commitment within the Sri Lankan context. Therefore, organizational commitment and contributing factors to organizational commitment need be to intensively be studied within the Sri Lankan context thus providing areas to be studied in future research.

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# SICASH

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## Expectations and Satisfaction of Employees with Visual Impairment and Blindness: Evidence from Sri Lanka

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### ABSTRACT

This study aims to determine the expectations of the blind employees and their job satisfaction. Herzberg's two factor theory of motivation has been used as foundation for exploring the expectations of employees. This research adopted a qualitative approach using in-depth interviews as the main data collection tool. Visually disabled employees consisting of totally blind and severely blind persons engaged in formal sector in Sri Lanka represented the study population. A sample of fifteen blind employees representing two major employment categories selected through snowball sampling method were interviewed. Content analysis was the main mode of analysis used to examine major themes. The study observed that in comparison to past literature, there is no substantial difference in employees' key expectations between visually disable and sighted employees. Further, the visually disable employees indicated that key expectations were mostly unmet, except the work environment. The Policy makers and employers need to take into consideration the concerns of blind employees aimed at addressing the issues related to their job satisfaction systematically. The need for public sector to adopt appropriate measures for ensuring safe working environment is highlighted in this study.

## **INTRODUCTION**

### **Background**

Employee motivation is key contributory factor for improved productivity and thereby the organizational performance. A number of factors that motivate employees have been identified since early days of research in this area (Mayo, 1933). Given the wide variation of employee expectations, it would be worth exploring how they change along with the physical and psychological positioning of employees (Graham, Shier, & Nicholas, 2016). Expectations of getting engaged in employment may not only be diverse, but vary from person to person. While a range of motivating factors including physical and physiological needs have been identified by past researchers, people expect several other forms of non-monetary benefits in the workplace. (Berger, Mcateer, Schreier, & Kaldenberg, 2013). This study deals with the expectations of employees with visual impairment and blindness and their satisfaction.

Four levels of visual disabilities namely, mild vision, moderate vision, severe visual impairment and totally blind have been recognized mainly based on medical perspective. (WHO, 2021). However, no major difference is observed between severely impaired and totally blind persons with respect to maintaining social relationships, work and day-to-day living. Hence, this study considers both employees with severe visual impairment and totally blind as one category and is referred in this paper as 'blind employees'.

### **Research Problem**

Given that the persons with visual impairment and blindness (PVI&B) represent a majority of disabled population, the employment and motivation of these employees are of interest to social and management researchers. The number of occupations that can be done by PVI&B are rather limited. There is a tendency for employing the PVI&B with a lower remuneration in comparison to sighted counterparts (Pascolini & Mariotti, 2011). Further, the employers' perception on the

competencies of PVI&B also matters much, when it comes to providing employment for such people. It is also observed that this area of research has not been adequately studied in this region.

### **Objectives**

Purpose of this study is to examine the expectations of employed PVI&B and whether they are satisfied if the expectations are met.

### **Justification**

Since empirical studies on employee expectations of the blind persons have not been adequately researched in the South Asian Region, including in Sri Lanka, this study would bridge a significant knowledge gap. The outcome of the research will help the policy makers and employers to understand the requirements of disabled employees and redesigning the work environment towards improved social inclusion. Further, this study will open the way for further research into problems and issues of disadvantaged people in all forms of disabilities.

### **Literature Review**

Visual disability can be defined as a state of low sight or complete sightlessness and misrecognized as a major health issue. The prevalence of this disability is relatively high in the low and middle-income countries where access to public health services is lacking. Out of 2 billion disabled people in the world, about 285 million people are visually disabled and scattered among the different vision levels (Pascolini & Mariotti, 2011). The estimated number of visually disable people in Sri Lanka is estimated at 996,939 (United Nations Population Fund, 2016). Findings of the literature survey from developing countries revealed that disable people are more prone to be unemployed and unemployment in particular is more prevalent among women. As such, likelihood of getting lower salaries is very high (Jaggernath, Øverland, Ramson, & Kovai, 2014).

A summary of a comprehensive literature on the expectations of employees in general is presented in Table 1. The details of these

factors are not elaborated in this paper due to space limitations. These 10 key expectations

of employees form the conceptual basis of this study.

Table 1: Expectations at Workplace

	Expectation	Literature
1	Employee Safety	Veltri et al., (2017) ; Garcia-Herrero et al., (2012)
2	Job Satisfaction	Singh and Jain, (2013) ; Hoppock and Splegler, (1938); Cotton and Tuttle, (1986)
3	Motivating Potential at Work	Schellenberg et al., (2016)
4	Remuneration	Schellenberg et al., (2016) ; Bell and Mino, (2015)
5	Company Reputation	Graham et al., (2016) ; Balkwell et al., (1980)
6	Employment as means of Social Reputation	Schellenberg et al., (2016) ; Kanas et al., (2011)
7	Equitable Treatment at Workplace	Donaldson, (2017); Schrader et al., (2013)
8	Potential for Advancement of Knowledge	Schellenberg et al., (2016) ; Ispas and Borman, (2015)
9	Prospects for Academic Advancements	Schellenberg et al., (2016) ; Argyropoulos and Martos, (2006)
10	Prospects of Career Advancement	Powell and Butterfield, (2003)

## METHODOLOGY

A qualitative approach using in-depth interviews was adopted for data collection. The Interviews were conducted during July-August 2020. The interviews lasted for about 45 minutes were audio recorded with respondents' permission. The interview transcripts were used for content and thematic analyses, aiming at identifying the common themes of occupational expectations of employed PVI&B and to elucidate perceived fulfilment of such expectations. Fifteen PVI&B, (10 skilled workers and 5 professional workers) identified through snowball sampling technique, represented the study sample. The employee expectations were grouped as 'Expected' and 'Not-expected'. On the other hand, the perception of meeting the expectation were classified as 'Satisfied', and 'Not Satisfied'.

## RESULTS

The summary findings of the analysis are present in Table 2 and Table 3. Findings shown in Table 2 reflect that no significant difference is observed in the expectation of blind employees at workplace between skilled and professional workers, except in two instances relating to skill workers with respect to educational opportunities and motivating potential at work. As table 3 illustrates, satisfaction with respect to each expectation criteria at workplace by respondents are mostly negative.

## DISCUSSION

The findings of this study highlighted that employed PVI&B recognize the prominence of safety in the work environment. This finding is in conformity with the observations of Garcia, Porlier, & Faleschin (2016) where safety is found to be an important expectation of visually disabled employees. Outcomes further show that while some employees expected employers to provide a safe working environment, a few appear to be not very concerned with this matter. In addition, a majority of skilled workers were of the opinion that their organizations are taking adequate safety measures. Jonathan & Mbogo(2016) support these findings as each employee has the responsibility to pay attention to take all safeguards in order to ensure their health and safety in the working environment. Table 3 brings to notice that employees' safety in the workplace is relatively poor in state institutions.

The findings revealed that only some participants were satisfied with their job. Among satisfied PVI&Bs, some respondents emphasized that the overall support extended by their managers matters a lot, apart from being able to make a living from their job. On the other hand, a majority respondents were not satisfied with the level of motivation they get in the workplace. Ridgway & Passey (1995) are of the view that without relevant stakeholders' motivation, it is difficult to achieve organizational goals and objectives. Based on the responses of skilled and professional

workers of this study, it was found that employees' motivation resulted from their need for a living income on one hand, and the job

freedom and the overall management support on the other.

Table 2: Employee Expectations

Indicator	Expectations of		Evidence ( excerpts of interview proceedings)
	PW	SW	
Employee Safety	EX	EX	"There must be a safety inside the company" (SW ) "We definitely need a safe work environment because we cannot see around" (SW) "We really need employee safety when we work" (PW)
Job Satisfaction	EX	EX	"I am so happy to be working here. I need happiness in the workplace" (SW) "I really expect job satisfaction from my job" (SW) "Job satisfaction make me happy and doing the job well." (PW) "Definitely, job satisfaction is what I expect the most" (PW)
Motivating Potential at Work	NE	NE	"I do not think anyone here has motivated me. But that's not a big issue for me " (SW) "No need of any external motivation for me to work " (SW) "I do the work of my own free will" (PW) "I have my inner motivation to do the job. That's how I was brought up" (PW)
Remuneration	EX	EX	"We definitely need a good salary" (SW) "Yea, I need a salary to live in this country" (SW) "I am working for my salary. I have many things to do with that money." (PW) "The first thing I expect from a job is a salary" (PW)
Company Reputation	MX	NE	"I like to work in reputed company." (SW) "I am not interested in company reputation because I am satisfied if I can work. In any place" (SW) "I don't need to get a reputation through the workplace" (PW) "I don't value much the reputation of the place I work." (PW)
Employment as means of Social Reputation	EX	EX	"I am a happy that I got social acceptance because I am working" (SW) "Like everyone else we like social status. With the job I get it." (SW) "People think that those who are working are intelligent and valuable. I like to get that social recognition" (PW) "Yes. I expect social status by doing a good job" (PW)
Equitable Treatment at Workplace	EX	EX	"I wish we could be treated like "normal" people" (SW) "I wish everyone in the company are treated the same way." (SW) "I wish I could be treated and respected the same as other teachers" (PW) "I hope everyone is treated equally like everyone else" (PW)
Potential for Advancement of Knowledge	EX	EX	"We need to gain more knowledge of things about our work" (SW) "I am expecting more knowledge and learn how to do the job " (SW) "Gaining more knowledge is important to us" (PW) "If we have more knowledge, we can do our job faster and easily" (PW)
Prospects for Academic Advancements	NE	EX	"I am not looking for getting more education qualifications. I am not a qualified person any way. " (SW) "More education is not expected in my job. I am satisfied with my status." (SW) "It would be better if more educational opportunities can be obtained. That would help me to get promotions." (PW) "I want to do Masters and PHD" (PW)
Prospects of career advancement	EX	EX	"I am keen to get a higher position in my job." (SW) "I hope to go to the upper seats and work" (SW) "I Like to move forward in my profession" (PW) "Yes, I like to get promotions" (PW)

Key: Skilled Worker- SW; Professional Worker- PW: Expected- EX; Not Expected NE; Mix Response- MX

Table 3: Satisfaction towards Meeting Employee Expectations

Indicator	Satisfaction towards Meeting the Expectations		Evidence (excerpts of interview proceedings)
	PW	SW	
Employee Safety	ST	NS	<p>"We get the level of protection that we expect here" (SW)</p> <p>"We have 100% safety as we get much attention from the top-management" (SW)</p> <p>"we don't have a safe working conditions in our the office" (PW)</p> <p>"The government has not taken any action to provide employee safety, for our specific needs " (PW)</p>
Job Satisfaction	ST	ST	<p>"Yes, we work very happily in this company" (SW)</p> <p>"I definitely enjoy my job because they paid very well" (SW)</p> <p>"Job satisfaction is really seen in the school" (PW)</p> <p>"Sometimes, the company does not respect us" (SW)</p>
Motivating Potential at Work	NS	NS	<p>"It's better if we get more motivation from higher management" (PW)</p> <p>"This school doesn't think much about blind teachers. No motivation from the Principal for me to work. " (PW)</p>
Remuneration	MX	NS	<p>"Though I work hard, I am not satisfied with the salary I get " (SW)</p> <p>"Salary we get from here is not quite good" (SW)</p> <p>"So not satisfied with the income received from the job" (PW)</p> <p>"I definitely want a better salary from the job" (PW)</p>
Company Reputation	NS	NM	<p>"I want to work in a company with a better reputation." (SW)</p>
Employment as means of Social Reputation	NS	NM	<p>"I am not happy with how people in the society treat me, even though I am employed" (SW)</p>
Equitable Treatment at Workplace	NS	MX	<p>"We have got an equality from other companies but not like this company" (SW)</p> <p>"I feel that no one in the company appreciates my work because I am blind" (SW)</p> <p>"I wish I would be treated the same way as other teachers" (PW)</p> <p>"Some teachers don't give due respect to me. That's the problem for me" (PW)</p> <p>"In this company we are all together and working together" (PW)</p>
Potential for Advancement of Knowledge	NS	NS	<p>"There are no opportunities to learn something new in this place" (SW)</p> <p>"We are not happy with the opportunities for us to gain knowledge" (PW)</p> <p>"We need to gain more knowledge from where we work; Not enough." (PW)</p>
Prospects for Academic Advancements	NM	NS	<p>"Not enough ...It would be nice to have educational opportunities as a teacher" (PW)</p> <p>"I do not get any chance to do my MBA, how can we be happy?" (PW)</p>
Prospects of career advancement	EX	NS	<p>"I hope we also can go to the upper seats of this company; bit we stagnate in stagnate in the same place" (SW)</p> <p>"We can't get promotions here because of our vision impairment" (SW)</p> <p>"We hope to go to higher positions but it's not possible in here" (PW)</p> <p>"However, no promotions were received from the government" (PW)</p>

Key: Skilled Worker- SW; Professional Worker- PW: Satisfied- ST; Not Expected -NS; Not mentioned-NM; Mix Response-MX



This study found that all participants are of the opinion that they are not adequately remunerated. Literature supports the finding that remuneration is a key expectation of employees in commensurate with their occupational level (Stronks, Mheen, Bos, & Mackenbach, 1997) and is equally applicable to PVI&B (Garcia, Porlier, & Faleschin, 2016). Further, this study observed company reputation is not a major expectation for some employee groups. This may be due to the practical difficulties in securing a job for PVI&B. Also, the skilled workers who have had worked for long years in that particular company are of the view that their personal standing is enhanced with the company reputation. Garcia, Porlier, & Faleschin (2016) revealed that the recognition of the work of PVI&B is a significant factor for blind employees. Evidence shows that social status of employees is another area of concern. John (2006) has shown that PVI&B are of the opinion that the social standing is a factor that is difficult to achieve due to their disability.

Both skilled and professional workers in this sample believe that they should be treated on an equal footing with other 'sighted' employees. In addition, majority of skilled workers expected to enhance their job knowledge with regard to their job while few did not. On the other hand, majority of the professional workers are willing to gain knowledge in order to climb the career ladder. Findings of Garcia, Porlier, & Faleschin (2016) also support this finding with respect to

PVI&B. The findings reveal that while the professional level workers have a desire to advance in their education, the skilled workers' expectation is only to gain further skills in the job.

It is noteworthy that this study indicates the employed PVI&B are concerned about their blindness as a factor which limits prospects for rising up in the ladder. Though not presented in the results tables, PVI&B demonstrated keen desire for supporting their children's well-being through their employment. This could be explained as cultural determinant of Sri Lanka where the parents' desire is to push their children to higher echelons.

### **Policy Implications and Limitations**

Findings of this study provide important insights for the employers and the policy makers to gain a better understanding of expectations harboured by PVI&B. This would help formulating appropriate strategies not only to keep the employed PVI&B satisfied and motivated, but also to realize the social inclusion and organizational goals. Since this is a qualitative study, investigating a smaller number of cases is adequate for realizing the research objectives. However, a quantitative study designed in the same line of investigation using a large sample representing diverse occupations can be undertaken to explore further into this topic.

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## Factors Influencing Use of Traditional Family Planning by Women in Sri Lanka

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### ABSTRACT

Family planning plays a crucial role in enhancing the health of the mother and the child. Contraceptives are used by most women in the reproductive age span (15- 49 years). Sri Lanka has named as one of the countries with a high usage of traditional family planning (TFP) methods than other Asian countries. However, the reasons for that were not been investigated. Therefore, this study is carried out to identify the significant factors influencing on usage of TFP by using data from Sri Lanka Demographic and Health Survey in 2016 with a sample size of 10835. A binary logistic regression model was developed to capture the factors influencing on the use of TFP. The model was invariant on the type of selection method and the selection criteria. The overall predictive power is 82.9%. The percentages of women using TFP is 16.3%. Among TFP users, withdrawal and rhythm method are 35% and 57% respectively. The knowledge on family planning, having advice from public health midwives, attendance to well women clinics, religion, ethnicity, decision to use family planning, husband's occupation, women's age, women's occupation, women's education level, number of children, and wealth quantile are significantly associated factors with the usage of TFP. The odds of the usage of TFP among the women having no children and women having 1 or 2 children are respectively 1.4 and 4.0 times higher than the women having 3 or more children. The factors identified are geared towards providing robust evidence based on data driven decision making (DDDM) and therefore the key population groups in need of contraceptive services can be targeted more effectively and efficiently. Organizing counselling programmes and promotions on family planning and conducting media awareness programmes to avoid some myths on modern contraceptives can be suggested.

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## INTRODUCTION

Family planning in global context plays a crucial role in enhancing the health of both the mother and the child. Growing demands for contraceptive utilization from both genders is to limit, space, or delay the number of births and size of the family. Different contraceptive methods are used by women in the reproductive age span between 15-49 years age (United Nations, 2017). It further indicates that 63% of women is using some form of a family planning method which varies from 70% in Europe countries to 25% in Western African countries.

In 1965, a national program for family planning was introduced in Sri Lanka and later it was integrated to the maternal and child health activities of the Ministry of Health in Sri Lanka. With the establishment of the Family Health Bureau in 1968 and the implementation of family planning services and training, Sri Lanka became one of the best states in South Asia in implementing family planning practices.

### Family Planning

Family planning is defined as 'the ability of individuals and couples to anticipate and attain their desired number of children and the spacing and timing of their births (WHO, 2020) and it is divided into two categories namely, (i) traditional family planning (TFP) and (ii) modern family planning (MFP) (UN, 2019). According to the SLDHS (2016), withdrawal and rhythm methods are the two TFP methods in Sri Lanka. Globally MFP methods prevent about one-third of pregnancy-related deaths, as well as 44% of neonatal deaths. In contrast, the failure rate of TFP methods is recorded as high. It can affect mother and child health, especially unwanted pregnancies, teenage pregnancies, abortions, maternal deaths, premature births etc. (Gunawardena and Hettiarachchi, 2012). The contraceptive methods help to prevent the transmission of HIV/AIDS and other sexually transmitted infections, but traditional methods are not capable of protecting people from these infections (Shaw, 2010). It shows that there is a risk for having sexually transmitted infections for those who are using TFP methods. Sri Lanka has been identified as one of the countries with high proportions

(15-21%) of who depend on TFP methods than the MFP methods (Singh et al., 1997). An extensive literature survey carried out by Karunaratna (2020) claimed that the factors influencing on the use of TFP have not yet been studied in Sri Lanka, though the required data has been already collected from various surveys. Therefore, the objective of this study is to identify the significantly influential factors on the usage of TFP by women and develop a model to predict the percentage of the use of TFP method under different conditions.

### Secondary Data

This study is based on the Sri Lanka Demographic and Health Survey (SLDHS) in 2016, conducted by the Department of Census and Statistics (DCS) Sri Lanka. This SLDHS 2016 survey is the 5<sup>th</sup> survey conducted in Sri Lanka with the objective of evaluating the impact of population, health and nutrition programmes employed by different government agencies. The survey design was a two-stage stratified probability sample design. At the first stage 2400 census blocks were selected randomly as primary sampling units and then 12 housing units within census block were selected as the secondary sampling units. Of the 28,800 housing units selected for the survey, and information for this study was obtained from 10835 women aged between 15 – 49 years old.

### Variables Used

Dependent variable is the status of use of TFP method (1=yes, 0=no). The details of independent variables are given in Table 1.

### Assessment of family planning knowledge (FK)

The family planning knowledge was assessed using 12 questions asked by the responded women in the SLDHS questionnaire. The questions have two answers as 'yes' and 'no'. Each correct and incorrect answers were scored as 1 and 0 respectively so that total marks for each responded vary between 0 and 12. Based on the total score, respondents were categorized into three categories (1=good, 2=moderate and 3=poor) when the score is between 10-12, 5-9 and 0-4 respectively. Such details were discussed in SLDHS report.

Table 1. Selected variables for this study

Variable	Levels	Code
Women's age	1 – '42-50'	WA1
	2 – '33-41'	WA2
	3 – '24-32'	WA3
	4 – '15-23'	WA4
Husband's age	1 – '49-63'	HA1
	2 – '34-48'	HA2
	3 – '19-33'	HA3
Marital status	1 – 'Married or living together'	MS1
	2 – 'Divorce or separated'	MS2
	3 – 'Widowed'	MS3
Number of children	1 – 'Childless'	NC1
	2 – '1 to 2 children'	NC2
	3 – '3 or above children'	NC3
Women's education level	1 – 'Degree & above'	WE1
	2 – 'Passed G.C.E A/L	WE2
	3 – 'Passed grade 1 to G.C.E O/L	WE3
	4 – 'No schooling or only pre school	WE4
Husband's education level	1 – 'Degree & above'	HE1
	2 – 'Passed G.C.E A/L	HE2
	3 – 'Passed grade 1 to G.C.E O/L	HE3
	4 – 'No schooling or only pre school	HE4
Residential sector	1 – 'Urban'	RS1
	2 – 'Rural'	RS2
	3 – 'Estate'	RS3
Districts by family planning usage*	1 – 'High usage districts'	DU1
	2 – 'Moderate usage districts'	DU2
	3 – 'Lowest usage districts'	DU3
Knowledge of family plan*	1 – 'Good'	FK1
	2 – 'Moderate'	FK2
	3 – 'Poor'	FK3
Decision to use FP	1 – 'My decision'	FD1
	2 – 'Husband's decision'	FD2
	3 – 'Decision of both'	FD3
	4 – 'Decision of PHM'	FD4
Ethnicity of women	1 – 'Sinhala'	RE1
	2 – 'Tamil'	RE2
	3 – 'Muslim'	RE3
	4 – 'Burger'	RE4
Religion of women	1 – 'Buddhism'	RR1
	2 – 'Catholic'	RR2
	3 – 'Islam'	RR3
	4 – 'Hindu'	RR4
Wealth quantile	1 – 'Highest quantile'	WQ1
	2 – 'Lowest quantile'	WQ2
	3 – 'Middle quantile'	WQ3
Women's occupation	1 – 'Manager, professional and administrative jobs	WO1
	2 – 'Clerical, sales, industry and machine related workers	
	3 – 'Unemployed'	WO2
	4 – 'Eliminatory occupation'	WO3
Husband's occupation	1 – 'Manager, professional and administrative jobs	HO1
	2 – 'Clerical, sales, industry and machine related workers	
	3 – 'Eliminatory occupation'	HO2
	4 – 'Unemployed'	HO3
Having advices from PHM	1 – 'No'	AP1
	2 – 'Yes'	AP2
Exposure to FP via electronic media	1 – 'Yes'	EE1
	2 – 'No'	EE2
Exposure to FP via printed media	1 – 'No'	EP1
	2 – 'Yes'	EP2
Exposure to FP via digital media	1 – 'No'	ED1
	2 – 'Yes'	ED2
Attend to well women clinic	1 – 'Yes'	AW1
	2 – 'No'	AW2
	3 – 'Not aware'	AW3

\*Variables were coded using criteria explained below

### Grouping District Based on Family Planning Usage (DU)

The categories of residential districts by family planning usage were also formulated by referring to the usage of contraceptives based on each district as given by the SLDHS report 2016. The three categories of DU (DU =1, DU=2 & DU=3) respectively was based on the percentage of family planning usage: > 70%, 40-70% & < 40% respectively.

### Distribution of TFM vs. MFM

The analysis found that among the family planning users, the percentages of women using TFP and MFP are 16.3% and 83.7% respectively. Among the TFP users, the percentage of withdrawal method and rhythm method are 35% and 57% respectively. The balance 8% is the users of both methods.

### Modelling TFP

The size and significance of the correlation coefficients based on the correlation matrix obtained for all variables in Table 1, using Spearman's rank correlation confirmed that there is no significant multicollinearity among variables. In order to find the significant variables when all variables considered simultaneously, a binary logistic model was developed using both stepwise forward LR and stepwise forward Wald. The entry and removal probability were set as 0.05 and

0.051 respectively. The validity of the model was confirmed based on the non-significance of the Hosmer-Lemeshow test statistic. The significance of each variable was tested using the Wald test. It was noted that the standard errors of the significant variables are low.

Based on the results, it can be concluded with 95% confidence the significant variables on TFP are knowledge of family planning (FK), status of seeking advice from PHM (AP), attendance of women clinic (AW), religion (RR), ethnicity (RE), decision to use family plan (FD), husband's occupation (HO), age of the women (WA), occupation of the women (WO), education level of the women (WE), number of children (NC), district by family planning usage(DU) and wealth quantile (WQ).

The fitted model for odd ratio of the use of TFP method by women, where p is the probability of use of TFP by women, is shown in equation (1). The estimates in (1) tell the relationship between the independent variables and the dependent variable and consequently the amount of increase (or decrease if the sign of coefficient is negative), these are not interpreted as in a normal regression equation. The coefficients of each category of the variable in the model are the odd ratios of the corresponding category with respect the lowest category of the same variable (according to the way we set in SPSS), the interpretation is given based on odd ratios.

$$\frac{P}{1-P} = 2.552 + 1.331 * \text{Knowledge level}(\text{FK1}) + 2.613 * \text{Knowledge level}(\text{FK2}) + 1.245 * \text{Seeking advice from PHM}(\text{AP1}) + 0.751 * \text{Attend to well women Clinic}(\text{AW1}) + 0.700 * \text{Attend to well women Clinic}(\text{AW2}) + 0.728 * \text{Religion}(\text{RR1}) + 1.854 * \text{Ethnicity}(\text{RE1}) + 0.147 * \text{Decision to use FP}(\text{FD1}) + 0.294 * \text{Decision to use FP}(\text{FD2}) + 4.264 * \text{Decision to use FP}(\text{FD3}) + 0.722 * \text{Husband's occupation}(\text{HO2}) + 0.660 * \text{Husband's occupation}(\text{HO3}) + 1.487 * \text{Women's Age}(\text{WA1}) + 2.339 * \text{Women's Age}(\text{WA2}) + 1.881 * \text{Women's Age}(\text{WA3}) + 1.248 * \text{Women's occupation}(\text{WO2}) + 1.380 * \text{Women's education}(\text{WE2}) + 2.436 * \text{Women's education}(\text{WE3}) + 1.423 * \text{Number of children}(\text{NC1}) + 3.983 * \text{Number of children}(\text{NC2}) + 1.396 * \text{Districts by FP usage}(\text{DU1}) + 1.769 * \text{Districts by FP usage}(\text{DU2}) + 1.237 * \text{Wealth Quantile}(\text{WQ1}) + 1.204 * \text{Wealth Quantile}(\text{WQ2}) \dots\dots\dots (1)$$

Results indicate that, the odds of the usage of TFP are 1.331 times and 2.613 times higher respectively among women those who have good knowledge and moderate knowledge on family planning (FP) than the women with

poor knowledge on FP. The odds of the usage of TFP are 1.245 times higher among women who are not seeking advice from the public health midwife compared to women who are seeking advice. The odds of the usage of TFP



are 1.854 times are higher among Sinhalese women compared to the Burger women. The odds of the usage of TFP with the decision to use family planning taken by both husband and wife is 4.264 times higher compared to the decision taken by the influence of public health midwife (PHM). The odds of the usage of TFP are 1.487 times, 2.339 times and 1.881 times higher respectively among women who are in the ages of 42- 50 years, 33- 41 years and 24- 32 years than the women who are in the ages of 15- 23 years.

The odds of the usage of TFP among women who are working as clerical, sales, industry and machine related workers are 1.248 times higher than the women who are unemployed while all the other variables in the model are fixed. The odds of the usage of traditional family planning among the women those who are childless and women those who have 1 to 2 children are respectively 1.423 times and 3.983 times higher than the women those who have 3 or above children.

## CONCLUSIONS AND RECOMMENDATIONS

When all the variables are considered simultaneously using binary logistic regression model, knowledge on FP, seeking advice from PHM, attendance in well women clinic, religion, ethnicity, decision to use FP,

husband's occupation, women's age, women's occupation, women's education level, number of children, districts by FP usage and wealth quantile are identified as significantly associated factors with the usage of traditional family planning. The overall predictivity power of the final model is 82.9%. The values of odd ratio confirmed that most influential factors are source of advice to use TFP, number of children in the family and education level of women.

The identified factors are geared towards providing a contemporary, robust evidence base, so that key population groups in need of contraceptive services can be targeted more effectively and efficiently. The government and the Ministry of Health should pay more attention to the counselling and promotion of family planning programmes among women who use traditional family planning methods in Sri Lanka, by providing them precise practical knowledge related to the use of modern methods. The Family Health Bureau and the Family Planning Association of Sri Lanka should organize family planning awareness programmes to be conducted by Public Health midwives to approach educated working women in Sri Lanka. It should be essential to promote the awareness programmes for working women at their places of employment.

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## Attitudes and Practices of Nurses' Regarding the First 24 Hours Post-operative Pain Management in Teaching Hospital, Rathnapura

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### ABSTRACT

Surgical patients experience a great intensity of pain during the first 24 hours of surgery due to various reasons including tissue damage during the surgery. Therefore, assessing nurses' attitudes and practices on assessment and management of pain especially in post-operative units is essential because nurses are the professionals who play a key role in managing patients' pain. A descriptive cross-sectional study was conducted among 135 government registered nurses in surgical units, Teaching Hospital, Rathnapura. Cluster sampling technique was performed and self-administered questionnaire was used. Ethical approval was obtained from the Ethical Clearance Committee, University of Colombo. The study participants were in the attitude that health workers should not encourage patients to tolerate pain (58.5%), believed non-pharmacological methods are not effective in managing post-operative pain (53.3%), ineffectively treated pain may not lead to chronic pain in future (58.5%), by using placebo injections health professionals can identify whether the pain is real (51.1%), health professionals' religious background affects for the attitude towards patients pain and suffers (55.6%) and if the patient does not complain pain, continuation of analgesics within first 24 hours is not necessary (64.4%). Of them 79.3% believed that patients should be individually assessed to determine cultural influences in pain and 97% are revealing effective communication and therapeutic relationship are as essential components in post-operative pain management. Although the pain assessment scale indicates the most accurate judgment regarding intensity of patient's pain (66.7%), only less than 50% of the participants were assessed the pain using a pain scale. Almost all the nurses follow up the post-operative patients' pain after administration of analgesics (97.8% reassess, 97% observe, 98.5% consider safety measures). However, whether the doctor has prescribed fixed schedule of pain medication, many of them follow that according to their assessment (45.9%). It is recommended to improve nurses' attitudes and practices regarding the first 24 hours post-operative pain assessment and pain management.

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## **INTRODUCTION**

Pain can be defined as “an unpleasant sensation that can range from mild, localized discomfort to agony (Shiel, 2018). In surgical patients, managing post-operative pain is a vital component. Insufficiently managed immediate post-operative pain may lead to unnecessary suffering, impaired recovery, immune suppression, sleep disturbances, physical and psychosocial dysfunction, increased muscular contractions and spasms, increased morbidity and impaired cognitive function (Basak, 2010). Inadequate pain control is inhumane and it may result increased morbidity or mortality too (Ramsay, 2000). Thus, to reduce suffering, to promote the healing process, rehabilitation and to prevent complications, postoperative pain should be alleviated as soon and as effective as possible (Pogatzki-Zahn, Segelcke, & Schugh, 2017).

Social history/issues, cultural and religious beliefs, past pain experiences and the first pain experience may influence for the perception of pain in patients. Pain assessment is a broad concept and it includes clinical judgment based on observation of the type, significance and context of the individual's pain experience. When assessing the level of pain, it should consider about the patient's cognitive ability, environment, level of anxiety and cause of pain (Jacques, 2019).

In addition, nurses spend more time with patients and have the responsibility for assessing patient's pain intensity, administering some prescribed analgesic treatments and monitoring their efficacy. Furthermore, nurses have a significant role in regular monitoring, assessing standards of care and early detection of treatment side effects (Ubino, 2003). Quality of the nursing care and pain management interventions for the patients who are suffering from post-operative pain are based on the knowledge and attitudes of the nurses (Basak, 2010). Lack of knowledge and practice on pain

## **RESULTS**

Among the participants (n=135) most were aged between 39 to 43 years, females (92.6%), and Sinhalese (98.5%). Response rate was

management among nurses remain as a universal problem and critical deficits in knowledge and misbelieves about pain management were evident by all nurses (Watt-Watson, Stevens, Garfinkel, Streiner, & Gallop, 2001, Umuhoza, Odile, 2017). Hence, in this study knowledge, attitudes and practices of nurses at the Teaching Hospital, Rathnapura will be assessed mainly concerning first 24 hours postoperative pain management. Thus, the present study was conducted to assess “Nurses’ attitudes and practices regarding postoperative pain management in the first 24 hours, in teaching hospital, Rathnapura”.

## **METHODOLOGY**

Descriptive cross-sectional study was conducted among government registered nurses working in surgical wards, Teaching Hospital, Rathnapura. Cluster sampling technique was undertaken. The participants were randomly selected from surgical units which can provide post-operative care within the first 24 hours after surgery. The number of estimated subjects was calculated by using G – power analysis 3.0. At least 119 subjects will be needed in significant  $\alpha$  level of 0.05. Considered dropout rate as 10%, final sample size was determined as 135 for this study. Data were collected using an anonymous self-administered questionnaire which was developed after a review of literature on the subject. The initial draft of the instrument was pretested at the Teaching Hospital, Kandy. Registered nurses in surgical units, Teaching Hospital Rathnapura, were included in this study. Nurses working in the medical units and paediatrics surgical units were excluded. Ethical clearance was granted from the Ethical Clearance Committee, University of Colombo. Before the data collection, permission to collect data was gained from the Director, Teaching Hospital, Rathnapura and the participants signed the consent forms before data collection. Data analysis was done by using the Statistical Packages for Social Sciences (SPSS) version 25.

100%. Among them 90.4% were qualified with a Diploma in Nursing. Most of the nurses’ work experience was within the range of 1-5 years (18.5%). Field of working of many respondents was general surgical wards (69,

51.1%). Furthermore, 66.7% have experienced surgical pain in their life and 76.3% have not attend any course or training program regarding pain management after completing their diploma or B.Sc. in Nursing course (Table 1).

### **Attitudes**

In the present study (n=135), 106 nurses (78.5%) viewed as patients should have no pain (Table 2). Among them 68.1%, believed that when administering analgesics for post-operative pain, it should be given early as possible. By assessing the patient (Figure 1), 53.3%) nurses think non-pharmacological methods are not effective in managing post-operative pain.

58.9% did not agree that nurses or doctors have to encourage patients to tolerate pain before administering analgesics", 55.6% (75) thinking that the health professionals' religious background might affect the attitude of pain and suffering and 82, 60.7% did not believe that adult patients' complaint of pain as unreliable. While 51.1% perceived as using placebo injections health professionals can identify whether the pain is real, 48.1% perceived as after administering opioids health professionals will lose the ability of diagnosing pain. Further 64.4% nurses think though the patient does not complain pain, continuation of analgesics within 24 hours is not necessary (Figure 2).

### **Practices**

Among the participants 48.9% assess the pain by using a pain scale (Figure 3). Most of the nurses (97.8%, 132) reassess the post-operative patients' pain after administration of analgesics, 97%, observe the patient after administered the analgesics and 98.5% of nurses consider the safety measures of patient after administering analgesics (Figure 4), 54.8% of them do it frequently (Figure 5). Although the doctor has prescribed fixed schedule of pain medication, some (45.9%) nurses administer them according to the assessment (Figure 6) and regarding "PRN/SOS" schedule of pain medication, 87.4% of the sample were following PRN/SOS schedule, after assessing the patient (Figure

7). 61.5% nurses were practicing non pharmacological methods to relieve post-operative pain (Figure 8), but only 52.6% nurses teach alternative methods to reduce pain. According to their practice, most accurate judgment regarding intensity of the patient's pain can be taken from patient (66.7%) (Figure 9). 79.3% revealed that the patients should be individually assessed to determine cultural influences in pain and 79.3%, of them have identified that effective communication and therapeutic relationship are essential components in post-operative pain management especially during first 24 hours (Figure 10).

### **DISCUSSION**

Of the sample, majority of nurses (58.9%) were in a positive attitude of patients' post-operative pain and they were not agreeing that health workers have to encourage patients to tolerate pain before administering analgesics. In the study of Mrozek, & Werner (2001), revealed that more than half of the respondents reported that patients should be pain free; however, only 5 respondents defined pain free as no pain and others defined it as being comfortable or able to perform activities of daily living. In contrast, in the study of Umuhozaa, et al. (2019), a large proportion of the nurses reported that they would encourage patients to endure a lot of pain before using opioid medication, revealing inadequate practices among the participating nurses.

"Assessment begins with the patient's self-report, which is the most reliable indicator of the subjective state referred to as pain". But the most significant barrier to effective pain management is nurses' reliance on their own subjective judgment (Al-Shaer, Hill, & Anderson, 2011). According to the nurses in the present study analgesics for post-operative pain should be given as early as possible by assessing the patient. Further, in the study of Al-Shaer, Hill, & Anderson (2011), 100% of participants have responded correctly to the question regarding self-report. With supporting that, in the present study 60.7% were not agreeing for the statement of "Adult patients' complain of pain was unreliable. Thus, they do not recommend that

pain medication should be done according to the nurses' assessment without considering patients' complaints.

Attitude was a hypothetical construct that represents a person's preference or hate for an element. Nurses' attitude towards pain management with alternative methods or non-pharmacological pain management therapies has been examined in many studies (Ali, Ibrahim, Mohamed, 2013). According to the current study, 53.3% were believed non-pharmacological methods were effective in managing post-operative pain. In the study of Umuhoozaa, et al. (2019), ineffectively managed post-operative acute pain can contribute to medical complications including pneumonia, deep vein thrombosis, infection and delayed healing, may be life-threatening, may leads to prolonged hospitalization, chronic post-surgery pain and can even be fatal. In contrast, in the present study 58.5% of nurses revealed that ineffectively treated post-operative pain may not leads to chronic pain in future. Further, according to the Umuhoozaa, et al. (2019), quite a large proportion of nurses said that they would give water for injection to determine if the pain was real, which is unethical. Similarly in the present study 51.1% nurses were saying, by using placebo injections, health professionals can identify whether the pain is real. Although everyone experiences pain to some degree, individual responses may be vary. Recognizing and specifying someone else's pain is clinically a well-known challenge. Researches on the biology and neurobiology of pain give a relationship between spirituality and pain (Dedeli & Kaptan, 2013). However, the use of interventions consistent with a patient's spiritual beliefs or religious practices are not routinely applied when planning pain relief (Tracy, 2017). In the present study 55.6% nurses believed health professionals' religious background affects for the attitude of pain and suffers.

Sometimes nurses demonstrated misconceived attitudes such as not giving the required dose of morphine to a smiling patient despite the patient being in pain (Wells, Pasero, & Mc Caffery, n.d). It reveals problems of inadequate knowledge and inappropriate attitudes regarding pain assessment and

management. With supporting that, 64.4% nurses were in the attitude of, if the patient does not complain pain, continuation of analgesics within the first 24 hours is not necessary. To identify the quantity and/or quality of one or more of the dimensions of the patients' experience of pain, it is necessary to measure the pain by using an assessment tool (Ali, Ibrahim, Mohamed, 2013). Of the participants in this study 66.7% revealed the most accurate judgment regarding intensity of patient's pain can be get by the patient and 49% of them were assessed the pain by using pain scale but the "Pain may be under treated as a result of inadequate assessment or the inappropriate use of analgesics, especially opioids" (Al-Shaer, Hill, & Anderson, 2011). After each intervention of pain management reassessment should be done to evaluate the effect, meet the patients' needs, and determine whether modification is needed. Most often opioids usage is avoided due to the fear of causing life-threatening respiratory depression. Nurse monitoring of sedation levels when opioids are initiated is one way to assure safety (Wells, Pasero, & Mc Caffery, n.d). In the current study, almost all the nurses, (97.8%) reassess pain, 97% observe the patient, 98.5% consider the safety measures of and 54.8% of them do this reassessment frequently after administering analgesics. However, it is unclear whether postoperative pain is more successfully treated by using as required (PRN/SOS) or fixed scheduled 'around the clock' (ATC) analgesic administration. During a patient's stay on a surgical ward, nurses hold a great deal of responsibility for pain management, especially when analgesics are prescribed on a PRN basis (Schafheutle, Cantrill, & Noyce, 2008). According to the study of Philip, Joy & Conlon as cited in Schafheutle, Cantrill, & Noyce, (2008), higher amount of analgesics was consumed in the ATC group compared with the PRN group: it would have been helpful to show that the higher volume in the ATC group led to better analgesia but they were not able to demonstrate this. But, there was limited evidence available to draw any conclusions about the efficacy of PRN versus ATC analgesic administration. In the present study whether the doctor has prescribed fixed schedule of pain medication, 45.9% of the



nurses follow the prescription according to their assessment of pain and regarding "PRN/SOS" schedule of pain medication, 87.4% of them administer medication within 24 hours after surgery following assessing the pain.

Non-pharmacological methods have unique advantages to relieving pain (Ali, Ibrahim, Mohamed, 2013). According to many researches, education about non-pharmacological interventions to relieve pain was inadequate. In the study of Mrozek & Werner, (2001), participants reported considerable familiarity with basic non-pharmacologic practices, but only asked residents to try these interventions (in addition to medication) an average of 38% of the time. In contrast, more than half of the participants in the present study (61.5%) were practicing non-pharmacological methods to relieve pain of post-operative patients. Only 52.6% of them are teaching alternative methods to reduce pain for their post-operative patients. Although the pain and its management are significant for the participants' postoperative experiences, it is often overshadowed by problems with language and communication. Thus, in the study of Bruinsma (2011), suggested need for assisting health professionals to provide a culturally appropriate pain management plan, the need of staff education for holistic pain assessments, use of interpreters and associated policies and guidelines as well as staff cultural awareness and sensitivity when caring for patients and their families. With positively supporting that, in the present study 79.3% of nurses believed patients

should be individually assessed to determine cultural influences in pain. Further, almost all the nurses (97%) are revealing effective communication and therapeutic relationship are essential components in post-operative pain management.

This study was conducted at the teaching hospital, Rathnapura. Even though it is a teaching hospital and the main hospital in the Sabaragamuwa province it may not be comparable to other large cities and hospitals. Therefore, this may limit the generalization of the findings.

## CONCLUSION AND RECOMMENDATIONS

According to the level of practice of nurses' regarding 24 hours post-operative pain management, majority of the participants revealed that the most accurate judgment regarding the intensity of patient's pain can be given by the patient. Less than 50% of the participants were assessed the pain by using a pain scale. However, almost all the nurses follow up their patients after administering analgesics and nurses were in a positive attitude of patients should have no/ free from pain. It is recommended to improve nurses' attitudes and practices regarding pain management, especially the pain which occurs during first 24 hours of a surgery, educational curriculum may include patient assessment and the integration of knowledge about pain into daily practice. Further, it is recommended to have the replication of the study with nurses at other hospitals in the country to generalize the findings.

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## Level of knowledge, Practice and Attitudes of Taking Anthropometric Measurements for Nutritional Assessments among Nurses Working in Dr. Neville Fernando Teaching Hospital, Malabe

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### ABSTRACT

A descriptive cross-sectional study was conducted using a convenient sample of 125 nurses working at Dr. Neville Fernando Teaching Hospital (NFTH). A self-administered questionnaire with both open and close ended questions is used to determine the level of knowledge, practice and attitudes of taking anthropometric measurements for nutritional assessments, among the nurses working in NFTH. Out of 136 questionnaires 125 were correctly completed and returned. Majority of the nurses (53%) had a sound knowledge of taking anthropometric measurements. There is a significant association between the level of knowledge and the educational qualifications of the nurses. Graduate nurses had a 'good' knowledge level compared to the diploma or certificate holders which is statistically significant. The majority of nurses had a practice of taking weight measurements (48%) while 37% of nurses had a practice of taking measurements of weight and height. The entire group of participants had the attitude that "anthropometric measurements are important for nutritional measurements". The majority (93%) of nurses were confident in taking weight measurements. Only 57% of nurses were confident in taking measurements of waist circumference. There is a significant difference in the knowledge level among graduate nurses, nursing diploma holders, and nursing certificate holders. Among them, graduate nurses' knowledge was higher than the other two groups. The level of knowledge, practice and attitudes in taking anthropometric measurements for nutritional assessments had no significant association with socio-demographic factors.

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## INTRODUCTION

In Sri Lanka, 30% of the population is overweight while 15% is underweight (World Health Organization [WHO], 2015). Overweight and obesity are common amongst teenagers/adolescents and young adults of the South Asian region (Jayawardena et al., 2017). The nutritional assessment consists of four major aspects including Anthropometric assessments, Biochemical Analysis, Clinical evaluation and Dietary history. Anthropometry includes measurements of body weight, height, abdominal circumference, calf circumference, mid-arm muscle circumference, and subscapular skinfold (Fuchs & Pierre, 2014). Anthropometric assessments are best to perform in the hospital setup considering the advantages reported by Gibson (1998): the procedures used were safe to humans and were non-invasive, it was applicable to large sample groups, equipment required for the technique is inexpensive, portable and durable, and even the measurements can be performed by relatively unskilled personnel. The measurement of body weight and height to calculate the Body Mass Index (BMI) is a major part of various nutritional screening and assessment tools (Green & Watson, 2005). Health care professionals should have good skills to perform nutritional assessments. According to Campbell et al. (2002) it would be difficult to monitor the patient's response to nutritional interventions without recording weight and height. Registered Nurses have close and continuous contact with patients; hence they are in an ideal position to screen or assess for malnutrition (Lennard - Jones et al., 1995) because self-reported weight and height in adults are not accurate (Krul et al., 2010 & Shiely et al., 2013) and inconsistencies in recording body weight can have a negative impact on patient care (Clarkson, 2012). Studies demonstrate that lack of appropriate material, lack of knowledge, and lack of time are the most prominent factors limiting the systematic measurement of body weight and height in hospitalized patients (Bavelaar et al., 2008).

Indicators of body weight status are determinants of overweight or obesity including body mass index (BMI), waist

circumference (WC), and waist-hip ratio (WHR) (Laquatra, 2004). People who carry excess fat within the abdomen (central obesity) are more likely to suffer the consequences of being overweight (Zhu et al., 2002). Fat distribution is measured by Waist Circumference (WC) and Waist to Height Ratio (WHR) as BMI does not give information about the total fat or how fat is distributed in the body (Hammond, 2004). A cut-off value of 75 cm for WC is proposed for both men and women based on the findings of Katulanda et al. (2010). Waist to Hip Ratio is also a simple and effective anthropometric index to identify obesity-associated metabolic risks among Sri Lankan adults (Jayawardana et al., 2012). WHR cut-off values proposed are 0.85 for women and 0.90 for men. The calculation of WHR needs two relatively difficult measurements and hence can be subject to more errors. (Katulanda et al., 2010). Convincing evidence indicates that WC and WHR are strongly associated with many non-communicable diseases declining quality of life and physical activity levels (Chapala et al., 2015). National Health and Nutrition Examination Survey (2004) indicates that correct head circumference assessment is taken by placing the insertion tape across the frontal bones just above the eyebrows, around the head above the ears on each side, and over the occipital prominence at the back of the head. Further it is reported that, the examiner must hold the insertion tape snugly around the head/ waist or hip to take correct measurements.

This topic yields few scholarly articles similar to this study when searched on the World Wide Web. Still, a thorough search would not show any results regarding studies done in Sri Lanka. The purpose of this study is to explore and describe the knowledge, practice, and attitudes of taking anthropometric measurements for nutritional assessments among nurses working in Dr. Neville Fernando Teaching hospital (NFTH), Malabe. Staff nurses who have completed their diploma/ degree from both private and government sectors were working together in the hospital at the time of data collection (from March to June 2018). Therefore study sample is composed of different educational levels as well as different years of experience in nursing

service. Nursing diploma holders passed out from both government and private nurses' training schools, nursing graduates from different state universities and nursing certificate holders were included for the study sample.

## **METHODOLOGY**

### **Study Design**

Cross-sectional descriptive design.

### **Study Population**

The study population consisted of 139 staff nurses working at NFTH.

### **Sampling Method and Sample Size**

According to the simple random sample size determination equation by Abramson (1991), the calculated sample size was 384. As it was larger than the study population, the non-probability sampling method was selected. 139 staff nurses were supposed to participate in the study, but three participants had to be excluded from the study by reducing the sample size to 136, as two nurses were on maternity leave and another one has informed her resignation at the time of data collection. A convenience sample of 125 nurses was responded to an anonymous, self-administered questionnaire after oral and written consent for participation in the study. Nurses who could not understand Sinhala or English medium and part-time employees working in NFTH were excluded from the sample.

### **Study Instruments**

A self-administered semi-structured questionnaire was used to determine the level of knowledge, practice, and attitudes of taking anthropometric measurements for nutritional assessments. The questionnaire consisted of 50 questions/statements in four sections. Section-A composed of 7 questions obtained information on socio-demographic characteristics such as age, sex, and marital status. It also sought information on years of practice, educational qualifications and the working area. Section-B of the questionnaire

consisted of 20 items with both statements and questions to assess the knowledge of nurses. Section-C comprised of 10 items to assess the practice of nurses. Section-D composed of 10 closed-ended questions and each correct answer scores 10 out of 100 to assess the attitudes of nurses.

### **Data Collection**

Data collection was done by distributing a self-administered questionnaire at a time convenient for them avoiding working hours. A pilot study was conducted on the self-administered questionnaire to determine the level of understanding and the time taken to complete the questionnaire with ten staff nurses working in another hospitals with similar characteristics. A few modifications had to be done and a maximum of 15 minutes per participant was taken to complete the questionnaire.

### **Data Analysis**

Statistical Package for the Social Science (SPSS) version 20.0 was used. Frequency tests were used to analyze the distribution of socio-demographic data. The bi-variated analysis was done using cross-tabulation tests and chi-square tests to compare the knowledge level among nurses. Section B of the questionnaire was scored to measure the level of knowledge. In this section, each correct answer to the items was scored one (1) and each wrong answer was scored zero (0). The number of correct answers multiplied by 100 and divided by the total number of items (20). Scores for knowledge level were categorized as, 0- 45: Poor, 46 - 75: Average, and 75 - 100: Good. The higher the score, the greater the knowledge. Frequency tests were used to analyze the practice and attitudes.

### **Ethical Considerations**

The verbal and written informed consent was obtained from each participant before data collection, after explaining the purpose of the study. Data collection was done out of their working premises at the time of off duties. No risk was identified for the participants. Privacy and confidentiality of provided information/data were ensured.

## **RESULTS**

### **Demographic Variables**

Many participants were females (88%) and the highest number of nurses were working in the Intensive Care Unit (16%). The majority (41%) of nurses were nursing diploma holders passed out from government nurses training schools. There were 16% B.Sc. nursing graduates while only 10% of the sample were nursing certificate holders.

### **Level of Knowledge and the Distribution of Factors Associated with the Level of Knowledge**

Data revealed that 53% of nurses have a good level of knowledge while 38% are having an average level of knowledge and only 9% are having a poor level of knowledge about taking anthropometric measurements. All (100%) B. Sc. Graduate nurses had a good level of knowledge while 54% of nursing diplomats from government nurses training schools and 45% of nursing diplomats from private nursing schools and 8% of nursing certificate holders had a good level of knowledge. The association between the level of knowledge and the educational qualifications is statistically significant at the 0.05 level of significance. Sixty-five (65%) of staff nurses had a good level of knowledge and they had less than 5 years of clinical experience while 18% of nurses had a poor level of knowledge who had clinical experience for more than 11 years. Forty-seven percent (47%) of female nurses have reported a good level of knowledge while six percent (6%) of male nurses were in the same category. Data revealed that 100% of participants from the dialysis unit have reported a high level of knowledge comparing to other units. The majority of nurses from Out Patient Department, Radiology Unit and blood bank have shown a poor level of knowledge. There is no significant association between the level of knowledge in taking anthropometric measurements and the working unit/word in the hospital.

### **Level of Practice in Taking Anthropometric Measurements**

A majority of participants (48%) had the practice of taking measurements of weight while only 6% of nurses had the practice of taking height measurements. A majority of nurses (40%) reported that they were practicing weighing often and 3% said that they never practice weighing. Composition of the sample according to the practice of taking measurements of height reviewed that a majority of participants (41%) had the practice of measuring height "sometimes" while 14% of participants had stated that they practice "never". A majority of participants (61%) were not having the practice of taking measurements of waist circumference and none of the nurses had the practice of measuring Hip Circumference. The majority of nurses (76%) had frequent practice of measuring head circumference. A majority of nurses (71%) have stated that they seldom use nutritional screening tools and nutritional guidelines for assessing patients. According to the data a considerable number of nurses take anthropometric measurements of adults (21%), while the majority (71%) of nurses have reported that they take measurements of children. Nurses from the Paediatric ward had an equal practice of taking anthropometric measurements of neonates and children (50%). A majority of respondents have indicated that lack of time as a discouraging factor to take measurements.

### **Level of Attitudes in Taking Anthropometric Measurements**

According to the distribution of data, all of the nurses (100%) working in NFTH believed that anthropometric measurements are important for nutritional assessments. But only 93% had the confidence in taking measurements of weight while 57 % had the confidence in taking measurements of height. The majority of nurses believed that they have confidence in taking measurements of waist circumference (57%) and head circumference (61%). The majority (76%) responded that they felt uncomfortable in taking measurements of body circumferences while 56% were not satisfied with the available resources for taking measurements. The majority (94%)



were willing to learn more about taking anthropological assessments and the majority of nurses (91%) had positive attitudes of including “anthropological measurements for nutritional assessments” in the nursing curricula.

## **DISCUSSION**

Lin and Perry (2007) have found that height is most commonly used as a nutritional index with children. These findings are similar to the findings of this study as all of the nurses working in the paediatric ward had a good practice of measuring height of children for nutritional assessment. Alison et al. (2009) stated that most health care professionals do not receive any specific training in how to carry out waist circumference measurement. Similar to that it is found that the majority of participants have not had training on waist circumference and hip circumference. This study found that nurses seldom use nutritional screening tools and nutritional guidelines for assessing patients. This finding is in agreement with Persenius et al. (2008) as nutritional assessment/screening tools and nutritional guidelines were seldom used for nutritional assessments by the majority of nurses in their study. The majority has stated that “lack of time” as the major cause of factors discouraging to take anthropometric measurements. This is in consistent with two studies by Bavelar et al. (2008) as they have cited too much work to be accomplished by nurses within a short time during their working hours. The majority of participants had positive attitudes towards taking anthropometric measurements and 94% of nurses were willing to learn more about nutritional assessments. This Finding is consistent with the study done by Kim and Choue (2009) to detect knowledge of nutritional assessment in Korean nurses as they have found those Korean nurses having a high desire to receive nutritional information.

## **CONCLUSION**

From the findings of this study, the results clearly show that majority of nurses are having knowledge about anthropometric measurements for nutritional assessments. Among them Bachelor of Nursing, graduates have a statistically significant higher level of knowledge compared to diploma holders who have completed their education from both government and private training schools. Knowledge, practice, and attitudes have not been significantly associated with socio-demographic factors such as sex, marital status, and years of experience. Lack of time and resources were identified as discouraging factors to take measurements.

## **LIMITATIONS AND RECOMMENDATIONS**

The cross-sectional nature of this study limits the capacity to demonstrate the level of knowledge, practice, and attitudes of nurses. Since the information was collected on self-administered questionnaires it is impossible to rule out information bias. This study was performed with 125 participants from 139 of the population. The results cannot be generalized to other populations as the study was conducted in a single hospital. Findings will help in adopting new teaching and learning strategies in nursing education to improve the level of knowledge and practice of nurses. All the practices associated with taking anthropometric measurements were not being assessed in this study. It should be looked into more deeply to obtain better results. Future research should use a larger sample size including participants from different hospitals to generalize the findings. The inclusion of nurses working on a part-time basis will increase the validity of the findings. Specifically, observation based longitudinal studies are recommended to assess the practice of taking anthropometric measurements for nutritional assessment.



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# SICASH

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## Common Complications Related to Peripheral Intravenous Cannulation (PIVC)

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### ABSTRACT

Peripheral Intravenous Cannulation (PIVC) is the insertion of a short, flexible, hollow plastic catheter into a peripheral vein. Indications of PIVC include facilitating hydration, maintaining electrolyte balance, administration of medication, supporting diagnostic procedures in acute and emergencies, infusion of blood and blood components, and parenteral nutrition. PIVC is associated with risks for several complications. The skin, one of the defence organs of the body is penetrated during the insertion of vascular access that results in additional potential risk for PIVC related complications include local and systemic complications. The PIVC induced complications cause significant discomfort, prolonged hospitalization, higher costs, and leads to other illnesses. This review was done to find out the common peripheral intravenous cannulation (PIVC) related complications. For this review, scholarly articles and guidelines published from 2008 to 2020 were obtained by searching MEDLINE, CINAHL, and Pub Med databases. It was found that the incidence of PIVC related complications were significantly high. Phlebitis, pain, infiltration, occlusion and dislodgement were local complications related to PIVC while phlebitis was the most common complication among them. Fear and anxiety were found as systemic complications of PIVC. The rates of PIVC-induced local complications is higher than PIVC-induced systemic complications. However, nurses must be responsible to apply correct techniques and follow the standard guidelines of PIVC. It is also recommended that the nurses must perform careful observations of patients with peripheral intravenous catheters to identify risks of PIVC induced complications and take necessary actions to prevent them.

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## **INTRODUCTION**

Peripheral intravenous cannulation (PIVC) is the insertion of a short, flexible, hollow plastic cannula or a catheter into a peripheral vein (Health Service Executive, 2017). It is a common procedure that is performed more than a billion in hospitalized patients in the world each year. Indications of PIVC include facilitating hydration, maintaining electrolyte balance, administration of medication, and supporting diagnostic procedures in acute and emergency situations (McGowan, 2013). In addition, some other indications of PIVC include infusion of blood and blood components and parenteral nutrition (Royal College of Nursing, 2016).

A complication is defined as a problem that develops from an existing illness which requires further treatment (Cambridge Dictionary, 2020). PIVC is associated with the potential for several complications (Cicolini, 2014). The skin, one of the defense organs of the body is penetrated during the insertion of a venous catheter that results in additional potential risk for PIVC induced hazards (Dougherty & Lamb, 2008). There are two types of PIVC related potential complications including local and systemic complications (Gorski, 2008).

Abusafia and Boztepe (2017) reported that, the insertion of PIVC is done in the majority of hospitalized patients and however, the occurrence of complications among them is common. Therefore, the study about PIVC induced complications is important because they may cause severe discomfort, unnecessarily extended period of hospitalization, increased costs, and extra illnesses (Kaur et al., 2019).

## **METHODOLOGY**

The review was mainly focused on common complications of PIVC. CINAHL, Google Scholar, MEDLINE and PubMed databases were used to select the articles according to the prism method. Two articles from CINAHL, one article from MEDLINE, six articles from PubMed while seven articles were selected for this review. Five key words including

peripheral, intravenous, cannulation, complications were used to conduct the literature search. A fewer number of related articles have been published on the topic. Hence, it was possible to find out only 10 articles published between the last five years. Among the other selected articles, three articles have been published within the last 10 years while only two articles have been published 12 years ago. Based on a search strategy, peer-reviewed articles were found except the web pages of the Cambridge dictionary and Nursing standards published by the Royal College of Nursing. By requesting Full-text articles written in English language, altogether 15 pieces of literature were found. Seven articles among the selected ones were carefully reviewed and PIVC related complications found from them were categorized into predetermined two themes as local and systemic complications. Gorski (2008) also has described that PIVC-induced complications can be divide into two types such as local and systemic complications.

## **FINDING AND DISCUSSION**

Alexandrou et al. (2015) conducted a cross-sectional study to assess the international prevalence of the use of peripheral intravenous catheters in medical and surgical departments of 14 hospitals in 13 countries across different regions of the world and revealed that 59% of patients had at least one PIVC related complication and 12% had experienced at least one symptom of phlebitis, the inflammation of the tunica intima, the inner layer of a vein.

Similarly, Abolfotouh et al. (2014) also conducted an observational prospective cohort study to investigate incidence and predictors of peripheral intravenous catheter-induced complications at King Abdulaziz Medical City (KAMC), Riyadh, Saudi Arabia and, revealed that 842 hospitalized adult patients had PIVC related complications. In the same study, phlebitis occurred in 148 (17.6%) patients among 359 of the purposive sample of adult patients who had PIVC. Other types of local complications have occurred in fewer percentages including 0.5% patients had occlusion described as the blockage of the vein

due to its inflammation, 3.9% patients had leaking from the cannula site, 2.4% patients had dislodgement of their cannulas and 7.6% patients had pain which is an unpleasant sensation and categorized as a local complication.

In a similar observational prospective study conducted by Simin et al. (2019) to assess the prevalence, seriousness and risk factors of PIVC related complications among 368 patients hospitalized also reported hospitalized patients had a 44% of significantly higher incidence with the occurrence of phlebitis, 16.3% of infiltration, 5.6% of dislodgement while 7.6% of occlusion. Providing similar ratings, Simin et al. (2019) also revealed that the increased rate of local complications including phlebitis, infiltration, occlusion and dislodgement while no evidence of having systemic complications.

Reporting similar findings, in a randomized control trial which was carried out by Danski (2016) in clinical and surgical sections in a large teaching hospital in Brazil, with 169 patients who hospitalized more than 96 hours including 90 participants with completely safe catheters were allocated to the trial group and 79 participants with short flexible catheters to the control group, it was revealed that 55.62% of overall complication rate including 18.34%, a higher incidence rate of phlebitis and 18.83%, 11.24%, and 9.47% of infiltrations, obstructions of the cannula and accidental tractions respectively. Even in the control group, the overall complication rate was 55.7%, the incidence of phlebitis, infiltrations, obstructions of the cannula and accidental tractions were 15.19%, 11.39%, 13.92% and 10.13% having no significant differences between the rates of the trial group. Participants in both trial and control groups, phlebitis, infiltration, obstructions of the cannula and accidental tractions were identified as PIVC related local complications with higher rates of phlebitis, while no patients were identified with systemic complications.

Reporting similar findings irrespective to the clinical prospective observational or randomized clinical control trials, studies

conducted by Alexandrou et al. (2015); Abolfotouh et al. (2014); Simin et al. (2019) and, Danski (2016) identified that the incidence of phlebitis has a significantly higher rate of PIVC related complication among the patients. When carefully reviewing all studies, the occurrence of local complications of PIVC such as phlebitis, pain, occlusion, leaking and dislodgement were identified while no patients had systemic complications of PIVC.

Reporting different type of findings compared to the findings of studies conducted by Alexandrou et al. (2015); Abolfotouh et al. (2014); Simin et al. (2019) and Danski (2016), in a prospective cohort study which was conducted by Abusafia and Boztepe (2017) to evaluate PIVC local complications among 100 hospitalized patients with 201 PIVCs in medicine and surgery services, it was revealed that infiltration was the most common complication of PIVC among patients having the highest rate of 72%. Similar to the findings of the study conducted by Abusafia and Boztepe (2017), in the quantitative observational study which was carried out by Chopade and Dhudum (2018) to assess the effectiveness of standard operating procedure related to peripheral intravenous therapy on prevention of intravenous related complications among staff nurses, it was reported that the infiltration rate at the catheter site was 25.3% and higher than the 6.3% of other complications than phlebitis and local infection at cannula site. However, similar to the other studies conducted by Alexandrou et al. (2015); Abolfotouh et al. (2014); Simin et al. (2019) and Danski (2016), Abusafia and Boztepe (2017) and Chopade and Dhudum (2018), this study also revealed that the incidence of local complications had higher ratings than of systemic complications.

Phlebitis is categorized as a local complication and also identified as the most common complication among the studies conducted by Alexandrou et al. (2015) and Abolfotouh et al., (2014). In the study conducted by Abusafia and Boztepe (2017) and (Chopade & Dhudum, 2018), infiltration was identified as the most common local complication of patients with PIVC. However, both phlebitis and infiltration



are categorized as local complications rather than systemic complications.

Meanwhile, a descriptive cross-sectional study which was conducted by Tee (2015) to assess adult patients' perception and experience of comfort, pain and anxiety with 120 adult patients revealed that 95% of patients had pain perception while 73.3% reported anxiety during the insertion of PIVC. Among the patients, 53.2% concerned that they were frightened of needle pain, 30.2% were afraid of the competencies of nurses while 13.5% were afraid of bleeding. Although pain, anxiety and fear can be categorized as a psychological experience rather than physical, those complications also can be categorized as local and systemic complications. Pain which is the local complication is more common having a higher prevalence rate of 95% among the patient while the prevalence of fear of pain and fear of bleeding were respectively 73.3%, 53.2% 30.2% and 13.5% showing evidence that there was 95%, a higher incidence of pain which is a local complication comparing to the other complication of PIVC.

During this review, there were two major types of PIVC related complications including local and systemic complications were identified. Possible local complications of PIVC that have been commonly reported were phlebitis, pain, and infiltration/extravasations although other complications such as occlusion, leaking from the cannula site and dislodgement were identified as less common local complications of PIVC among the patient while anxiety was identified as the commonest systemic complication among them. At the same time, anxiety and fear were identified as systemic complications but were found only from one of the seven studies. However, throughout this review, it is highlighted that the incidence of local complications was higher than the incidence of systemic complications.

The results of this review would be applicable for practicing approved nursing standards of PIVC for improving the management of PIVC and minimizing PIVC related complications. Cicolini (2014) recommends that the correct use of nursing guidelines must be practiced by nurses to improve nursing care related to PIVC. Although the occurrence of systemic complications is fewer than the local complications, systematic complications may be more serious than local complications because local complications can be observed from outside very early while systemic complications can be identified by performing careful and close observations because those may not be easily observable from outside. Therefore, it was recommended that careful and frequent assessment of signs and symptoms of the cannula site must be done by nurses to identify complications that may lead to serious complications (The Royal Children's Hospital Melbourne, 2020).

## **CONCLUSION AND RECOMMENDATIONS**

In this review, phlebitis, pain, and infiltration/extravasation, occlusion and dislodgement were identified as local complications of PIVC while phlebitis were highlighted as the most common complications among them. Anxiety and fear were identified as systemic complications. PIVC related local complications were reported as higher incidence than systemic complications. However, nurses are responsible to apply correct techniques and follow standard guidelines of management of PIVC and prevent PIVC related complications. It is also recommended that the nurses must perform careful observations of patients with peripheral intravenous catheters to identify risks of PIVC induced complications and take necessary actions to prevent them and minimize the suffering of patients.



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## ANEXURE

Table 1: Summary of the Review

	Article 1 Abolfotouh et al. (2014)	Article 2 Alexandrou et al. (2015)	Article 3 Abusafia & Boztepe (2017)	Article 4 Chopade & Dhudum (2018)	Article 5 Tee et al. (2015)	Article 6 Siminet al. (2019)	Article 7 Danski et al. (2016)	
							trial	ctrl
Overall							55.56%	55.70%
Local Complications								
Phlebitis	17.6%	12%	6%	6.3%		44%	21.11%	15.19%
Pain	7.6%							
Infiltration			72%	25.3%		16.3%	12.22%	11.39%
Occlusion	0.5					7.6%	8.89%	13.92%
Leaking	3.9							
Dislodgement	2.4					5.6%	8.89%	10.13%
Systemic Complications								
Blood Stream Infections								
Fear of Pain					30.2			
Fear of Bleeding					13.5			
Anxiety					73.3			

# Posters



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## Production of Cassava Starch Composite as a Sustainable Alternative for Plastics

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### ABSTRACT

Production of petroleum-based non-biodegradable plastic is increasing all over the world while making a huge threat to the environment. As a solution, in the past few decades, there has been a marked advance in the development of bio-plastics from renewable resources mainly from starch-based materials for different applications. The aim of this study was to develop a bio-plastic from Cassava (*Manihot esculenta*) and reinforce with materials to improve the tensile properties with respect to HDPE towards industrial applications. Initially, starch was extracted from the Cassava tubers and using the 'doctor-blade method', plastic films were prepared with various formulations. By varying percentages of Citric acid and Phosphoric acid, a series of plastic films were made and to optimized tensile strength with to respect HDPE. An optimized recipe for plastic films containing Cassava starch, Citric acid and, Phosphoric acid was selected to incorporate reinforcing modifiers such as Graphene Oxide (GO) and r-GO. GO for reinforcement was produced using Tour's method. The chemical and mechanical properties of the produced films were recorded and analysed using Fourier Transform Infrared Spectrometer (FTIR) and tensile strength tester respectively. Additionally, an ANOVA was also performed for all the tensile strength results, at a confidence level of 95% to select the optimized recipe. The FTIR spectroscopy revealed an appearance of ester carbonyl peak at 1700-1750 cm<sup>-1</sup> indicating that the hydroxyl group of starch has been cross-linked with Citric acid forming an ester group. Tensile strength results indicated that the strength of the cross-linked films have also increased beyond the reported value for HDPE, which is 20 MPa. The tensile strength and FTIR spectroscopy results obtained for different films concluded that the optimized Citric acid percentage as 3%(w/w) with 1%(w/w) Phosphoric acid. The ANOVA indicated that there is a statistically significant effect on tensile strength at 95% confidence level from the interaction between Phosphoric acid and Citric acid. Time limitation and waiting period for certain results restricted the fast progress of the project and therefore had to limit the original scope. In conclusion, plastic films containing 96% Cassava starch were prepared to match the tensile strength of HDPE and some preliminary studies of reinforcement were carried out with GO and r-GO. Further studies to show the permeability, biodegradability and solubility should be carried out with these plastic films to optimize towards industrial applications.

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# SICASH

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## Factors influence in adapting of bottled water consumption in selected urban, semi urban and rural areas of Matara DS division

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### ABSTRACT

Bottled drinking water usage shows a rising trend in worldwide and has become a key component in the segment of non-alcoholic beverages while becoming a massive environmental issue due to the plastic wastes accumulated due to this industry. Apart from the demographic factors such as gender, occupation and age, factors such as degree of urbanization also affect for the consumption pattern of bottled drinking water. Therefore a survey was conducted to examine the factors that influence bottled water consumption in selected urban, semi urban and rural areas of Matara Divisional Secretariat division in Sri Lanka. Grama Niladhari divisions of Walgama North, Hiththetiya and Issadeen town were selected as urban areas, Thudawa, Meddewaththa and Godagama as semi urban areas and Weherahena, Maakawita and Kekanadura as rural areas for the study. Randomly selected 150 respondents were interviewed using a structured questionnaire. Survey was carried out during July to August in 2019. According to the survey 18% and 12% of the respondents in urban and semi urban areas use bottled water as their primary drinking water source respectively while none of the respondents use bottled water as primary drinking source in rural areas. The influence of demographic factors such as age, gender and occupation on bottled water consumption varies in urban, semi urban and rural areas of Matara DS division. People in urban and semi urban areas have a better awareness on the origin and the treatments done to the bottled water than that to the people in rural areas. In urban areas bottled water is used for drinking (96%) and cooking (6%). But in rural and semi urban areas used only for drinking. In rural areas, bottled water is used in a flood condition and when travelling. In rural and semi urban areas, salty, muddy conditions and chlorine taste and odor of tap water, frequent water cuts and health concerns lead people to buy bottled drinking water.

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## A Comparative Study between Tissue Biopsy and Liquid Biopsy in the Diagnosis of Cancer

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### ABSTRACT

Tissue biopsy is invasive, and it can be accompanied by surgical complications and pain. Concept of liquid biopsy is the analysis of tumors utilizing biomarkers circulating in liquids, for example, the blood. Samples may be insufficient and need repeating- Tissue biopsies may not generally be effortlessly acquired and frequently may include the utilization of progressively obtrusive methodology. In tissue biopsy, a long thin needle is inserted into the area of suspicion. Liquid biopsy is a test done on a blood sample to find DNA fragments from cancer cells or cancer cells in a blood clot. The basic needle biopsy uses a large needle with a cutting tip to draw a strip of tissue from a suspicious area. Liquid biopsies can be used to help detect cancer at an early stage. Most pathologists depend on playing out a tissue biopsy to analyze a malady and they are prepared explicitly to perform different cytological tests on the submitted tissue example. The needle used throughout a core biopsy is Associate in Nursing empty cylinder that allows to untangle a core of tissue for testing. Tissue diagnostic test to assist Associate in Nursing analyze Associate in Nursing upset or to preclude an upset or condition. Advantages and Disadvantages of Liquid biopsy Advantages of Liquid biopsy ct-DNA and CTCs represent the overall tumor heterogeneity and help in the complete assessment of patient's resistance and in predicting response to 1790M- targeted inhibitors.

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## Applications, Benefits and Drawbacks of Bioprinting – A Review

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### ABSTRACT

Tissue regeneration technology, also known as 'bioprinting' is a work in progress and has made many advances in recent years. Following the invention of 3D printing in the 1980's, bioprinting has evolved to print various tissues such as heart valves, hepatic tissues and breast cancer cells. Now, many commercial bioprinters are available. Bioprinters show variety in the way they function, their speed, and their cost of operation. There are three common techniques used in this technology: inkjet-based, laser-assisted and extrusion-based bioprinting. The printers require a bioink and scaffold to ensure production of mechanically stable constructs which are able to mimic human tissues. Specific hydrogels and biomaterials are chosen for each printing method. Mainly, gelatin, agarose, alginate, hyaluronic acid, chitosan and fibrin are used. Biopolymers such as PEGDA, PEG and PEGX-PEG are used for structural maintenance of tissues. The Bioprinting technology aims to improve treatments for burns, injuries and cardiovascular diseases by replacing traditional treatments such as autografts, allografts and skin grafts. Ethical issues and legal issues exist with this novel technology but its benefits for animal testing, drug discovery and organ transplantation cannot be ignored.

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## Biotechnology - The Panacea When Everything Else Fails

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### ABSTRACT

Biotechnology is a vivid and a widely applied component in the present world. As the whole humanity is under a huge threat of a global pandemic, the presence of innovative biotechnological applications is in dire need. In this review, we are discussing about a plethora of major immunological threats that took place in the globe from the dawn of time. The biggest spotlight would be given to the remarkable biotechnological advancements that are carried out by accomplished research scientists across the globe, regarding the SARS-CoVid-2 virus, as it is the biggest threat prevailing at the moment. A diverse number of researches are being conducted by individuals and organizations in every nook and corner of the world to combat this threat and these experiments are mainly being performed by genetically altering the DNA and RNA sequences of the virus model and by modifying the genetic information of human host cells. A couple of vaccines that are capable of reducing the virulence of the above-mentioned virus have been introduced by scientists and now are being administered at a global level. The latest additions to these vaccines are Moderna, Pfizer-BioNTech vaccine, AstraZeneca vaccine and the Johnsons & Johnsons vaccine. Different Covid-19 detection tests such as the RT-PCR test, rapid antigen test and serological test are also being implemented with the aid of biotechnology. Furthermore, a simple suggestion to make the testing procedure more convenient for this virus is also being discussed in the latter part of the review. These types of immunity-based attacks can be avoided to a certain extent by the effective use of biotechnological techniques.

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## Molecular Approach to the Covid 19 VIRUS

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### ABSTRACT

Covid – 19 has become a burning problem that has spread all over the world. Cities locked down, airports closed, children have no way of attending school. It is said that for the past few months, more than 2/3 of the world's population were under lockdown. All these happened as a result of a tiny virus. This article refers to the scientific approach of the Covid -19 virus and how this virus could be eradicated from the world. It includes the latest facts that are found by researchers, scientists and biotechnologists all around the world. It mainly focusses on the structure of the virus, the types of Corona viruses and the lifecycle of the Covid -19 virus. Further it discusses different types of the Corona virus that have affected the whole world in the past and this article shows how this virus has spread among the main countries in the world. University of Oxford, a leading university in UK as well as around the world is taking the lead in finding a vaccine for this deadly virus. Also, how our very own Sri Lankan Scientists and Biotechnologists are striving hard to find a cure for this virus is further discussed in this article. Few recommendations are given in order to get protected from this deadly virus.

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## Metal Recovery from Printed Circuit Boards through Biotechnology

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### ABSTRACT

The increase of e-waste generated through electrical and electronic equipment has led to vast exploitation in recent years as they have increased the risk of destruction of both life and the environment. The end-of-life PCBs represent one of the most significant wastes in this category. PCBs contain a high amount of Cu and Zn with concentrations around 25% and 2% respectively. Pyrometallurgical treatments and hydrometallurgical treatments are the most common methods used for PCB recycling at present. Bio-hydrometallurgical strategies have been identified as a successful alternative for the existing methods as they reduce the economic costs and are more environmentally friendly. The poster introduces a sustainable bioleaching process by using two bacteria *Acidithiobacillus ferrooxidans* and *Leptospirillum ferrooxidans*. This developed technology allows to obtain a high PCB concentration and to reduce the metal toxicity on the bacteria metabolism. Ferric iron was used as the oxidant to leach Cu and Zn. The best conditions were when *At. ferrooxidans* was used at 30°C, with a solid concentration of 5% (w/v) with 10g/L of Fe<sup>2+</sup> for 9 days. The carbon footprint assessment proved the environmental advantage of the process. The bioleaching treatment which was the most efficient method according to the analyzation explained that the amount of raw material reduction that results in decreasing the bioreactor size and lowering the energy requirement could be facilitated by increasing the PCB concentration. Through this process, the environmental impact could be decreased up to 4 times compared to the existing bioleaching processes.

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## Off the Wall: A Literary Analysis on 'The Fly'

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### ABSTRACT

The poster analyzes the literary depth and purpose of the poem, "The Fly" written during the Romantic period by the Gothic painter, engraver and poet, William Blake. It briefly explores the biography of the author and his contribution to the period through his voluminous works of poetry which illustrate ideas on religion, politics and the social environment of that era which was influenced by the French and Industrial Revolutions. This poem could lay claim to the Romantic Era as it is based on themes including personal contemplations on ideas of valuing all life great and small, the inevitable march of time and how one must make the most of every moment of life. The literary devices used include using the fly as a symbol of the trivial lives men lead, the imagery of summer representing new life in bloom, in addition, rhetorical questions that challenge conventional thought are also seen. There are also underlying notions of the appreciation of nature, how the most seemingly insignificant of events can cause man to contemplate the brevity of life, an unspoken warning against playing God is also given. The poster emphasizes Blake's ability to compel readers/listeners to put themselves in the position of a fly, under the power of something greater and more powerful than themselves. It illustrates the futility of leading directionless lives of revelry until the fateful hand of death takes hold. The clear, powerful, yet simple message it sends is – carpe diem, seize the day, the minute, the hour and the opportunities before they inevitably pass us by.

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## The Social Vision Reflected Through the Poetry of William Blake

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### ABSTRACT

The poetry of William Blake is an ideal portrayal of social issues which prevailed during the poetic period of romanticism. The poem “London” has been presented in a way to make the readers aware about the concept of commercialization. London, was not a peaceful city anymore. Corruption has gnawed the innocence of people. Thus, it has made them immoral. Furthermore, Blake’s progressive vision of the 20<sup>th</sup> century concept on gender equality is promoted in ‘The Sick Rose’, which is a symbolical representation of women’s plight in parasitic relationships. The poem, ‘The Sick Rose’ indicates problems which are parallel to those of our current society where, sensual pleasures are given more prominence over spirituality. Simply, reciprocation of love does not exist anymore due to insatiable sensual desires of mankind. In addition, Blake displays his social vision in presenting children as the victimized entity in “Holy Thursday” and “The Chimney Sweeper”. The pain, torture and agony encountered by children who were brought up under institutional care were not publicly displayed. However, all this was suppressed by religion and the religious leaders, which indeed is ironic and repulsive. “The Chimney Sweeper” is a denunciation of the material conditions and the institutions: the established church, mercenary and the uncaring parents who promoted child labour. Blake’s social vision could have been influenced by the French revolution and industrialization which would have brought out quite a few social problems which are valid in the 21<sup>st</sup> century as well.

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## A comparison study of removing Rhodamine B from waste water by functionalized natural and synthetic porous carbon.

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### ABSTRACT

Textile industry discharge a huge amount of dye containing waste water which pollutes water, soil and also have adverse effect on human health, animal and plant. Approximately 10 – 15% of the synthetic dyes is released into the industrial waste, causing serious environmental problem, flora and fauna of aquatic ecosystem. It causes contamination of surface water, accumulation of toxic and carcinogenic substances in water. Rhodamine B is widely used in industrial purposes. However, the organic dyes will cause serious environmental and biological problems. Thus the removal of dye from water is a great challenge and a pressing task. Various porous carbon materials were applied to remove organic dye materials such as Rhodamine B from wastewater. Synthetic porous carbon was synthesized through the sol-gel method and carbonization process and naturally abundant waste materials like Rice husk and Coconut husk available at low cost were used as functionalized porous carbon materials which were obtained from slow pyrolysis process. According to the FT-IR, SEM and adsorption analysis adsorption capacities of these porous carbon materials were determined for Rhodamine B. HNO<sub>3</sub> treated porous carbon materials were expressed positive results for absorptivity of RhB.

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