



Abstracts

17th Academic Sessions and 16th Vice Chancellor's Awards

04th March 2020



University of Ruhuna
Matara, Sri Lanka



Abstracts

17th Academic Sessions and 16th Vice Chancellor's Awards

ISSN 2362-0412

All Rights Reserved

©2020 University of Ruhuna, Matara, Sri Lanka

Editor- in- Chief

Dr. Wijerathne Bohingamuwa, Faculty of Humanities and Social Sciences

Organizing Committee and Editorial Board

Chairperson

Senior Professor P. Hewage, Faculty of Humanities and Social Sciences

Secretary

Dr. Nandasiri Keembiyahetti, Faculty of Humanities and Social Sciences

Editorial Board

Dr. W. Bohingamuwa
Rev. Dr. Beligalle Dhammajothi
Mr. Dammika Jayasinghe
Dr. Darshana Liyanage
Dr. K.A. Nisantha
Dr. Chaminda Kumara
Mr. Nishantha Kariyawasam
Ms. Wasana Fernando
Ms. Indu Gamage
Ms. S.M.N.M. Dissanayaka
Ms. K.H.M.A.U. Kariyawasam
Ms. H.S. Hidellaarachchi
Ms. K.V.J. Koshalee
Ms. S.T.W.M. Pushpananda
Ms. G.A.R.C. Jayarathna
Ms. D.S. Anupama
Ms. C.A. Dahanayake
Ms. P.P. Samarawickrama



Faculty Representatives

Prof. J. Lenora, Faculty of Medicine

Dr. Yasoda Hirimuthugoda, Faculty of Agriculture

Dr. Anududdhika G. Jayasinghe, Faculty of Engineering

Dr. K.S.S. Atapaththu, Faculty of Fisheries and Marine Sciences & Technology

Dr. Dushmanthi Silva, Faculty of Humanities and Social Sciences

Dr. Shyama Ranabahu, Faculty of Humanities and Social Sciences

Dr. G.T. Wasantha Sriyani, Faculty of Management and Finance

Dr. R.D.A. Gunasekara, Faculty of Science

Dr. P.K. Subash Jayasinghe, Faculty of Technology

Ms. Kanchana Wijesekara, Faculty of Allied Health Sciences

Dr. Kokila Ramanayaka, Main Library

Mrs. Manjula Yapa, Administration

Web Editor

Mrs. Upeksha Gamage, Faculty of Humanities and Social Sciences

Treasurer

Dr. Chandika Gunasinghe, Faculty of Humanities and Social Sciences

Printers

Samara Advertising (Pvt) Ltd., Matara



How to cite

Author(s), 2020. Title of the paper. In *Abstracts of the 17th Academic Sessions of University of Ruhuna*, edited by Wijerathne Bohingamuwa. Page No. University of Ruhuna, Matara



Foreword

In my capacity as Chair, I take pleasure in sending this foreword for the Abstracts Book of the 17th Academic Sessions and the 16th Vice Chancellor's Awards which are extremely important events in the university calendar usually held in a single ceremony, and this time, hosted by the Faculty of Humanities and Social Sciences, will take place at the University of Ruhuna Wellamadama Campus, Matara, on March 4th, 2020.

Further, I am happy to indicate that 'Innovation and Creativity for Social Well-being' the theme of the Academic Sessions this year is of timely relevance as, in the face of numerous challenges and chaos that currently threaten the world almost daily, the entire nation demands from the academic community innovative and creative interventions in achieving social well-being in a spirit of sustainable development. So the topics on innovation, creativity, and the well-being of the society have steadily gained ground in the sustainable development discourse. I sincerely hope that the academic sessions will deliberate on various crucial issues that need to be addressed and come up with intelligent conclusions and recommendations that will lead society to a better state of development.

This year we are proud to announce that the Academic Sessions and the Vice Chancellor's Awards takes place under the patronage of Vice Chancellor Senior Professor Sujewa Amarasena who heads the Senate of University of Ruhuna.

I look forward to the sessions being attended widely and paving the way for appreciating innovation and creativity for social well-being.

I wish the sessions much accomplishment.

Senior Professor P. Hewage
Chair – The 17th Academic Sessions and the 16th Vice Chancellor's Awards
University of Ruhuna



Message from the Dean

It is with great honor that I write this message to the 17th Academic Sessions and the 16th Vice Chancellors' Awards Ceremony of the University of Ruhuna, which brings together academics and researchers in all the ten faculties of the university to present, discuss and share their research outputs. I am delighted that this year's Academic Sessions were hosted by the Faculty of Humanities and Social Sciences, with the support from all other faculties of the University.

As we know, there has been a remarkable growth in the higher education sector in Sri Lanka during last few decades. The demands for innovations in the field of science and technology and as well as in the field of humanities and social sciences, including management, have created new avenues for academic research. I am proud that the University of Ruhuna is moving in this new direction under the leadership of the newly appointed Vice Chancellor, the Senate and the Council.

In this context, this year's academic sessions were organized under the theme 'Innovation and Creativity for Social well-being'. This timely theme was chosen in line with the University's mission 'To advance knowledge and skills through teaching, research and services to serve society' as its contribution to university's vision 'To be the prime intellectual thrust of the nation'. So, it is expected that innovations and creativity will ultimately contribute to social well-being.

As the Dean of the hosting faculty, I take this opportunity to extend my gratitude to the organizing committee, including the Chair, Secretary, Treasurer and other committee members not only from the Faculty of Humanities and Social Sciences, but also from all the other faculties. I am aware that they have all worked very hard. Their commitment and dedication ensure the success of the event.

Let me also thank Prof. Kusuma Karunarathne, Professor Emeritus the keynote speaker of the event, the Chairpersons of the sessions, the Discussants and the Paper Evaluators. I congratulate on the Vice Chancellors' Awardees for their excellent contribution in their respective disciplines.

Professor Upali Pannilage
Dean, Faculty of Humanities and Social Sciences



Contents

Foreword	v
Message from the Dean	vi
Message from the Vice Chancellor	viii
Conferment Emeritus Professorships	ix
Recipients of the 16 th Vice Chancellor's Awards	x
Recipients of the Best Presenter Awards - 16 th Academic Sessions	xi
Keynote Speech	xii
Invited Oration	xx
Abstract Index	xxix
Technical Sessions	
Agriculture and Environmental Science	1
Humanities and Social Sciences	15
Language, Religion and Literature	28
Management and Entrepreneurship	34
Mathematics, Engineering and Technology	41
Medicine and Allied Health Sciences	57
Science, Fisheries and Aquatic Sciences	69
Reviewers of the 17 th Academic Sessions	76
Author Index	80



Message from the Vice Chancellor

It is with great pleasure that I send this message for the Abstract Book of the 17th Academic Sessions and the 16th Vice Chancellor's Awards of the University of Ruhuna. The Academic Sessions is the most prestigious academic event of the university calendar, which is attended by the academic community across ten faculties. Over the past 16 years, it has provided an interdisciplinary platform for researchers and practitioners to showcase their research findings and innovations and get them moderated in the presence of a scientific community. The Faculty of Humanities and Social Sciences, which is the largest of all faculties in the university, takes the privilege of hosting the event this year. The conference theme 'Innovation and Creativity for Social Well-being' seems timely, exiting and thought-provoking.

By the time the University of Ruhuna celebrated its 40th anniversary recently, it had made tremendous progress in its pursuit of excellence in higher education. According to the National Science Foundation statistics, the University of Ruhuna topped in research with the highest number of citations in the Science Citation Index for 5 consecutive years, and has also developed links with a number of reputed universities worldwide, enhancing its research capacity and postgraduate education. I am proud to observe the significant improvement in research carried out by our academic staff in quantity, quality and relevance in line with our vision 'To be the prime intellectual trust of the nation'.

The Vice Chancellor's Awards scheme was introduced in 2004 with an aim to recognize the achievements of the staff and the students during the relevant year, and has continued so long parallel to the Academic Sessions. I take this opportunity to recognize the academic excellence of all the award winners and wish them good luck for a brilliant future.

I take this opportunity to offer my sincere thanks to the contributors to this event, including paper presenters, reviewers, session chairs, discussants, and the dedicated and hard-working organizing committee.

I look forward to witnessing an exciting and successful conference, sharing insightful ideas, technical knowhow, and research experiences among the staff.

Senior Professor Sujeewa Amarasena
Vice Chancellor- University of Ruhuna



Conferment of Emeritus Professorships

Prof. Sarath Amarasinghe

Faculty of Humanities and Social Sciences

Prof. S. Wawwage

Faculty of Humanities and Social Sciences

Prof. P.R.T. Cumaratunga

Faculty of Fisheries and Marine Sciences & Technology

Prof. B.G. Nanayakkara

Faculty of Medicine



Recipients of the 16th Vice Chancellor's Awards – 2020

The Most Outstanding Scholar

Dr. Manjula Hettiarachchi
Faculty of Medicine

The Most Outstanding Young Researcher

Dr. Sunanda Kodikara
Faculty of Science

The Most Outstanding Student Inventor/Innovator

K. T. Methdasun Sandamal (TG/2016/0005)
Faculty of Technology

The Highest Recipients of Grants

Prof. Channa Yahathugoda
Faculty of Medicine

The Most Outstanding Convener of International Conferences/ Promoter of International Relations

Dr. Sunanda Kodikara
Faculty of Science



Recipients of the Best Presenter Awards 16th Academic Sessions-2019

Best Presenter (Oral) of Technical Session: Science, Fisheries and Aquatic Sciences

Prof. W.T.S. Dammini Premachandra (Faculty of Science)

Best Presenter (Oral) of Technical Session: Medicine and Allied Health Sciences

Ms. E.H. Silva (Faculty of Allied Health Sciences)

Best Presenter (Oral) of Technical Session: Agriculture and Environmental Sciences

Dr. Dananjali Gamage (Faculty of Agriculture)

Best Presenter (Oral) of Technical Session: Social Sciences and Management

Dr. Amila Buddhika Sirisena (Faculty of Management & Finance)

Best Presenter (Oral) of Technical Session: Engineering and Technology

Dr. H.C.P. Karunasena (Faculty of Engineering)

Best Presenter (Poster) of Technical Session: Agriculture and Environmental Sciences

Ms. H.P.A.T. Weerakoon (Faculty of Fisheries and Marine Sciences and Technology)

Best Presenter (Poster) of Technical Session: Engineering and Technology

Mr. E.P. Rohan (Faculty of Engineering)

Best Presenter (Poster) of Technical Session: Biochemical Sciences

Ms. A.P.H.I. Abeyesuriya (Faculty of Science)



Keynote Speech

21st Century Education - Prospects and Challenges

Professor Kusuma Karunaratne, Professor Emeritus

Department of Sinhala, University of Colombo

Introduction

After two decades into the 21st century, our society seems to have entered the Information Age or better described as Information Revolution, by choice or by force of circumstances.

Many describe the present society in diverse names, e.g., Digital Economy or even as e-world – “e” designating electronics meaning digital electronics - the foundation for all aspects of information and communication technology.

Ray Lane, one time Chief of the Oracle Corporation (a large software company in the US) at the end of the last century, argued thus:

"We will not have an Information Age until everyone can participate and that won't happen until the cost and complexity of computing is substantially reduced. This will only happen through a standard, low-cost device that provides universal access".

I believe that, that device Ray Lane envisaged is in your possession now - the laptop or the smart phone. This is the reason why I say that we have already entered the Information Age.

Having reached the Information Age or the digital economy, let us see what our challenges are, especially in the field of higher education. As we know, the Sri Lankan economy has moved up from a least developed economy to a middle income economy and arising out of this improved economy, the parents are eager and also have the means to invest on their children to participate in higher education and earn degrees of their choice. This has brought about a phenomenal change in the requirements of higher education resulting in a surge of students



seeking higher education in diverse fields, which have been either not popular or not been in existence earlier, e.g., Software Engineering (to develop complex computer programs).

In addition, the new economy is looking for persons capable of handling an exploding knowledge base in finance and banking, logistics, transport, insurance, software development, systems administration, modern management methods, multimedia, publishing, conservation, sustainable development, resource recycling, waste management and disposal as such etc. This, in turn, creates pressure on universities and higher educational institutions as industry looks to educational institutions, mainly the universities to provide the necessary education, training and skills. This creates an enormous pressure on universities by way of having to provide highly skilled lecturers and trainers in the emerging fields, physical space to accommodate increasing student numbers, enormous fund requirements and the like.

All these point to one fact that the traditional methods of pedagogy based on lectures and textbooks will be highly inadequate in educating and training graduates to handle the new economy. As such, we need to create new methods and processes to satisfy the growing needs of higher education and training.

Modern trends and challenges in learning requirements

The trends and challenges in learning requirements are in a way, similar globally. Carol Twigg, an expert in university education and the Vice President of EDUCOM, a nonprofit consortium of 600 Colleges and Universities in the US dedicated to the transformation of higher education through the application of Information Technology studied this subject as far back as a quarter century ago and came out with a futuristic paper entitled ‘The Global Learning Infrastructure’.

Carol Twigg categorized the future trends in leaning into five areas:

- I. Access
- II. Convenience
- III. Quality
- IV. Cost effectiveness
- V. Market responsiveness

Let me elaborate a bit on some of these topics.



Access

Traditionally, we are used to undergraduates of 18 - 22 years attending university degree programs, mostly living on campus or in the vicinity or within the precincts. This setting is bound to change with more and more adults seeking higher education. Further, there will be greater numbers of adults who aspire to pursue higher education but cannot do so, due to issues such as employment requirements, inconvenient class hours, campus inaccessibility, family responsibilities, and problems of travel and even physical disabilities.

The new trend will be more part-time adult learners collecting academic credits over a period longer than 3 or 4 years, to earn a degree.

Convenience

In the past, when we were university students, we studied for nine months, sat for the examination and had nearly three months' vacation. If we failed even one or two subjects, we could not proceed to the next year. We had to repeat the entire program for that year. The credit system put an end to that method. If you fail to get some credits, you can proceed to the next semester and complete those credits subsequently.

Things will change further in the future, for example, weekend programs, extended university hours and later 24 x 7 that is 24 hours for seven days of the week. Some of such facilities are available even now via Internet to be accessed at leisure from your own home, provided you have a computer and an Internet connection. Credit courses will certainly, move out of campus classrooms and the need to live on the campus or near the campus will be reduced or removed.

Quality

In the past, universities were the primary source of new and specialized knowledge. The research was mainly carried out in the universities. Today, the most vital knowledge is created, stored and disseminated by numerous sources round the world. Governmental organizations, private Corporations and Companies and laboratories produce so much of research, information and knowledge resulting in thousands of research articles published worldwide every day. The print which was the most predominant mode of managing knowledge is being supplemented and replaced by computers, Internet, e-mail, CD's and DVD's.



We were used to studying at a university and preparing ourselves for a lifelong career. The future will be different from that. Professionals will have to acquire new knowledge and skills over lifelong working.

The future professionals will have to change their career, perhaps, a few times during working life. Though we acquire the basic knowledge and skills in the university, the knowledge explosion and technology innovation will force the professional to acquire further knowledge and skills with time.

As work becomes knowledge intensive due to innovations, there will be a necessity to acquire new knowledge and skills and professionals will have to know the methodology to acquire such knowledge and skills by themselves. In the future, industry will require university graduates who have the capacity to learn new things by themselves which require innovative thinking. The emphasis will be 'learning how to learn'.

Cost Effectiveness

The traditional system of professors, lecturers, classrooms, laboratories and textbooks will not be able to support the massification of university education. If the university student population were to grow by 20 percent to satisfy the student demand for higher education, the funds required for physical and academic expansion will certainly not be available as per the traditional method. Further, physical expansion and training of adequate academic staff cannot be done at such a pace. No government will be able to afford such expansion unless methods are evolved to curtail cost escalation and innovate new methods of teaching and instruction.

Meeting future learning requirements with ICT (Information and Communication Technology)

The traditional university system with the best of facilities suffers from numerous deficiencies. Still undergraduate failure rates and dropout rates are significant. A fair number of graduates do not pass out within the stipulated time period. Many take six to seven years to graduate. Often, a fair amount of teaching and instruction is provided by instructors, teaching assistants and untrained probationary lecturers, thus affecting the quality of education and also, the aspiration of students.



Fortunately, ICT provides a satisfactory method to cater to a very large number of students with easy access at their convenience. Through Internet, it is now possible to offer instructional material to anyone, anytime, anywhere. Students can access courseware seven days a week, 24 hours of the day. There is no case of missing a lecture. The available courseware delivered by specialists and senior academic staff available on the network makes it possible to access quality information at any convenient location and at any convenient time. This eliminates the need for large auditoriums to accommodate thousands of students. Since the lecture had been recorded by specialists, even junior academic staff can coordinate teaching activity and can communicate with the specialist lecturer in case of clearing any doubt.

The university needs to provide only broadband wireless access (WIFI) as practically all students possess laptops or smart phones. In this manner, the cost per student can be substantially reduced, to enable larger numbers of students.

Further, the Internet provides a vast amount of learning material or information which obviates the need for large and expensive libraries. As there are very effective search engines, e.g., Yahoo, Google, Safari, etc. accessing relevant information by students is much simplified. Students do not have to spend hours in physical libraries looking for the relevant information.

The Internet and the worldwide web (WWW) have offered us an unprecedented advantage for higher education. In fact, we are yet to realize and exploit this valuable opportunity. Some of the best of universities in the US like MIT have their courseware available on the Internet. Whether it is engineering, management, humanities or other, the course material is accessible via Internet.

How much does it cost to access? e.g., MIT courseware - IT IS FREE.

Courses are delivered by most noteworthy Professors and accessing such course material, at no cost, is difficult to imagine. If we compare the tuition cost of these universities for their own students, it is over USD 50,000 per year. Offering the same material free of charge over Internet is a boon to any student. This provides an opportunity for our universities to exploit this rare chance by incorporating such available courseware in some of our own degree programs. This could easily be the answer for the shortage of senior academics in our universities.



One of the problems faced by universities with large numbers of students is the evaluation of students. Setting examination papers, correcting answer scripts and awarding marks by the academic staff have become a time-consuming process. If standard evaluation processes could be designed, the process would be much less time consuming. Such methods are not new in the field of education. After all, most universities in the US test the ability of entering students at the undergraduate level by way of SAT (scholastic aptitude test) and ACH or achievement tests. At postgraduate level, the testing is by GRE (Graduate Record Examination), etc.

These are some of the innovations that would be helpful in handling large numbers of students. The suggested methods are not cost intensive as compared with traditional methods. In order to achieve these, the basic requirement is that we should be able to live.

Our planet is increasingly threatened by our own activities. Unless the dangers of what we do are brought to the attention of all, especially, to the university students, the bulk of us may become ignorant of the harm we do.

As such, new compulsory course units will have to be mounted for all students in the areas of:

- i. Environment protection
- ii. Sustainable development
- iii. Energy conservation
- iv. Limits to growth in a Resource Limited World
- v. Importance of food production, adequacy and waste
- vi. Global warming

Even though these are commonly known topics, these need to be incorporated in our studies as much as we include religious studies in our school curriculum. This is a necessity as not paying attention to these subjects could lead the mankind to ruin.

The Futuristic Model for Higher Education

The Digital Global Learning Infrastructure

Carrol Twigg of EDUCOM, in a paper written by her, had proposed a futuristic model for massification of higher education. Her proposal is the Digital Global Learning Infrastructure (DGLI).



The DGLI is a student-centric virtual, global web of educational content and services enabled by digital electronic technology and the Internet. This contrasts with the traditional "bricks and mortar" campus-centric university. The DGLI will offer a set of extraordinary new tools, self-paced multimedia modules that deliver leading pedagogy, in-depth outcome assessments and online interaction with fellow students and teachers that facilitate continuous feedback and improvement.

Currently, individual universities are engaged in a number of educational functions namely: content creation and delivery, administration of instructional material, setting standards and accreditation, marketing, management, finance, student evaluation, award of relevant degrees, etc.

Each and every university is engaged in all these functions. As opposed to this, in the DGLI all these functions are disaggregated, globalized and carried out by separate specialized entities within the DGLI, thus improving the system efficiency.

In the DGLI, the core-enablers are the World Wide Web and the Internet. In this proposed system, the world's top specialists in individual fields will provide the content to be uploaded to the Web. These could be peer-reviewed and accredited and once done, will form the courseware. The courseware will not be just written material, It could be lectures in audio or video, graphics and demonstrations, laboratory exercises, where relevant, using advanced multimedia technology including animation.

The administration of instructional material, setting standards, student evaluation and award of grades will be performed by special agencies.

Management and finance will be undertaken by other expert entities and the award of degrees by different universities participating in the DGLI will be done in collaboration with such universities as per their individual requirements. Marketing of resources within the DGLI will be delegated to marketing specialists. Thus the DGLI will comprise deferent specialist entities integrated to give students or learners their chosen academic content or degree as required.

The benefits of the DGLI as opposed to brick and mortar universities are primarily of access, quality and costs. Any interested learner will be able to access the DGLI irrespective of location or status as long as he has an Internet



connection and a device such as desktop, laptop or smart phone that could be connected to the Internet. It would normally be a wireless connection.

Students, no matter where they live can access the best resources from around the world. Students even in remote towns will gain access to the world's leading pedagogical content and the DGLI ensures that the content creators are world leading specialists and there is no doubt about the quality of content. The cost of Internet connection and devices have come down sharply over the years and even in Sri Lanka, millions of students already have Internet connection and are in possession of some device that could be connected to the Internet. The cost of study over the DGLI will be minimal as compared with US university costs and will be substantially less than local university costs.

Conclusion

The learning requirements of society as a whole are changing in view of increasing numbers, composition and diversity of the student population. The key to address these critical challenges is the development of the Digital Global Learning Infrastructure, DGLI.

The DGLI will enable an increasingly heterogeneous student population and the emerging economy to satisfy the learning demands of the future. The World Wide Web and the Internet are already in place and some elements of the DGLI are already active. With the rapidly changing IT technology, the contemplated DGLI could be in place perhaps in less than a decade. The DGLI will be the best facility to satisfy the needs of the enterprising student community.

Finally, I urge anyone interested to log on to the Internet and search for free video lectures on any topic of choice for example, literature, economics or computer science etc. You will be amazed to see thousands of lectures available free for you to study and learn. Well-known universities in the US or even in India provide thousands of Open Courseware for free and these lectures and demonstrations are delivered sometimes by world famous Professors. Some universities offer certification and degrees after completing the credit requirements for a reasonable fee. These form some elements of the proposed DGLI and the inklings of more things to come in the near future as higher education undergoes a revolution.



Invited Oration

Advanced Sociological Research to Address Social Issues in the Contemporary Sri Lankan Society

By

Dr. Sarath Amarasinghe

Background

It is an honour and privilege for me to be invited to deliver the Oration of the 17th Academic Sessions and 16th Vice Chancellor's Awards 2020 of the University of Ruhuna. I formulated my topic 'Advanced Sociological Research to Address Social Issues in the Contemporary Sri Lankan Society' in an effort to identify the role of sociologists in resolving some fundamental issues confronted by the Sri Lankan society today.

Social issues may vary from society to society due to various unfavourable conditions that develop from time to time. However, a common situation witnessed globally is that they affect the smooth functioning of the livelihoods of the people concerned. As Kendall (2007) defines 'A social issue/problem is a social condition or a pattern of behaviour that harms some individuals or all people in a society and that a sufficient number of people believe warrants public concern and collective action to bring about change'.

Sociology is the systematic study of human society and sociologists are always supposed to be empathetic to the changes and issues appearing in societies because the discipline of sociology compels them to search and research into the causes and impacts of such changes and issues. Hence, sociological research starts with two simple reasons:

- a. Changes taking place in society such as poverty, urbanization, crime, etc.
- b. The curiosity and questions created by such social changes.

The ultimate objective of sociological research is to understand the social reality behind such social changes and issues so as to ensure the smooth functioning of the societies concerned.



Methodological Paradigms of Sociological Research

There are several classifications of sociological research based on the objectives of investigations, methodologies adopted, and procedures followed in the investigations. They include (a) quantitative, qualitative and mixed research and (b) theoretical and applied research.

Quantitative and Qualitative Research Paradigms

Quantitative Research	Qualitative Research	Mixed Research
Experimental designs	Narratives	Sequential
Non-experimental designs, such as	Phenomenology	Concurrent
Surveys	Ethnographies	Transformative
	Field Research,	
	Case studies	

Quantitative research paradigm that facilitates the use of measurable quantitative information used to be dominant during the 20th century due to the enhanced emphasis given to scientificity in social research. However, with the identification of the limitations experienced in quantifying and measuring human behaviour and social needs, the qualitative paradigm became as an alternative method during the 1980s. This facilitated the use of more reliable and in-depth investigations than quantitative research and is considered as a polar opposite of that paradigm. With the experiences on advantages and limitations of respective research paradigms, mixed research that involved using both quantitative and qualitative techniques to corroborate through a triangulation process (Bryman, 2012), become popular at the beginning of the 21st Century. Mixed research paradigm provided more sophisticated alternatives to the researcher by either sequentially using techniques of one paradigm after another in the same research, to use techniques of both paradigms in the same research concurrently, or to use techniques of one paradigm dominantly over the other in a transformative manner of the same research.

Theoretical or fundamental research is explanatory in the sense that it facilitates the development of a causal relationship between the social changes and issues while leading to the advancement of ‘knowledge for the sake of knowledge’. Applied research is for development purposes and it seeks to solve practical problem emerging from such social changes and issues.



The main difference between these two methods is that the purpose of theoretical research is to increase understanding (ideally, by developing new theories or scrutinizing the existing theories), while applied research is “deliberately intended to bring about social change” (Babbie, 2018). They are action-oriented investigations to meet the solutions for social issues. However, they are not always mutually exclusive of the reality.

Social Engineering in Solving Social Issues

The recent partnership developed between theorists and practitioners in order to apply the existing knowledge-based theories to solve societal problems promoted a new concept called social engineering. It is expected that the outcome of this collaboration may contributed to the development of the field of sociology as well as socio-economic advancement of the society concerned.

However, in practice it was revealed that there are some methodological limitations in social engineering and planning. It can be illustrated in relation to research on poverty and programmes implemented to alleviate poverty in Sri Lanka and the world around in general. With the dawn of the new millennium, social engineers could identify poverty as the major social problem highly confronted by the nations in the developing countries of the world. Accordingly, in setting the millennium development goals, social engineers agreed ‘eradication of poverty and hunger’ as the first goal to be achieved by 2015. These social engineers being unable to identify the diversity of physical, cultural, social and political backgrounds of the problem inherent to the respective countries due to methodological irrelevances as many as 1.2 billion people were found to be still remaining in poverty in those countries. This situation further led to the relevant social engineers to reset the goals for the eradication of extreme poverty and hunger by 2030 (Sustainable Development Goals - SDGs, e.g., SDG 01- No poverty, SDG 02 - Zero hunger).

This situation clearly indicates the mismatch between the objectivity of the theory and its application by social engineers in socially and culturally diversified environments. It may be mainly due to the causal relationships they assume with regard to the particular social issues, and not due to the application of the same theory for similar cases in different social and cultural settings. This situation has encouraged sociologists to propose a new version of social engineering known as ‘self-management’.



According to this new version of social engineering, the development of a society needs to be considered as a social activity. It includes the researcher being capable of identifying the socio-cultural and political dimensions of the society where he/she works and gets the popular support in identifying their development needs and implementing possible strategies to overcome their problems in a spirit of self-motivation.

“Self- motivated social planning is believed to be true social engineering, in that a society monitors its own developmental progress, instead of merely attempting to invent methods which will ensure that a society will be capable of adjusting to a set of social demands that are not necessarily relevant” (Murphy, 1981).

Wright Mills (1959) adopts a particular approach to sociological research called ‘sociological imagination’. He promotes this concept not as a science, but rather as an imaginative way of thinking and understanding the social world. According to him, it is an intellectual craftsmanship to combine desperate ingredients to create a new perspective for understanding the world (Giddens, 2006). It explains that, in history, all past events have led up to the present in shaping the current social issues in various societies, mostly following the same pattern. Mills argued that history is an important element in sociological imagination.

Mills further points out that researchers should avoid dependency on any rigid set of procedures, methods and techniques in forceful terms. “Let every man be his own methodologist; let every man be his own theorist; let theory and method again become part of the practice of a craft. Stand for the primacy of the individual scholar; stand opposed to the ascendancy of research teams of technicians. Be one mind that is on its own confronting the problems of man and society” (Mills, 1959).

Evidence of Advanced Research on Sri Lankan Social Issues

Based on the above intellectual analysis of advanced sociological research, it is useful to look at the role of sociological research conducted to alleviate certain social problems in Sri Lanka and their outcomes. Therefore, I present a few examples of research and supervision under this theme which I have been engaged in during the last few years of my academic career.



Study - 01: Commercial Sexual Exploitation of Children in Sri Lanka (Amarasinghe, 2002)

The study was conducted in collaboration with the International Labour Organization. The literature review of this study revealed that the boom in the tourist industry in the 1980s in Sri Lanka has been the main cause of sexual exploitation of children for commercial purposes. This resulted in the scandalous reputation the country earned as a destination of for child sex. The Department of National Planning (1991) estimated in 1991 that there were about 30,000 children currently engaged in commercial sex. The hypothesis postulated in this research was that “child prostitution has become one of the serious social issues in Sri Lanka and has exposed children to a variety of psycho-social, physical and health problems”.

This study was conducted in eight maritime districts where tourism had flourished. Qualitative and in-depth investigations such as in-depth interviews with key informants were conducted initially in tracing child prostitutes and the underground set-up where the trade was in operation. At the later stages, through the rapport developed with the particular subjects who were sex workers, the survey method was adopted to collect quantitative information.

This study revealed that more male children than female children were highly subjected to commercial sexual exploitation at the hands of foreign seekers of sexual services. The children were subjected to such sexual exploitation due to a variety of push factors such as unfavourable family surroundings, ignorance of parents, absence of parents due to migration or and poverty and a variety of pull factors such as attraction to an erotically exciting lifestyle the children are subjected to in the trade, income and gifts available from the tourists, existing peers as well as underground networks of the sex industry.

This study unveiled significant negative and long lasting impacts on children such as leaving school, involving in crime and addiction, confronting physical and mental illnesses, and an acute sense of social insecurity. As a result of the findings which was presented to many fora, it made it possible to implement several programs in collaboration with the Ministry of Health, International Labour Organization and some NGOs to protect the vulnerable children and to promote their sense of social and economic security.



Study - 02: Sustainable Measures to Safeguard the Families of CKDu Patients in Sri Lanka

Chronic Kidney Disease of Unknown Etiology (CKDu) is one of the social problems found to be recently developed among several developing nations, including Sri Lanka during the recent past. It is known as the progressive loss in kidney function for some unknown reasons to the patients over a period of some months or years. This situation has increased the gravity of the problem of identifying the possible interventions in favour of the affected communities.

The hypothesis formed on this situation was that poverty and ignorance are major reasons for contracting CKDu in agricultural communities. The study was conducted in collaboration with Ministry of Social Empowerment, Welfare and Kandyan Heritage (Amarasinghe, 2017). The literature review revealed that there were approximately 20,000 admissions/ re-admissions of patients with renal failure to government hospitals with approximately 2,000 deaths recorded annually (Presidential Task Force, 2017).

The investigations concerned with it were conducted in the Elahera DS area of the Polonnaruwa District where there were relatively a higher number of 402 patients were reported. There the key informant discussions were conducted initially tracing the affected families and focus group discussions with CKDu patients were conducted adopting qualitative information. A questionnaire survey was administered to collect quantitative information from affected families so as to gather quantitative information. Where it was necessary, case studies were conducted to collect in-depth information from the selected families. The study found that a change of traditional carbonic agriculture to high yielding varieties which depended on draught-prone agrochemicals, contamination of the ground water due to the increased use of agrochemicals, consumption of food and water collected from the area, working in contaminated paddy lands, and ignorance of the disease were the major reasons for the spread of the illness in the area. There isolation of affected families through social labelling, livelihood breakdown, poverty and dependency, psychological loneliness were major problems confronted by affected families.

This study proposed possible short-term measures such as provision of medical treatment facilities locally, introducing new livelihood activities to victimized families, sensitization programs to educate about the causes and prevention of illness, and psycho-social programs to mobilize the victims. In the long-term



measures were recommended to sensitize farmers towards carbonic agriculture in a way to reducing dependency on agro-chemicals and effective health and agricultural programs to mobilize poor communities.

Study 03: A Socio-economic Analysis of the Emergence of Liberation Tigers of Tamil Eelam (LTTE) Movement. PhD Thesis, Gamage, G.C.L (June 2017)

The separatist war launched by the LTTE was a major social issue that caused a great loss of life, property, and social security, and crippled the smooth functioning of a society. A large number of Tamil youth had involved in carrying out the massive attacks on during this period. Frustration of Tamil youth over the distribution of power and their resentments over the severity of the caste-based restrictions turned the Tamil youth into militants was the hypothesis formulated to guide the study.

The literature review revealed that the dominant Wellala caste of Tamil communities traditionally held the socio-economic and political power over the majority of other service castes in Sri Lanka in the north and the east. They were capable of securing higher administrative positions and social privileges traditionally and it caused to develop resentments in the Tamil society in general and among the youth in particular. Further the lack of access to the benefits of social development programs and youth unemployment became some reasons for them to develop a resentment against the Sri Lankan government.

A sociological investigation was conducted in eight villages, four in the northern and four in the eastern province, where the participation of Tamil militants was relatively higher. There predominantly qualitative data collection techniques such as key informant interviews, case studies and focus-group discussions were launched to collect information from the ex-militant youths, villagers and the relevant government officials.

This study found that the economically and culturally deprived youth suffering from caste discrimination and poverty were highly attracted to the LTTE due to their aggression against society and the challenges of frustration they were confronted with. In overall terms, the ethnicity-based political resentment developed against the Sinhalese hegemony in the socio-economic and political spheres had further sustained their attraction to this movement.



This study proposed several short-term and long-term strategies to overcome the existing frustration of the youth and sustain reconciliation in the north and east. Under short-term strategies, it pointed out the necessity of area-specific development programs to identify the felt and immediate needs of the youth and implement with the participation of the respective youth categories. Under long-term strategies, it has specified the programs to enhance poverty-alleviation mechanisms and to provide productive employment to the unemployed.

Concluding remarks

The advanced sociological research has thus high potential to examine social issues in society and come up with viable strategies to solve them. The examples given in this oration provide inside knowledge and directions to further research in the areas of various social issues in the contemporary Sri Lankan society.

However, it seems that there is a lack in the action-oriented component of many of these research projects while putting the theories into practice in working out solutions. Major causes for these limitations can be specified as higher concentration over the academic aspects of these researches and financial constraints to implement the proposals in collaboration with the relevant institutions in the long term. The social engineering component of sociological research may be fulfilled to a satisfactory extent if the findings of such research can be implemented through a long-term monitoring process.

References

Amarasinghe, S.W. (2002), *The Commercial Sexual Exploitation of Children in Sri Lanka*, International Labour Office, Geneva, Switzerland.

Amarasinghe, S.W. (2017), *Sustainable Measures to Safeguard the Families of CKDu Patients in Sri Lanka*, Ministry of Social Empowerment and Kandyan Heritage.

Babbie E.R. (2013), *The practice of social research*, 14th ed. Boston, MA: Cengage Learning.

Bryman, A. (2012), *Social Research Methods* (4th ed.). UK: Oxford University Press. Cambridge University Press. Chamber's Oxford Dictionary, Reprint edition (March 31, 1986).



Gamage, G.C.L, A Socio-economic Analysis of the Emergence of Liberation Tigers of Tamil Eelam (LTTE) Movement. PhD Thesis, University of Ruhuna (June 2017)

Giddens, A (2006), *Sociology* (Fifth edition), Cambridge, Polity.

Kendall, Diana (2007) *Social Problems in a Diverse Society*, 5th Edition, Pearson.

Mills, C.W. *The sociological Imagination*, Penguin Books, Harmondsworth, 1959/1970.

Murphy, John. W. (1981), *Applied Sociology, Social Engineering, and Human Rationality*, *The Journal of Sociology and Social Welfare*, Volume 8 Issue.

Dr. Sarath Amarasinghe
Department of Sociology (1979-2018)
University of Ruhuna



Abstract Index

Agriculture and Environmental Science

- Topographical and Land Use Changes in Yakkalamulla Divisional Secretariat of Galle District, Sri Lanka 1
M.P.G.C. Damayanthi and S. Wijeratne
- Flood Protection Methods and Their Suitability to Matara Divisional Secretariat in Sri Lanka 2
N.K.N. Kaushalya and S. Wijeratne
- Below-Ground Carbon Stocks of Mangrove Ecosystems in Sri Lanka: Implication for Climate Change Mitigation 3
K.A.S. Kodikara, P.L.I.G.M. Cooray, M.P. Kumara, N.P. Dissanayake, T. Douglas, D.D.N. Sripal L.P. Jayatissa
- Peelability of Improved Accessions and Commonly Used Varieties of *Cinnamomum Verum* J. Presl: Implications for Harvest Management 4
K.A.S. Hansika, K.A.S. Kodikara, A.A. Wijeweera, G. Senanayake, K.G.G. Wijesinghe, L.P. Jayatissa
- Present Status of Male Calves Fattening Systems in Trincomalee District, Sri Lanka 5
D. Senaratna, K. Priyatharshani and N.S.B.M. Atapattu
- Exploration of Root Morphology and Plant Nitrogen Uptake of Different Wheat Species 6
K.M.C. Fernando, C. Wibowo and D.L. Sparkes
- Hydrophobic Effects on Water Retention in Potting Media 7
J.K.P.N. Prathibha, U.I. Samarawickrama and D.A.L. Leelamanie
- Elevated Carbon Dioxide Mediated Early Growth Responses of Wheat (*Triticum aestivum* L.): An Analysis of Source and Sink Interactions 8
D. Gamage, M. Thompson, P. Dehigaspitiya, N. Hirotsu, M. Sutherland, S.Seneweera
- The Effect of Salinity on Growth Performance of Mangrove Associated



Penaues monodan in Sri Lanka 9
P.W.A. Perera, S. Ratnavel, N.Y. Hirimuthugoda, and W. Rajapakse

Solving the Crisis of E-Waste: Present Status and Future Challenges:
A Case Study in Faculty of Agriculture, University of Ruhuna, Sri Lanka 10
S. R. Amarasinghe and G. C. Samaraweera

An Attempt on an Alternative Transformation Method: Seedling
Transformation of Rice (*Oryza sativa L.*) and Anthurium (*Anthurium
draeanum Linden ex Andre*) Using 35S:VlmybA2 and 35S:Gus 11
T.T.D. Dahanayake, S. Fukai and S. Geekiyanage

Economic impacts of Climate Change on Smallholding Coconut Growers:
A Ricardian Approach 12
W.N. De Silva, W.A.A.M. Bandara and H.M.K. Sandamali

Effect of Maturity of the Explant to Develop Shoots from *Ziziphus jujuba*
(Masan) Using *in Vitro* Techniques 13
Y.M.S.M. Yapa, L.N.S. Silva, N.M.S.D. Navarathna,
G.K.M.M.K. Ranaweera, and N. Dahanayake

Mineral Composition of Iron Ore Occurrence at Pelwatta in Uva Province
of Sri Lanka 14
U. Premarathne, N.P. Ratnayake and H.A.H. Jayasena

Humanities and Social Sciences

Diminishing Identity of Cultural Minority Communities in Contemporary
Societies: A Study Based on Coastal Indigenous People of Vahare
Batticaloa, Sri Lanka 15
S. Gunasekara and H.L.S. De Zoysa

People's Use of Public and Private Green Spaces in a Residential Zone
of Galle City, Sri Lanka 16
D.B.C. Jayasinghe, G.P.T.S. Hemakumara, P. Hewage



Impact of Small and Medium Enterprise Income on Household Poverty in Rural Sri Lanka: A Descriptive Approach H.K. Sarath, D. Atapattu and B.M. Sumanarathne	17
ශ්‍රී ලංකාවේ දරිද්‍රතාව පිටුදැකීමේ දී සුළු හා මධ්‍ය පරිමාණ ව්‍යවසායන්හි කාර්යභාරය, විභවතා සහ ගැටලු පිළිබඳ විස්තරාත්මක ප්‍රවේශයක් එච්.කේ. සරත්, ඩී. අතපත්තු, බී.එම්. සුමනරත්න	18
Public Choice of President 2019: A Shape of Individual Consciousness of Political Networks A. Samarakoon	19
Growth of Coastal Population and Its Impact on Coastal Resources of Sri Lanka W.K.V. Dayalatha	20
The Use of Social Media in Tourism Promotional Policy Formulation: A Case Study of Using WhatsApp to Rebuild Tourism after the Easter Attack 2019 in Sri Lanka K.H. Lakmali	21
Impact of Extra-curricular Activities on Academic Performance in Secondary School Education in Sri Lanka N. Keembiyahetti, K.N. Samarasinghe	22



Estimation of Carbon Foot Print: Emission of Household Consumption P.W.S. Fernando and W.P.M. Jeewanthi	23
Socio-economic Changes of Tea Small Holding Communities: A Case Study of Mawarala GN Division, Matara District, Sri Lanka P. Hewage, J.A.T. Madhushani and R.D.K. Wickkramasinghe	24
Does Exchange Rate Matter for China Sri Lanka Trade? N. Keembiyahetti and H.K. Sarath	25
Demanding a Sinhala-Buddhist Nation State: Challenges and Prospects Ven. G. Sugunasiri	26
Health and Social Problems among Male Prison Inmates with Past Illicit Drug Use in Prison, Galle I.L.A.N. Darshana, R. Ruben and C.J. Wijesinghe	27
Language, Religion and Literature	
Diverse Roles of ESL Teachers in Developing Learner Autonomy S. Batuwatta, S.A.A.K. Satharasinghe	28
ලේඛන හා භාෂණ සිංහලයේ අතීත ආධ්‍යාන අනුසර්ගක පදිම පිළිබඳ ප්‍රතිරෝධාත්මක අධ්‍යයනයක් ඩබ්ලිව්. ඩී. නිලකරත්න, මොරකන්දේගොඩ අරියවංස හිමි නූතන සිංහල කෙටි කවි විචාරයෙහිලා ක්ෂණික අන්තර් දෘෂ්ටි (Epiphany) සංකල්පයෙහි ඇති වැදගත්කම (තෝරාගත් කෙටි කාව්‍ය නිර්මාණ කිහිපයක් ඇසුරෙන්) අපරැක්කේ සිරිසුදාම හිමි	29
පාලි සංදේසයන්හි සංස්කෘත සංදේශ ලක්ෂණ කෙතෙක් දුරට විද්‍යමාන වේ ද?: තුලනාත්මක අධ්‍යයනයක් ඕපනයක උපේක්ෂා ධම්මධීරා මෙහෙණිය	31
Is Threefold Vijñāna in Yogācāra Idealism an Innovative Concept? A.A.R. Priyanka	32
සිංහල භාෂාවේ අනුරූප පද යෝජනය පිළිබඳ විමර්ශනයක් මොරකන්දේගොඩ අරියවංස හිමි	33



Management and Entrepreneurship

Ensuring Sustainable Competitive Advantage through Strategic Entrepreneurship: A Test of Ireland's Model of Strategic Entrepreneurship 34
M.C.K.H. Mallika, M.G.S. Bagya and H.M.N.N. Herath

The Impact of Human Resource Management Practices on Corporate Entrepreneurship 35
P.S.D. Punchihewa, M.N. Maduwanthi and G.T.W. Sriyani

Exploring the Effect of Internal and External Factors on the Business Growth of Small and Medium Scale Enterprises in Sri Lanka 36
G.T.W. Sriyani

The Impact of Non-banking Activities towards Bank Performance: Special Reference to Domestic Licensed Commercial Banks in Sri Lanka 37
G.K.C. Jeewantha, H.A.C. Jeewanthi and J.K.A. Madushani

Relationship between Extrinsic Rewards and Employee Job Satisfaction of Operational Level Employees 38
R.M.D.D. Rathnayake

Customer Engagement and Its Impact on Brand Loyalty with Special Reference to Young Consumers in Sri Lanka 39
A. B. Sirisena

The Impact of Market Orientation on Organizational Performance: "A Study of Small and Medium Scale Hotels in Tourism Industry in Southern Province of Sri Lanka" 40
U.K.B. Aravinda and T.S.L.W. Gunawardana

Mathematics, Engineering and Technology

Modification of Soil Grading to Enhance the Properties of Compressed Stabilized Earth Blocks 41
S.N. Malkanthi and A.A.D.A.J. Perera

Evaluation of the Feasibility to Develop a Bottom Ash Based Geopolymer Concrete 42



H.P. Sooriyaarachchi and K. Dasanayaka	
Performance of Repaired Concrete Elements with Corroded Reinforcement T.M.M.B. Tennekoon and H.P. Sooriyaarachchi	43
The Most Critical Factor Affecting the Workmanship and Its Availability in Sites in Practical Sense Derived Using Primary Data U.D.P.M. Gunasinghe and G.S.Y. De Silva	44
Review of the Performance of Building Demolition Practices in Sri Lanka N. Gamage, G.S.Y. De Silva and A. Karunawardena	45
Evaluation of the Effectiveness of Concrete Durability Indicators for Concrete Made with Supplementary Cementitious Materials under Different Curing Regimes H.P. Sooriyaarachchi and K. Dasanayaka	46
Wireless Energy Transmission for Access Limited Underground Sensors D.S. De Silva	47
An Investigation of the Internal Combustion (IC) Engine Performance with Diesel Blended Liquid Fuel Extracted from Waste Polyethylene E.P. Rohan, B. Sumith and L.K.T. Srimal	48
The Opportunity of Reducing Life Cycle Cost of Boats in Sri Lanka by Integrating Alternative Consumables for Vacuum Assisted Resin Transfer Moulding (VARTM) Process M.T.T. Ranjan, U.I.K. Galappaththi and S. Baduge	49
Development of a Computationally Efficient Hybrid CPU and GPGPU based Numerical Model to Simulate Morphological Changes of a Fresh Single Plant Cell A.K.C.I. Kodithuwakku, K.G.P. Hansani, S. Baduge and H.C.P. Karunasena	50
Three-dimensional Numerical Study on Fluid Dynamic Performance of Various Shaped Wave Energy Convertor Flaps in a Wave Tank N.H.D.S. Manawadu, I.D. Nissanka and H.C.P. Karunasena	51



Prototyping and Experimental Design Validation of Soft Actuated Oral Physiotherapy Device for OSF Patients	52
K.J.C. Kumara, I.V.T.P. Induruwa, W.A.M.S. Wijesekara, J.G.V. Priyanka, P. Peiries and R. Jayasinghe	
Computationally Efficient Simulation of a Mesh Free Based Plant Cell Model Undergoing Indentation by External Probes	53
K.G.P. Hansani, A.K.C.I. Kodithuwakku, S. Baduge and H.C.P. Karunasena	
Seismic Vulnerability Assessment Criteria: A Study on Available Methods as a Guide for Sri Lanka	54
N.G.R.K. Gunathunga, G.S.Y. De Silva and A. Karunawardena	
Identification of Ancient Monuments and Ruins in Sri Lanka Using Image Processing Techniques	55
P.H.P.N. Laksiri	
Information Measures and Geometrical Properties of Normal and Lognormal Probability Density Functions	56
N. Yapage	
Medicine and Allied Health Sciences	
Subclinical Atherosclerosis in Patients with Type 2 Diabetes is Significantly Associated with Visceral Fat	57
C.M. Wickramatilake, T.P. Weerathna, I. Kodikara and G. Liyanage	
Skin Closure of Pfannestiel Incision in Lower Segment Caesarean Section: Comparison of Wound Outcome with Interrupted vs. Subcuticular Techniques	58
D.L.W. Dasanayake, A.K. Jodhi, K.U.G.A. Roomadu and G.K.R. Saumya	
Compared to Exercise and Metformin Alone, Combination of Treatment for Six Months for Patients with Pre-Diabetes Helps to Maintain Sustained Weight Loss	59
A.T.I.M. Amarasinghe, S. Lekamwasam, T.P. Weerathna, M. Sumanathillake	



Effects of Metformin for Six Months on Glycaemic State, Lipid Profile and Anthropometry among Individuals with Pre-Diabetes A.T.I.M. Amarasinghe, S. Lekamwasam, T.P. Weeraratna, M. Sumanathillake	60
An <i>in Vitro</i> study to Determine the Potential Ultraviolet Radiation Screening Capability of the Indigenous Medicinal Plant <i>Olax zeylanica</i> (Mella) C.E. Liyanaarachchi, M. Napagoda, S. Witharana and L. Jayasinghe	61
Demographic Associations of Diabetes Status by Both Fasting Plasma Glucose Concentration and Glycated Haemoglobin in a Community Survey in Galle District, Sri Lanka K.G.P. Wasana, A.P. Attanayake, T.P. Weeraratna and K.A.P.W. Jayatilaka	62
Reliability and Validity of the Brief COPE Scale into the Sri Lankan Context E. Weeratunga, C. Senadheera, M. Hettiarachchi, U. Ekanayaka and B. Perera	63
Development and Cross-validation of Anthropometric Predictive Equations to Estimate Total Body Fat Percentage in Adult Women in Sri Lanka N. Rathnayake, G. Alwis, J. Lenora and S. Lekamwasam	64
Relationship between Pattern of Physical Activity and Bone Mineral Density, Bone Mineral Content in a Group of Postmenopausal Women in Sri Lanka N. Rathnayake, G. Alwis, J. Lenora, S. Lekamwasam	65
Nutritional and Psychosocial Factors Affecting Cognitive Function of Early Female Adolescent School Children in Galle Educational Zone: A Cross Sectional Study H.J.H. Madhushanthi, S.W. Wimalasekera, C.S.E. Goonewardena, A.A.T.D. Amarasekara and J. Lenora	66
Association between Physical Activity and Executive Functions of Institutionalized Physically Independent Elderly People of Southern Province in Sri Lanka M.W.K. Gamage, D.C. Hewage and K.D. Pathirana	67



Local Stability Properties of a Delayed HIV– I Dynamics Model with Beddington-DeAngelis Functional Response B.G.S.A. Pradeep, N.S. Rathnayaka and M.P.A. Wijayasiri	68
--	----

Science, Fisheries and Aquatic Sciences

Heterogeneous Fenton Catalyst for the Treatment of Textile Wastewater D.S.M. Kumari and S. Wanniarachchi	69
---	----

An Analysis of Temperature Distribution along the Receiver Tube of a Parabolic Trough Reflector and Non-concentrated Solar Radiation E.M. Ranatunga, N.K. Hettiarachchi and M.K. Abeyratne	70
---	----

Removal of Fluoride from Drinking Water Using Heat Treated pellets of Eggshell Powder and Clay Mixture W.P.I.S. Wikramanayaka, R.A. Maithreepala, and A. D. Jayasinghe	71
---	----

Anomalous Propagation of the Sri Lanka Dome during 2014: Forcing Mechanisms G. Pathirana, G. Chen, M.K. Abeyratne, D. Wang, T. Priyadarshana	72
---	----

Effects of Particle Size of Feather Meal on Growth Performance and Feed Utilization of Nile tilapia (<i>Oreochromis niloticus</i>) S.S. Heratha and A. Yakupitiyage	73
--	----

Heat Shock Stress Induced Oxidative Damage in Submerged Macrophytes C. Chalanika, T. Asaeda and K. Sanjaya	74
---	----

Biochemical Responses of Aquatic Macrophytes against Mechanical Stress of Water Turbulence K.S.S. Atapaththu and T. Asaeda	75
---	----

Agriculture and Environmental Science



Topographical and Land Use Changes in Yakkalamulla Divisional Secretariat of Galle District, Sri Lanka

M.P.G.C. Damayanthi and S. Wijeratne*

Department of Geography, Faculty of Humanities and Social Sciences, University of Ruhuna, Matara, Sri Lanka

Abstract

The land use in the earth's surface is changed temporally and spatially based on the physical features of the earth and human activities. Topography, climate, weather, water and soil are the physical factors which determine the land use changes. The objective of this study is to analyze the interrelationship between topography and land use changes in the selected areas of Yakkalamulla Divisional Secretariat Division in Galle District. Types of land use and the distribution of the study area were mapped using aerial photographs, and the data of land use changes were collected through a field survey using 60 data collection checklists. The data were analyzed using the Geographical Information System (GIS) and Statistical Package For Social Sciences (SPSS). The extent and magnitude of changes were calculated and the variation of topography and land use changes was determined. The findings reveal that the distribution of land use has been changing with the effect of topographical settings. The total land area of 11146 hectares of Yakkalamulla Divisional Secretariat mainly consists of the Malandeniya mountain range and Kottawa Forest Reserves. Among the other land use types, tea and rubber are the major agricultural land users in mid-highland areas indicating 50 per cent of tea and 60 per cent of rubber. Paddy which has shown 10 per cent of the all land use is broadly extended in low valleys; while 25 per cent is residential areas and 15 per cent is commercial land areas. With the increase of population and destruction of topographical setting due to human activities and poor land use management, regular land use in agriculture has changed over time. The changes have also caused in increasing environmental problems such as soil erosion, landslides, and floods. Furthermore, due to the changes in the land use pattern and their distribution, the physical landscape of the study area has also changed.

Keywords: *Land use, Topography, Land, Population, Landscape*

***Corresponding Author:** samanwijeratne@yahoo.com



Flood Protection Methods and Their Suitability to Matara Divisional Secretariat in Sri Lanka

N.K.N. Kaushalya and S. Wijeratne*

Department of Geography, Faculty of Humanities and Social Sciences, University of Ruhuna, Matara, Sri Lanka

Abstract

Matara District is one of the severe flood prone areas in Southern Sri Lanka, and most of the people and properties are annually affected by this disaster. Constructions of irrigation canals and flood controlling bunds, building of pump stations to discharge the excess water were introduced as the main techniques for the flood control. Although these flood protection methods were introduced to minimize the flood damages, they were not properly able to control the flood risk level with the increase of human activities. The main objective of this study was to examine the weaknesses or failures of existing flood protection methods and their suitability. Godagama and Tudawa *Grama Niladhari* Divisions of Matara Divisional Secretariat were selected as the study area. Primary data were collected using a descriptive questionnaire, from 85 households in two GN divisions and the data were analyzed through Geographical Information System (GIS) and Statistical Package For Social Sciences (SPSS). Findings reveal that most of the flood protection methods are not formal, long lasting or permanent. Shortcomings of former flood protection techniques, informal land use, and infrastructure development have caused to increase the flood damages and the risk level. It is also important to note that the study area is prone to frequent flooding, and the construction of buildings can be observed as its main cause. The risk of flood can be minimized by controlling informal constructions and holding awareness programmes. The results of this study can be used to future flood mitigation projects and disaster management planning.

Keywords: *Disaster, Flood, Protection, Risk, Suitability*

***Corresponding Author:** samanwijeratne@yahoo.com



Below-Ground Carbon Stocks of Mangrove Ecosystems in Sri Lanka: Implication for Climate Change Mitigation

**K.A.S. Kodikara^{1*}, P.L.I.G.M. Cooray¹, M.P. Kumara², N.P. Dissanayake¹,
T. Douglas³, D.D.N. Sripal¹, L.P. Jayatissa¹**

¹ Department of Botany, Faculty of Science, University of Ruhuna, Matara, Sri Lanka

² Faculty of Fisheries and Ocean Science, Ocean University, Tangalle, Sri Lanka

³ Small Fishers Federation, Pambala, Chilaw, Sri Lanka

Abstract

Mangrove forests are highly effective in climate change mitigation as they play a significant role in carbon sequestration compared to any other vegetation category. However, both carbon sinking and out-welling, are poorly simulated due to insufficient information on ecosystem carbon pools, particularly on below-ground carbon contents. Therefore, this pilot study was aimed at evaluating the below-ground carbon stocks of mangrove ecosystems in Sri Lanka, using Rekawa and Batticaloa lagoons from the southern and eastern coasts, respectively. Three belt transects were marked from water margin to landward edge of the mangrove belt, representing different species assemblages. Three soil cores, each with 20 cm in diameter and up to the depth of 60 cm, were taken from random places to represent the whole transect. All mangrove roots in each of the soil core were extracted and their dry weights were determined by oven-drying at 105 °C. Soil samples without roots were also taken from different depths with a soil corer of 3.8 cm in diameter up to the parent material. Dry combustion method (4 hrs) in muffle furnace at 500 °C was used to determine the organic matter contents in soil samples, which are subsequently converted into soil carbon contents. The results showed that the below-ground carbon storage in Rekawa and Batticaloa lagoons are $1,253.57 \pm 84.10$ mg carbon ha⁻¹ and 643.62 ± 56.56 mg carbon ha⁻¹ respectively. Rekawa lagoon is rich in mangrove species diversity and less disturbed as compared to Batticaloa. Therefore, it is suggested that this difference would make the observed difference in carbon stocks. These values are almost double the reported carbon storage of the forest types of the world, for example tropical rainforests and tropical deciduous forests. Further, the results showed that mangrove soils tend to hold 85-90% of soil organic matter indicating their importance in sequestering carbon. Therefore, the need to strengthen the policies for mangrove conservation is imperative in order to protect and enhance the below-ground carbon stocks in mangrove ecosystems.

Keywords: *Carbon budget, Economic and ecological services, Lagoons, Legislations, Mangrove*

***Corresponding author:** sunandaruh@gmail.com



Peelability of Improved Accessions and Commonly Used Varieties of *Cinnamomum Verum* J. Presl: Implications for Harvest Management

K.A.S. Hansika¹, K.A.S. Kodikara^{1*}, A.A. Wijeweera², G. Senanayake³,
K.G.G. Wijesinghe², L.P. Jayatissa¹

¹Department of Botany, Faculty of Science, University of Ruhuna, Matara, Sri Lanka

²Department of Export Agriculture, Cinnamon Research Center, Pallolpitiya, Thihagoda, Sri Lanka

³Department of Agriculture Biology, Faculty of Agriculture, University of Ruhuna, Matara, Sri Lanka

Abstract

Cinnamomum verum (family Lauraceae) is one of the important spices used all over the world. Being the largest cinnamon producer with the highest quality products, Cinnamon trade provides a sizeable contribution to the country's economy. Quills, which are prepared of using peeled Cinnamon bark, are the major product of export, which accounts for 90% among the other cinnamon products. Cinnamon peeling cannot be performed throughout the year and it basically interrupts the continuous harvesting of Cinnamon throughout the year. Therefore, this study was aimed at investigating the peelability variations of improved accessions of Cinnamon, *Sri Vijaya* and *Sri Gamunu* and commonly used variety *Pani Miris Kurundu*. Peelability variation was studied along different phenophases in Cinnamon: growth, flushing, flowering and fruiting. Cinnamon stems of same maturity were harvested by using the same labor force during each phenophase. The bark was detached and both removed bark and the remaining parts of the bark were dried at 50^oC in an oven separately and dry weights were measured. Peelability was calculated by dividing mean dry weight of the bark from the sum of mean dry weights of the removed and remaining bark. The thickness of the peeled bark was measured using IMAGEJ software. According to the results, in *Sri Gamunu*, peelability (96.2±2.5%) was significantly higher (P<0.05) in phenophases of growth, flushing and early fruiting period as compared to late fruiting phase. Peelability (88±1.2%) was significantly reduced (P<0.05) in flowering phase in *Sri Vijaya*. In contrast, peelability was significantly lower (P<0.05) in flowering and fruiting phases in *Pani Miris Kurundu* (88±2.1%) as compared to growth and flushing phenophases. The highest bark thicknesses of *Sri Vijaya* and *Sri Gamunu* were recorded in red flushing (1.37±0.03 mm) and early fruiting (0.91±0.28 mm), respectively. There was no relationship between the bark thickness and peelability in any of the varieties. Improved accessions show high peelability which is economically more advantageous and these results can readily be used for harvest management.

Keywords: Accessions, Cinnamon, Harvest, Peelability, Varieties

*Corresponding Author: sunandaruh@gmail.com



Present Status of Male Calves Fattening Systems in Trincomalee District, Sri Lanka

D. Senaratna*, K. Priyatharshani and N.S.B.M. Atapattu

Department of Animal Science, Faculty of Agriculture, University of Ruhuna, Sri Lanka

Abstract

Male calves are separated from mother cows 2-3 hours post-delivery and male calves are slaughtered at an early stage of life by disturbing welfare of both mother cow and newly born calf. Fattening of male calves is regarded as an alternative management method for early slaughtering. Hence, this study investigated the socio-economic perspectives of male calves fattening farms (FF), welfare status of fattened calves and the perception of different ethnic groups on cattle slaughtering to explore the actual situation of meat industry in Trincomalee District (TD). Data were collected from 40 FF (63%) covering different ethnic groups (n=180; 60 from Sinhala, Tamil and Muslim each) using purposive sampling technique by adopting a survey questionnaire and directing farm observations. The study revealed that all FF were running in small scale basis those followed extensive management where 80% farmers obtained calves from their own farms for fattening (24% calves). Average selling weight of fatteners varied from 180±10 to 243±10 kg and average carcass weight at selling was 208±10 kg. At present, farmers mainly reared local breeds (85%) like Thamankaduwa white over Jersey (3%), Sahiwal (4%) and local crosses. As most of the farmers (55%) fed the animals mainly with available grass, fattening has taken more time. However, the average feed cost encountered around 74 % of total cost of production and body condition score (BCS) of animals varied in a satisfactory level (BCS 3-4 in 55% of FF). The cattle are slaughtered by Muslim people (82%) over Tamil (8%) and Sinhala (10%) people in Trincomalee District. Irrespective of the ethnic group, perception was not to slaughter cattle even after fattening. It is concluded that male cattle fattened in small scale farms in Trincomalee District have a positive impact on improving the performance and welfare of the cattle and also a method to minimize unethical and illegal male calf slaughtering.

Keywords: *Fattening systems, Male calves, Slaughtering, Trincomalee, Welfare*

***Corresponding Author:** dulcy@ansci.ruh.ac.lk



Exploration of Root Morphology and Plant Nitrogen Uptake of Different Wheat Species

K.M.C. Fernando^{1,2*}, C. Wibowo² and D.L. Sparkes²

¹Department of Crop Science, Faculty of Agriculture, University of Ruhuna, Mapalana, Kamburupitiya, Sri Lanka

²Division of Agriculture and Environmental Sciences, University of Nottingham, Sutton Bonnington Campus, Loughborough, Leicestershire, LE12 5RD, United Kingdom

Abstract

The present wheat breeding programmes focus on developing genotypes with efficient root systems to uptake more water and nutrients under resource limited conditions. However, available information on root system architecture and nitrogen (N) uptake of existing wheat species is very limited. Therefore, a controlled environment column experiment was conducted to study root architectural traits and plant N uptake of different wheat species at Sutton Bonnington Campus, University of Nottingham, UK. Seven genotypes included cultivated emmer (*Triticum dicoccum*), spelt (*T. spelta* L.) and modern bread wheat (*T. aestivum*). A split plot design was used in the experiment where main plot factor was N levels and sub-plot factor was genotypes. Three levels of N equivalent to 50, 100 and 200 kg N ha⁻¹ were applied. Root samples at different depth were scanned and analysed using *WinRHIZO* software at anthesis and maturity. Total root length, root volume, root biomass, average root diameter, root length density and root N uptake efficiency were recorded. Plant N uptake was calculated at anthesis and maturity (excluding N in roots). All measured root traits, except average root diameter, were significantly different among genotypes at all depths. However, the effect of N was not significant on all root traits of this experiment. Spelt genotypes recorded the highest total root length, root volume, root biomass and root length density at all depths while emmer genotypes recorded the greatest root N uptake efficiency. Plant N uptake was significantly different only among genotypes where all spelt genotypes had high plant N uptake followed by bread wheat and emmer. Plant N uptake of the genotypes had a very strong positive relationship with total root length, root volume, root biomass and rooting depth of genotypes. Therefore, it could be concluded that the high plant N uptake of plants may be due to robust and vigorous root systems of the plant.

Keywords: Anthesis, Maturity, Nitrogen uptake, Root architecture, Wheat species

***Corresponding Author:** menaka@crop.ruh.ac.lk



Hydrophobic Effects on Water Retention in Potting Media

J.K.P.N. Prathibha, U.I. Samarawickrama and D.A.L. Leelamanie*

Department of Soil Science, Faculty of Agriculture, University of Ruhuna, Sri Lanka

Abstract

Potted plant industry in Sri Lanka has been developed rapidly and is more famous among farmers. Potting media act as the backbone of the potted plants by providing water, nutrients and physical support to them. Development of water stress condition by surface evaporation is an identified key issue in some common potting media. Soil water repellency restricts spontaneous water penetration. The objective of this study was to identify the evaporation level changes with the time in different potting media by adding hydrophobic organic matter. Dried leaves of *Casuarina equisetifolia* (*Casuarina*) and *Pinus caribaea* (*Pinus*) were used as hydrophobic organic matter and they were incorporated separately in two levels (10% and 20%) into potting media. Each potting mixture was kept in separate open top containers and placed them in the controlled environmental chamber. Moisture content of each potting mixture was measured gravimetrically in regular intervals. *Pinus* has a lower level of water drop penetration time (about 4000s) compared to *Casuarina* (more than 10000s). Moisture content in each sample was rapidly decreased within first few hours (35.6 %, 32.9 %, 26.9 %, 24.4%, etc.) Soil water retention can be increased by adding hydrophobic organic matter. Application of higher rates of hydrophobic organic matter increases the level of soil water retention compared to when they are applied in lower level. Application of *Casuarina* in higher rates shows the highest level of soil water retention than the application of *Pinus*. Adding hydrophobic organic matter helps to minimize the evaporation loss and limit the favorable conditions to develop water stress for potted plants.

Keywords: *Soil water repellency, Hydrophobic organic matter, Soil water retention, Casuarina, Water stress*

* **Corresponding Author:** udaranga@soil.ruh.ac.l



Elevated Carbon Dioxide Mediated Early Growth Responses of Wheat (*Triticum aestivum* L.): An Analysis of Source and Sink Interactions

D. Gamage^{1&4*}, M. Thompson^{1&2}, P. Dehigaspitiya¹, N. Hirotsu^{1&3},
M. Sutherland¹, S. Seneweera^{1,4 &5}

¹Centre for Crop Health, University of Southern Queensland, Toowoomba, QLD 4350, Australia; ²Centre for Crop Science, Queensland Alliance for Agriculture and Food Innovation, University of Queensland, Australia; ³Graduate School of Life Sciences, Toyo University, Oura-gun, Gunma, 374-0193 Japan; ⁴Department of Agricc. Biology, Faculty of Agriculture, University of Ruhuna, Mapalana, Kamburupitiya, Sri Lanka; ⁵ National Institute of Fundamental Studies, Hanthana Pedesa Road, Kandy, Sri Lanka

Abstract

The physiological and molecular mechanisms of plant growth responses at elevated [CO₂] were investigated through developing an understanding of the source and sink interaction using wheat. Wheat plants were grown under ambient [CO₂] (400 μmol mol⁻¹) and elevated [CO₂] (700 μmol mol⁻¹) for six weeks. Above ground and below ground biomass accumulation, total leaf area and the rate of photosynthesis were measured in 42 days after planting. Total soluble carbohydrate concentration in different plant organs were measured. Expression analysis of genes involved in photosynthesis (*rbcL*, *rbcS*), carbon metabolism (*SPP1*, *SPS1* and *SUS1*), nitrogen metabolism (*Fd-GOGAT*, *NADH-GOGAT*, *GS2a*, *GS2b*, *GSr1*, *GS1a*), cell wall metabolism (α and β – expansins, Xyloglucan endotransglucosylase/hydrolases) was performed using real-time quantitative-PCR. There were significant interactions between [CO₂] and cultivar for above (P<0.01) and below ground biomass (P<0.01), total leaf area (P<0.01), total soluble carbohydrate content (P<0.01) and leaf photosynthesis (P<0.05). Transcript abundance of key genes showed a marked difference at elevated [CO₂] showing a significant [CO₂] effect across all organ types and the cultivars (P<0.05). Genes involved in cell wall metabolism and sucrose synthesis were highly expressed in growing sink tissues. Significant correlations exist between sugar concentration and some genes encoding carbon metabolism (*SPP1*) and Xyloglucan endotransglucosylase/hydrolases (*TaXTH3*, *TaXTH5*), implying that these metabolic activities may play a leading role in determining the growth response to elevated [CO₂].

Keywords: Carbon and nitrogen metabolism, Cell wall metabolism, Elevated [CO₂], Organ-specific, Post-photosynthetic processes, Transcript abundance

*Corresponding Author: dananjali@agbio.ruh.ac.lk



The Effect of Salinity on Growth Performance of Mangrove Associated *Penaeus monodon* in Sri Lanka

P.W.A. Perera^{1*}, S. Ratnavel¹, N.Y. Hirimuthugoda¹, and W. Rajapakse²

¹ Department of Animal Science, Faculty of Agriculture, University of Ruhuna, Mapalana, Kamburupitiya, Sri Lanka

² National Aquatic Resources Research and Development Agency, Crow Island, Colombo 15, Sri Lanka

Abstract

Salinity is considered as the most important factor deciding the water quality and affecting the survival and the growth of *Penaeus monodon* juvenile. Fifteen small glass aquaria (60 × 30 × 30 cm³) filled with brackish water collected from mangrove ecosystem and five different salinity levels (0, 10, 20, 30, 35ppt) were used as experimental units with triplicates to study the effect of salinity on the survival and the growth of *P. monodon* juveniles over a period of four months. 20 larvae of *P. monodon* were stocked at 20 individuals/ tank with 15 cm PVC pipes as shelters to avoid cannibalism. Shrimp larvae were fed ad libitum twice a day (9:00 am and 15:00 pm) with commercial pelleted prima feed. The shrimp were blotted dry and the body weight and length were measured fortnightly, while mortality (if any) was noted daily. The highest length recorded was 9.3 cm and the lowest length was 7.1 cm at the end of four months at 20 ppt. On the other hand, shrimp growth was linear at about 0.08 units per day. The maximum growth index and the highest survival (90%) were observed at 20 ppt. The lowest survival rate (<40%) was observed in both 0 ppt and 35ppt salinities. An increment of crude body protein content was recorded in parallel with the increment in salinity. The highest (70.31%) and the lowest (64%) crude protein contents were recorded at 35ppt salinity levels respectively. In this study, *Penaeus monodon* hyper-osmoregulated when salinity was beyond its iso-osmoticpoint and hypo-osmoregulated when it was inferior to this point. The erratic rains and the salt water intrusion due to climate change effects would alter the salinity levels in lagoons creating negative impacts on the natural shrimp production in the lagoons in Sri Lanka. Therefore, sustainable eco system management steps are essential to be introduced to ensure the water quality in lagoons.

Keywords: Climate change, Salinity fluctuations, *Penaeus monodon*, Sri Lanka

*Corresponding Author: pwaperera@yahoo.com



Solving the Crisis of E-Waste: Present Status and Future Challenges: A Case Study in Faculty of Agriculture, University of Ruhuna, Sri Lanka

S. R. Amarasinghe^{1*} and G. C. Samaraweera²

¹ Department of Soil Science, Faculty of Agriculture, University of Ruhuna, Sri Lanka

² Department of Agricultural Economics, Faculty of Agriculture, University of Ruhuna, Sri Lanka

Abstract

The improper disposal of E-waste causes severe environmental problems by contaminating the soil and water sources. This creates alarming threats to human and animal lives. The usage of electronic devices has been drastically increased during last decades in Sri Lanka. Universities are one of the major E-waste generating places in Sri Lanka. However, there is no proper disposal technique for E-waste disposal. Therefore, the present study was conducted as a case study in the Faculty of Agriculture, University of Ruhuna, Sri Lanka. The major objectives of the study were to identify and quantify the E-waste disposed in the Faculty, to identify the disposal methods of E-waste inside the Faculty premises, to identify the awareness level regarding the hazardous effects, government regulations of E-waste, and to develop a model for a sustainable E-waste disposal system. Field observations, interviews and questionnaires were used to collect data by using Stratified Random Sampling method. A sample of 165 students were selected from first, second and third year batches, 35 staff members, and seven Technical officers from seven departments and responsible personnel from Information Technology Unit and Dean's office were selected in order to obtain a representative sample from the population of the Faculty. Descriptive and inferential statistical tools were used to analyse the collected data. According to the results, the minor E-waste such as USB drives, headsets, batteries, CDs and DVDs were the most common disposal waste during past five years period. However, the major E-goods such as mobile phones, laptops and PCs showed less disposal during past five years in the Faculty premises. A considerable proportion (22%) of the students has purchased second hand E-goods, which can be used without any repairs. This is a major reason for the increment in E-waste bulk in the Faculty as second hand electronics lose their functions earlier than new electronics. The analysis revealed that a majority of staff members (97%) were aware of hazardous effects of E-waste. When level of awareness of government regulations about E-waste was tested, a majority of the students (80%) were unaware of such regulations while a majority of staff members (60%) were aware of this fact. Moreover, the majority of the staff members (55.6%) have handed them over to the faculty to be disposed separately. Furthermore, the study identified that there is a significant difference ($p=0.015$) between groups of different degree programs offered by the Faculty and the disposal methods of E-waste often used. A model for sustainable E-waste disposal was developed and a majority of the faculty staff members and students had agreed to implement the suggested E-Waste model. Moreover, recommendations were given to minimize the improper and unsafe E-waste disposal inside the Faculty using the 3R concept.

Keywords: *Disposal, E-Waste, Hazardous, Sustainable, University of Ruhuna*

***Corresponding Author:** rajika@soil.ruh.ac.lk



An Attempt on an Alternative Transformation Method: Seedling Transformation of Rice (*Oryza sativa L.*) and Anthurium (*Anthurium draeanum Linden ex Andre*) Using 35S:VlmybA2 and 35S:Gus

T.T.D. Dahanayake¹, S. Fukai² and S. Geekiyanage^{3*}

¹ Board of study in Agriculture, Faculty of Graduate Studies, University of Ruhuna, Sri Lanka

² Faculty of Agriculture, Kagawa University, Miki-cho, Kagawa, Japan

³ Department of Agricultural Biology, Faculty of Agriculture, University of Ruhuna, Sri Lanka

Abstract

The *Agrobacterium tumefaciens* mediated gene transformation is one of the widely used plant gene transformation methods to overcome barriers of conventional breeding. The objectives of this study were to determine the effect of seedling transformation on Sri Lankan rice and anthurium using 35S:*Gus* as an alternative transformation method and the potential of 35S:*VlmybA2* as a visual marker. Improved rice varieties (Bg 352, Bg 300, At 362, Bg 358, Bg 359 and Ld 368) were used. Two weeks old embryonic calli, one week old seedlings and two months old plantlets regenerated through calli (Bg 352, Bg 300 and At 362) were used as explants for transformation. In anthurium, two months old embryonic calli, six months old plantlets derived from calli and one month old seedlings of '*Makandura* were used for transformation. The infected explants were selected on antibiotic medium containing Kanamycin 50 mg/l. One week after transformation phenotypic screening was carried out for the infected explants based on the purple pigmentation for 35S:*VlmybA2* and the infected explants were histochemically tested for GUS activity and the anthocyanin test was carried out to determine the success of transformation with 35S:*VlmybA2*. The putative transformed explants indicated GUS activity as determined from the blue spots observed in the histochemical test and the purple pigmentation along with positive results in anthocyanin test proved the success of transformation. Integration of transgenes was carried out using PCR with relevant primers of *VlmybA2* and *GUS*. Positive gel results indicated the success of transformation of both crops. Seedling transformation using 35S: *Gus* is successful for anthurium (*Makandura*) and tested local rice. The potential of *Agrobacterium* carrying 35S:*VlmybA2* as a safe visual marker for seedling transformation must be further confirmed. Above experiment will be useful as an initial attempt on developing safer transgenic plants in the future.

Keywords: *Anthurium*, *Gus*, *Rice*, *Seedling transformation*, *VlmybA2*

***Corresponding Author:** sudarshanee@agbio.ruh.ac.lk



Economic impacts of Climate Change on Smallholding Coconut Growers: A Ricardian Approach

W.N. De Silva*, W.A.A.M. Bandara and H.M.K. Sandamali

Department of Agricultural Economics, Faculty of Agriculture, University of Ruhuna, Mapalana, Kamburupitiya, Sri Lanka.

Abstract

Coconut is considered as one of the major export crops in Sri Lanka, which is frequently affected by climate extremes. Therefore, this study was conducted with the objective of analyzing the economic impact of climate change on smallholding coconut growers and to provide appropriate suggestions to develop the coconut sector in Sri Lanka. The primary data were collected from a sample of 93 smallholding coconut growers in Kurunegala District following Simple Random Sampling technique. Pre-tested questionnaire survey and informal group discussions were employed as data collection tools. The results of the study revealed that all the farmers were aware of the climate changes taken place in the area, which directly affected both quality and quantity of the coconut yield. The Ricardian Model revealed that the fluctuation in climatic factors including rainfall and temperature had a significant positive impact on farmers' net revenue. In addition to climatic factors, land extent, farming experience and access to extension services affected significantly the farmers' net revenue. Furthermore, it was revealed that average annual net revenue per acre was LKR 172,937 and varied between the minimum of LKR 4,470 and maximum of LKR 210,764. Forty per cent adopted strategies to cope with the adverse impacts of climate change which was accelerated by the lack of financial assistance, poor irrigation facilities, lack of extension services and shortage of labor. Finally, it was concluded that smallholding coconut growers were highly vulnerable to the changes in climatic parameters, which had a direct impact on productivity of the coconut sector. Therefore, this study suggested to implement an effective extension service and introduce a subsidy program to empower the coconut smallholders to overcome the negative impacts of climate change and increase productivity of coconut smallholders.

Keywords: *Climate change, Coconut smallholders, Ricardian approach, Socio economic impact*

***Corresponding Author:** nilanthade@agecon.ruh.ac.lk



Effect of Maturity of the Explant to Develop Shoots from *Ziziphus jujuba* (Masan) Using *in Vitro* Techniques

Y.M.S.M. Yapa, L.N.S. Silva, N.M.S.D. Navarathna, G.K.M.M.K. Ranaweera, and N. Dahanayake*

Department of Agricultural Biology, Faculty of Agriculture, University of Ruhuna, Mapalana, Kamburupitiya, Sri Lanka

Abstract

Jujube (*Ziziphus jujuba*), commonly known as *Masan* in Sri Lanka is a tree, which belongs to the family of *Rhamnaceae*. Jujube has been categorized as an underutilized fruit crop in Sri Lanka because of very poor seed germination and micropropagation of the Jujube plant, which is of timely importance. The aim of this research was to investigate the effect of the maturity level of the nodal segments of Jujube plant to develop shoots from the tissue culture. For that, nodal segments of four types of different maturity levels such as apical bud (T1), immature shoots (T2), semi-mature shoots (T3) and matured shoots (T4) were selected as the explants from a high yielding and healthy Jujube plant. Prior to collecting explants, Draconil (fungicide) was applied to the mother plant five times within 15 days. In the laboratory, all explants were washed under running tap water for one hour. Then, they were washed with soap water for five minutes and rinsed well by distilled water. Then, under aseptic condition, all segments were sterilized dipping in a 20% clorex solution for 10 minutes and repeated it twice. Then, the nodal segments were washed well with double autoclaved distilled water for four times and finally, the explants were dried using autoclaved blotting papers. Furthermore, they were carefully transferred to a MS Medium without hormones. The experiment was arranged in a Completely Randomized Design (CRD) with all four treatments as three replicates for each treatment and 10 nodal segments were cultured for each replicate. Number of developed axillary shoots were counted after 14 days, and data were analyzed using SAS. A Semi-matured explant was observed of having significantly highest average number of developed axillary shoots (4.5) and it was different from other three maturity levels at 5% significant level. It was finally observed that semi-mature nodal explants are the best to produce shoots from Jujube plant using *in vitro* techniques.

Keywords: *Ziziphus jujube*, Shoots, Explants, Draconil

*Corresponding Author: daha27@yahoo.com



Mineral Composition of Iron Ore Occurrence at Pelwatta in Uva Province of Sri Lanka

U. Premarathne^{1*}, N.P. Ratnayake² and H.A.H. Jayasena³

¹Department of Oceanography & Marine Geology, Faculty of Fisheries and Marine Sciences & Technology, University of Ruhuna, Matara, Sri Lanka

²Department of Earth Resources Engineering, Faculty of Engineering, Moratuwa University, Katubedha, Moratuwa, Sri Lanka

³Department of Geology, Faculty of Science, University of Peradeniya, Sri Lanka

Abstract

The occurrence of several iron ore veins embedded in a metamorphic rock outcropping on a hill named Horakgodakanda, which is located at Pelwatta area in Uva province of Sri Lanka, was reported in 2001. The veins exposed at the top and the western slope of the hill are 30 to 100 cm in thickness and 2-3 m in length. A trench excavated along the northern end of the hill cross cuts many thinner (1-2 cm thick) iron ore veins. Mineral composition of ore in this locality has not been fully understood yet. The objective of this research was to understand the mineralogy of the iron ore. Multiple unweathered samples from three (3) large ore bodies exposed at the top of the hill, a vein located at the edge of the western slope of the hill and two thinner veins exposed on the side walls of the trench were collected for analysis. 12 samples (two samples from each vein) were powdered and analyzed using *Bruker D8 Focus* X-ray diffractometer. The XRD pattern was recorded at Cu-K α radiation (1.54Å), a voltage of 40kV, a current of 40 mA, 2 θ range from 5° to 80° and step size of 0.02 on free-flowing fine powdered samples, placed on a double tape pasted to the plastic sample holder. Data were interpreted using QualX (v.2.13) software with POW_COD data base. The results of the study showed that the iron ore veins located at the top of the hill were mainly composed of hematite. A sample from the trench contained magnetite, while the other was a mixture of magnetite (62.5%) and hematite (37.5%). The samples from the western slope of the hill were magnetite. This indicates that iron ore bodies at Pelwatta had been originally composed of magnetite, a part of which has been later converted to martite, a variety of hematite that is pseudomorphous after magnetite. The exact process that led to martitization is not fully understood yet.

Keywords: Magnetite, Iron ore, Martite, Pelwatta, Sri Lanka

*Corresponding Author: premarat@yahoo.com

Humanities and Social Sciences



Diminishing Identity of Cultural Minority Communities in Contemporary Societies: A Study Based on Coastal Indigenous People of Vahare Batticaloa, Sri Lanka

S. Gunasekara* and H.L.S. De Zoysa

Department of Sociology, Faculty of Humanities and Social Sciences, University of Ruhuna, Matara, Sri Lanka

Abstract

Sri Lankan indigenous people, also known as the *Vedda* Community, represent a minority group of the country since they belong to a small proportion of the population when compared to the dominant population. The research problem of this study is to examine why the coastal indigenous people of Sri Lanka are losing their identities in the contemporary society. The main objective is to explore the causes, which have affected the diminishing identities of coastal indigenous people of Vahare, Batticaloa. Qualitative research methodology was used for the research. Primary data were collected through 12 in-depth interviews and observation. Thematic analysis was adopted to analyse the data. Findings reveal that colonization and modernization of the post-independence era of Sri Lanka led the coastal indigenous people into an assimilation process, and as a result, this community merged with the Tamil community culturally, economically and socially. The modernization process with the development of economy, transportation, education and infrastructure influenced this assimilation. Consequently, cultural pluralism occurred in this community and their socio-cultural, political and economic chaos was designed on the Tamil cultural platform. Even though the majority of coastal community has merged with Tamil community, some can be seen retaining their own cultural and religious practices as well. It was also found that indigenous people were skeptical whether they could transfer their identity as *Veddas* to their next generation. Consequently, they cannot be totally identified as Tamil people and they are categorized into a minority group in the Sri Lankan society. Therefore, this community believes that they face problems in terms of prejudice, discrimination and marginalization by the dominant population of the country. In conclusion, assimilation into the dominant group, weak traditional modes of production and losing traditional lands have contributed to diminish the identity of coastal indigenous community in Sri Lanka.

Keywords: *Assimilation, Coastal Veddas, Diminishing, Discrimination, Modernization*
***Corresponding Author:** dinetputa2009@gmail.com



People's Use of Public and Private Green Spaces in a Residential Zone of Galle City, Sri Lanka

D.B.C. Jayasinghe, G.P.T.S. Hemakumara*, P. Hewage

Department of Geography, Faculty of Humanities and Social Sciences, University of Ruhuna, Matara, Sri Lanka.

Abstract

Urban green spaces can address problems related to urbanization such as pollution and urban heat island effects. A city's green spaces include both public and private green spaces, which although different, can provide positive benefits to residents. This paper investigates people's use of public and private green spaces in a primary residential zone of Galle city, Sri Lanka. Every housing unit in the selected residential zone ($n=280$) were surveyed to collect data for a quantitative and spatial analysis to identify the use of public and private green spaces and the data was analyzed through one-way ANOVA parametric test. Research findings revealed that 73 per cent of respondents have regularly used public green spaces, yet, 10 per cent has not used this space although 80.33 per cent of green coverage is available in their plot of land. It was observed that 25 per cent of average extent of private green space is maintained by the residents. Only 10 per cent of respondents have allocated more than 50 per cent of space for private gardening in their land while 35 per cent of respondents have maintained less than 10 per cent of land out of their total land space for private gardens. The respondents who regularly use public green spaces have only 32 per cent of green coverage in their plot of land while participants who moderately use public green space have 35.09 per cent of green coverage. Those who use small amount of time in public green spaces have 50.19 per cent of green coverage and the respondents who have never used public green space have 80.33 per cent of green coverage in their plot of land. Thus, it could be concluded that there is a relationship between the frequency of public green spaces usage and the extent of private green spaces maintained by the residents. The results indicate that when the extent of private green spaces maintained by the respondents increases, their frequency of using public green spaces decreases.

Keywords: *Private green space, Public green spaces, Residential garden, Urbanization, Urban green spaces*

***Corresponding Author:** shemakumara@hotmail.com



Impact of Small and Medium Enterprise Income on Household Poverty in Rural Sri Lanka: A Descriptive Approach

H.K. Sarath* , D. Atapattu and B.M. Sumanarathne

Department of Economics, Faculty of Humanities and Social Sciences, University of Ruhuna, Matara, Sri Lanka

Abstract

Poverty in Sri Lanka is predominantly a rural phenomenon wherein more than 70 % of rural population and rural sector contribute more than 82 % to total poverty in Sri Lanka. Poverty in rural areas is higher among agricultural households, while the poverty rate for rural nonfarm-households is significantly low. The majority of studies suggests a strong positive relationship between small and medium enterprises (SMEs) growth and economic growth and thereby a negative relation with the incidence of poverty. In this regard, SMEs are said to enhance competition and entrepreneurship and hence have external benefits on economy-wide efficiency, innovation, and aggregate productivity growth. Evidence shows that SMEs contribute significantly to household incomes, especially when people on low incomes increase and stabilize their incomes by engaging in SMEs activities. Hence, it is generally agreed that the development of SMEs can be a key ingredient in poverty- reduction. The main objective of this paper is to investigate the impact of SMEs income on household poverty in rural Sri Lanka. The sampling frame for the current study is SMEs in southern province in Sri Lanka in which 390 enterprises were selected from the target population of 123,645 SMEs under multistage cluster sampling. Collected primary data was descriptively analysed on a bivariate uncontrolled manner to investigate the importance of SMEs income in reducing household poverty. Findings reveal that more than 80 % of households is above the average poverty line, while 36 % of them earns at least two times above poverty line. Considerable proportion of households makes even three times the poverty line. The majority of households generates sufficient earnings to meet absolute poverty line in the rural sector. The majority of those that are above the absolute poverty line has met their basic food, shelter and educational needs by utilizing the enterprise income.

Keywords: *Economic growth, Multistage Cluster Sampling, Poverty line, Rural poverty, Small and Medium Enterprise*

***Corresponding Author:** katuku@econ.ruh.ac.lk



ශ්‍රී ලංකාවේ දරිද්‍රතාව පිටුදැකීමේ දී සුළු හා මධ්‍ය පරිමාණ ව්‍යවසායන්හි කාර්යභාරය, විභවතා සහ ගැටලු පිළිබඳ විස්තරාත්මක ප්‍රවේශයක්

එච්.කේ. සරත්*, ඩී. අනපත්තු, බී.එම්. සුමනරත්න

ආර්ථික විද්‍යා අධ්‍යයනාංශය, මානව ශාස්ත්‍ර හා සමාජීය විද්‍යා පීඨය, රුහුණ විශ්වවිද්‍යාලය, මාතර, ශ්‍රී ලංකාව

සංක්ෂේපය

ජාතික දරිද්‍රතා මිනුම් සහ ජාත්‍යන්තර දරිද්‍රතා මිනුම්වලට අනුව ශ්‍රී ලංකාවේ දරිද්‍රතා මට්ටම පහත වැටීම පිළිබඳ සාධනීය ලක්ෂණ පෙන්නුම් කළ ද, අංශ මට්ටමින් ශ්‍රී ලංකාවේ දරිද්‍රතාව අධ්‍යයනය කිරීමේ දී පසුගිය දශක කිහිපය පුරා නාගරික අංශයට සාපේක්ෂ ග්‍රාමීය හා වතු අංශවල ඉහළ දරිද්‍රතා මට්ටමක් පෙන්නුම් කර ඇත. ඒ අනුව ශ්‍රී ලංකාවේ දරිද්‍රතාව මූලික වශයෙන් ම ග්‍රාමීය ප්‍රජාවයක් වන අතර බහුමාන දරිද්‍රතා දර්ශකයට අනුව ඉහළම බහුමාන දරිද්‍රතා මට්ටමක් පෙන්නුම් කෙරෙන්නේ ද ග්‍රාමීය හා වතු අංශය තුළ ය. ශ්‍රී ලංකාවේ දරිද්‍රතාව අඩුකිරීමේ දී ගොවිපල නොවන හෙවත් සුළු හා මධ්‍ය පරිමාණ ව්‍යවසායන්ට ඉහළ දායකත්වයක් සැපයිය හැකි ය. ශ්‍රී ලංකාවේ දරිද්‍රතාව පිටුදැකීමේ දී සුළු හා මධ්‍ය ව්‍යවසායකයන්ට කාර්යභාරයක් පවතී ද? ඒ සඳහා පවතින විභවතා මොනවා ද? සහ තවදුරටත් සුළු හා මධ්‍ය පරිමාණ අංශ මුහුණ දෙන ගැටලු මොනවා ද? යන පර්යේෂණ ප්‍රශ්න තුන මත මෙම අධ්‍යයනය සිදු කරන ලදී. ශ්‍රී ලංකාවේ දරිද්‍රතාව පිටුදැකීම සම්බන්ධ ව සුළු හා මධ්‍ය පරිමාණ අංශයේ ශක්‍යතාව හා එහි විභවතා හඳුනා ගැනීමත් සහ එයට එරෙහි ව පවතින සංරෝධක මොනවා ද යන්න අධ්‍යයනය කිරීමත් මෙම අධ්‍යයනයේ මූලික අරමුණ වේ. එසේ ම ශ්‍රී ලංකාවේ දරිද්‍රතාව පිටුදැකීමේ දී සුළු හා මධ්‍ය පරිමාණ අංශයට කළ හැකි කාර්යභාරය කෙබඳු ද යන්න මත මෙම අධ්‍යයනයේ පර්යේෂණ ගැටළුව ගොනුවේ. බහු පියවර පොකුරු නියැදීමේ ක්‍රමය මත දකුණු පළාතේ 123,645 ක් වූ සමස්ත ව්‍යවසායකයන්ගේ 390ක් අධ්‍යයන නියැදිය ලෙස තෝරා ගනු ලැබිණි. මෙම අධ්‍යයනයට අදාළ නියැදියේ ප්‍රමාණය තීරණය කිරීම සඳහා Krejcie සහ Morgan විසින් (1970) ඉදිරිපත් කරන ලද වගුව උපයෝගී කර ගන්නා ලදී. ආර්ථික වර්ධනය ශක්තිමත් කිරීම හරහා දරිද්‍රතාව අඩු කිරීමට දායකවීම, සාපේක්ෂ ව අඩු නිපුණතාවලින් සපිරි කොටස් ඇතුළු ව සේවා නියුක්ති ඉඩ ප්‍රස්තා විවර වීම, කුඩා පරිමාණ සැපයුම්කරුවන් අතර සම්බන්ධතා ගොඩනැගීමට ඉවහල් වීම, අන්ත දරිද්‍ර ජනතාව කෙරෙහි පුළුල් අවධානයක් යොමු වීම හරහා දරිද්‍රතාව පිටුදැකීමට උපකාරී වීම, බදු ගෙවීම්වලට දායකවීම තුළින් දරිද්‍රතාව පිටුදැකීමට මහ පෙත්වීම හා ප්‍රජා සංවර්ධනයට ඉතා පුළුල් අවකාශ පැවැතීම යන ක්‍ෂේත්‍ර ගණනාවක් ඇතුළත්ව ශ්‍රී ලංකාවේ දරිද්‍රතාව පිටුදැකීමේ දී සුළු හා මධ්‍ය පරිමාණ ව්‍යවසායකයින්ගේ කාර්යභාරය, එහි විභවතා සහ ගැටළු එහි න්‍යායාත්මක රාමුව සහ අනුභාවික නිරීක්ෂණ ආශ්‍රයෙන් විග්‍රහ කළ හැකි වේ. ප්‍රාග්ධනය හා අවශ්‍ය සම්පත් අත්කර ගැනීමට සීමිත ප්‍රවේශ පැවැතීම මෙම අංශය මුහුණ දෙන ප්‍රධාන ම ගැටලුව වේ.

ප්‍රමුඛ පද: ආර්ථික වර්ධනය, දරිද්‍රතාව, සුළු හා මධ්‍ය පරිමාණ ව්‍යවසායන්, ප්‍රජා සංවර්ධනය
* සමායෝජක කථිතෘ: katuku@econ.ruh.ac.lk



Public Choice of President 2019: A Shape of Individual Consciousness of Political Networks

A. Samarakoon*

Department of Public Policy, Faculty of Humanities and Social Sciences, University of Ruhuna, Matara, Sri Lanka

Abstract

Humans are cognitively limited information processors. Hence, they cannot comprehend all of the possible factors in a typical campaign and election simultaneously, nor would they want to, even if they could. As a remedy for the lower capacity of processing information, humans have decided to be a part of networks, groups, institutions and structure. Marx explains the nexus of humans and structure/ institutions as the 'conditions of life', which are determined by social labour and social wealth. This paper examines the effects of social networks in the processing of information in electing representatives. The research has also attempted to produce a new epistemology to understand the effects of social labour and social wealth on the ability of processing information in the elections of representative democracy. Therefore, this research examines the types of social networks that are mostly associated with shaping individual consciousness and how those social networks define the conditions of life. The study used qualitative approach in which empirical data were collected from the *Grama Niladari* divisions of Vattappola and Welamboda in Udunuwara Divisional Secretariats of the Central Province. Semi-structured questionnaire was used to interview 50 respondents. Secondary data were collected from a library survey. The empirical data were analysed using narrative analysis. Findings reveal that peer groups of the working sphere, Buddhist welfare associations at the village level and the groups of micro-finance beneficiaries are the primary networks in shaping individuals' political consciousness. Caste and past-pupil associations also made the impacts on constructing political consciousness. These groups define the conditions of life through national security, a strong political leadership and mega-scale development projects. The research claims the argument that the human cognitive capacity in building political consciousness depends on the nature and scope of social networks, social labour and social wealth.

Keywords: *Individuals, Marxism, Presidential election, Social choice*

***Corresponding Author:** arunisamarakoon@gmail.com



Growth of Coastal Population and Its Impact on Coastal Resources of Sri Lanka

W.K.V. Dayalatha*

Department of Geography, Faculty of Humanities and Social Sciences, University of Ruhuna, Matara, Sri Lanka

Abstract

The coastal settlements of Sri Lanka have grown in size and increased in its economic importance since the 1950s, particularly in the wet zone. By 1981, 5.04 million people of the total population and in 2012, more than a half of the population of 21 million people, lived in coastal districts in Sri Lanka. This paper examines the trends in population growth in Sri Lanka during the period from 1981 to 2012, their impact on coastal environmental degradation and some coastal policy implications. The study was guided by secondary data gathered through the Department of Census and Statistics and Divisional Secretariat Divisions and the study area consisted of all coastal districts of Sri Lanka. Spot Observations were conducted to understand the characteristics of the population throughout the selected districts namely Matara, Galle, Hambantota, Jaffna, Trincomalee and Mannar. Findings indicate a trend in considerable growth of coastal population in the coastal districts; specifically, the population in the coastal districts of Sri Lanka was enumerated to 7.9 million in 1981 and by 2012 it increased to 11.5 million. Important coastal resources such as mangrove, fish, water sources and coral reef in coastal areas have conspicuously degraded due to population growth and human activities. Sri Lanka's coastal fish production was rising from 1981 to 2012 and in the same period, it was observed that the population has also increased in the coastal areas. It was also noticed that live coral and mangrove cover has gradually decayed in different scales due to population increase. These results indicate the importance of pertinent monitoring and awareness programs to identify the causes for resource degradation, which indirectly pollute the coastal environment and taking immediate action to prevent further damage to the coastal environment.

Keywords: *Coastal settlements, Environmental degradation, Observations, Population Growth, Resources*

***Corresponding Author:** wkavdayalatha@yahoo.com



The Use of Social Media in Tourism Promotional Policy Formulation: A Case Study of Using WhatsApp to Rebuild Tourism after the Easter Attack 2019 in Sri Lanka

K.H. Lakmali*

Department of Public Policy, Faculty of Humanities and Social Sciences, University of
Ruhuna, Matara, Sri Lanka

Abstract

Social media in policymaking is becoming a method to promote the bottom-up approach in policymaking and it has enhanced the citizen's participation in this process. During the last few years, researchers have identified the importance of social media in the risk management, disaster management, education and health sectors, but the tourism promotional policies have received limited attention. Moreover, among social media, Facebook has been widely researched as a social media platform, but other platforms like WhatsApp have received less focus. Even though the professional group chats have been identified as knowledge hubs and have high potentials in policymaking, they have not received significant attention in tourism. Therefore, this research has focused on to examine how the WhatsApp professional groups have acted as policy-making groups to rebuild tourism in Sri Lanka after the Easter attacks in 2019. The research was done as a qualitative research and it used semi-ethnographic research methods. The researcher collected data while being a member of a particular WhatsApp group. Group discussions and observations were the major data-gathering tools. Thematic analysis has been used to analyze the collected data. The findings indicate suggestions on how to protect small entrepreneurs and how they should be provided with loan facilities, possible promotion activities for tourism, Sri Lankan tourism brand promotion activities and sharing the information among the group from different media platforms. Several problems could be identified in terms of the group chat where some members were talking about sensitive political related matters and non-related topics to the theme, even though they have initially accepted a code of conduct. However, the study found that WhatsApp group professionals could significantly influence and promote tourism in Sri Lanka by communicating public opinions about tourism-related matters.

Keywords: *Citizen participation, Policymaking, Social media, Tourism promotion,
WhatsApp*

***Corresponding Author:** hiroshilakmali@gmail.com



Impact of Extra-curricular Activities on Academic Performance in Secondary School Education in Sri Lanka

N. Keembiyahetti*, K.N. Samarasinghe

Department of Economics, Faculty of Humanities and Social Sciences, University of Ruhuna, Matara, Sri Lanka.

Abstract

Extra-curricular activities play a vital role in school education by helping school students to go above and beyond school requisites. It helps students to develop essential life skills such as positive character building, dedication, and self-mastery. However, it is arguable whether the excess time spent on extracurricular activities weakens academic performance of students. Thus, this study aims at assessing the impact of involvement in extra-curricular activities on academic performance of secondary school students in Sri Lanka, which is mostly driven by public money. This cross-sectional study was conducted using a stratified sample of 300 students selected from the G.C.E. (O/L) candidates of 2018 representing national schools and Provincial Council schools in Galle, Matara and Hambantota districts in the southern province. A multiple regression analysis was employed taking G.C.E. (O/L) Examination results in the form of an index number as the dependent variable and the participation or non-participation in a cluster of extra-academic activities as independent variables. Research data was collected through a questionnaire. According to the findings, any systematic relationship between academic performance of students and their involvement in extracurricular activities was not observed when all extra activities are equally treated and pooled. Nevertheless, when disaggregated, the study revealed that students who engaged in aesthetic activities had a higher chance to receive better results in academic performance, whereas those participated in sports and outdoor activities had a lesser chance to score high marks in examinations. Further, given all other factors equal, it was revealed that female students were performing better than their counterpart male students in examinations. Accordingly, the researchers recommend government schools to conduct extra academic supportive programs closer to examination for the students who participate in sports and outdoor activities in order to resettle their mind-set to concentrate more on subject related matters.

Keywords: *Academic Performance, Aesthetic activities, Extra-curricular activities*

***Corresponding Author:** nandasiri2007@gmail.com



Estimation of Carbon Foot Print: Emission of Household Consumption

P.W.S. Fernando* and W.P.M. Jeewanthi

Department of Geography, Faculty of Humanities and Social Sciences, University of Ruhuna, Matara, Sri Lanka

Abstract

‘Carbon Foot Print’ (CFP) has become a widely used term and a concept in the public debate on responsibility and abatement action against the threat of global climate change. The term CFP is commonly used to describe the total amount of CO₂ and other Greenhouse Gas (GHG) emissions for which an individual or organization is responsible. The main objective of this study is to estimate CFP emission of household and individual consumption. This study used primary data which were collected through a questionnaire survey and semi-structured interviews. A sample of 60 respondents was selected purposively among academic, non-academic and undergraduate population within the University of Ruhuna and from the outside community. The data were analyzed descriptively. Findings reveal that 61.7 % of respondents consume home-made food while 13.3 % consumes fast food from outside. It was found that 16.7 % of respondents consume carbonated drinks once a month while another 1.7 % consumes them daily. About 45% of respondents use waste classification method in their day to day life. It was revealed that 31.0 % of the academic staff is well aware of the concept of CFP. The estimation of CFP indicated that the maximum CFP belongs to academic staff while the minimum CFP was found among undergraduates. In conclusion, it can be noted that Sri Lanka as a country needs to take necessary actions to make the public aware of the CFP and the responsibility towards minimizing the carbon emissions.

Keywords: *Carbon foot print, Greenhouse gas emission, Energy consumption, Waste Classification, Food and beverages*

***Corresponding Author:** wasanasurandi@gmail.com



Socio-economic Changes of Tea Small Holding Communities: A Case Study of Mawarala GN Division, Matara District, Sri Lanka

P. Hewage*, J.A.T. Madhushani and R.D.K. Wickkramasinghe

Department of Geography, Faculty of Humanities and Social Sciences, University of Ruhuna, Matara, Sri Lanka

Abstract

The irregular pattern of the settlement development has divided the population of Sri Lanka into three communities: rural, urban, and estate. According to the data of the Census of Population and Housing, 77.4 per cent of people are living in rural areas and 18.2 per cent are living in urban areas. The workers in the plantation sector who are living in estate areas comprise 4.4 per cent. The estate sector in comparison to other sectors is not given sufficient provisions of services for the community development. However, the socio-economic status of the estate community has shown some improvement during the decade of 2010-2019. The main objective of the present study is to identify the changes that had recently occurred in the tea plantation sector with particular reference to Indola Estate of Mawarala GN Division of Matara District. This study was conducted based on primary and secondary data. The primary data were collected from randomly selected 30 families by using an interviewer administered questionnaire. In addition, discussions were also used as a method of primary data collection. The secondary data were collected from the sources such as research articles, books and internet. The qualitative and quantitative methods were used in data analysis. The charts, tables, maps, figures and photos were used for presenting information. It can be recognized that in the past, socio-economic development in the estate sector of Mawarala GN division had faced challenges such as; having more children in the family, overcrowding in the home, both parents being employed at estates, underage marriages, focusing only on primary education, unawareness about the importance of education, being in debt and poverty, health and sanitation problems. Yet, it is clearly identifiable that there is some development in the estate, having minimized the negative impact of above issues. In conclusion, it can be recognized that the improvement of education, health, and demographics have contributed to the improvement of estate workers' life style.

Keywords: *Estate settlements, Regional development, Socio economic situation, Tea cultivation, Tea plantation*

***Corresponding Author:** kankanamge.2015@gmail.com



Does Exchange Rate Matter for China Sri Lanka Trade?

N. Keembiyahetti* and H.K. Sarath

Department of Economics, Faculty of Humanities and Social Sciences, University of Ruhuna, Matara, Sri Lanka

Abstract

China is the second-largest import source for Sri Lanka with current contribution of 19 % of Sri Lanka's total imports. In 2009, China and Singapore were of equal importance in Sri Lanka's import market, sharing ten per cent each. China currently has expanded its share in Sri Lankan imports three times over Singapore and has reached to the level of India. Sri Lanka's trade deficit with China, which was very marginal in 2000, has grown twelve times larger than it was nineteen years ago. This study attempts to realize whether the bilateral exchange rate is a decisive factor determining the China-Sri Lanka trade controlled for the other economic fundamentals. The objective of this research is to examine whether Sri Lanka will gain or lose by the continuous currency depreciation in China-Sri Lanka trade. Using quarterly data from 2004Q1 to 2018Q4, obtained from the Central Bank of Sri Lanka and International Monitoring Fund, we estimate the standard real export real imports functions developed by Rose (1989) with slight modifications to include dummy variable to capture structural breaks. The findings revealed that only the real export from Sri Lanka to China can be explained by the exchange rate whereas the exchange rate is insignificant with regard to real imports. More certainly, one per cent of local currency depreciation causes a 0.3 % increase in real exports to China in the long-run. Except for the real Gross Domestic Product of Sri Lanka, all the other economic fundamentals fail to explain unprecedented imports from China to the Sri Lankan market. Accordingly, it can be concluded that most part of the China-Sri Lanka trade is not driven by real economic fundamentals, including the exchange rate. Continuous currency depreciation will vary marginally improved export earnings but has no significant influence on real imports. Thus, currency depreciation will make a loss to the economy because higher import volumes at a depreciated currency will result in an increase in import expenditure.

Keywords: *China- Sri Lanka, Exchange rate, Real exports, Real imports, Trade deficit*

***Corresponding Author:** nandasiri2007@gmail.com



Demanding a Sinhala-Buddhist Nation State: Challenges and Prospects

Ven. G. Sugunasiri*

Department of Pali and Buddhist Studies, Faculty of Humanities and Social Sciences,
University of Ruhuna, Matara, Sri Lanka

Abstract

Demanding a system of governing for a country depending on its sole historical nationality has now become a threat to its internal political affairs when considering globalization. Francis Fukuyama's thesis asserts an end to the world political history, involving the whole world eventually in a potential Western-American order. Conversely, Samuel Huntington recently showed that the world politics has been moving into a nationalistic interest, which will lead to probable future struggles among civilizations. These two ideas, to some degree, have determined the notion of the political theories evoked by national interest in Sri Lanka. Therefore, the objective of this study is to identify the potential threat of imperialism when overcoming the challenges within and out. Based on the discourses initiated by Sri Lankans, such as Nalin de Silva, Gunadasa Amarasekara and Sumanasiri Liyanage, the study examines the significance of enduring a nation with its own socio-political inheritance in the presence of international politics. The study was conducted using the historical investigation method and adopted a critical, analytical and phenomenological approach. The findings reveal that before colonialism, Sinhala-Buddhist cultural ideals were given the priority in the governance of Sri Lanka. The colonizers promised to rule the state giving priority to the Sinhala-Buddhist ideals through the constitution, yet they did not do so. However, even after the independence in 1948, the state was not established accordingly. The study found that the misunderstanding of the concept of Sinhala Buddhist state is challenged as people are deeply unconscious towards it. This demand is analyzed as a political ideology that entirely focuses on ruling the state depending on the historical claim that power is not to be entertained by the ruler but to be used to protect Buddhism in terms of unifying the country. Thus, the challenge is to re-unify the divided ethnicities after understanding the historical legacy, which was well respected earlier. Unified country would then be the final answer against the struggles, embracing neo-liberal capitalism and western imperialism.

Keywords: *Sinhala-Buddhist nation state, National thought, Challenges, Colonization, Governance*

***Corresponding Author:** ven.sugunasirithero@gmail.com



Health and Social Problems among Male Prison Inmates with Past Illicit Drug Use in Prison, Galle

I.L.A.N. Darshana^{1*}, R. Ruben² and C.J. Wijesinghe¹

¹Department of Community Medicine, Faculty of Medicine, University of Ruhuna

²Psychiatry Unit, Teaching Hospital, Karapitiya, Sri Lanka

Abstract

Users of illicit drugs face numerous health and social problems. Prison inmates are more vulnerable for health and social problems than general population. This research was aimed to assess health and social problems among male prison inmates with a history of past illicit drug use in Prison, Galle. A cross sectional study was conducted among a random sample of 254 male prisoners with a history of illicit drug use in prison, Galle. The presence of health and social problems known to be associated with illicit drug use prior to imprisonment were identified using a self-administered questionnaire. Ethical approval was obtained from the Ethical Review Committee, Postgraduate Institute of Medicine, University of Colombo. Accident and injuries (23.2%) and dental carries (16.9%) were reported as common health problems among incarcerated males with a history of past illicit drug use in Prison, Galle, whereas legal problems (72.8%), financial problems (51.6%) and employment problems (26.0%) were identified as common social problems. Prison inmates who had a history of poly drug use ($\chi^2= 21.93$, $p<0.001$), were addicted to illicit drugs ($\chi^2= 26.25$, $p<0.001$) and had a higher level of problematic drug use ($\chi^2= 24.37$, $p<0.001$) were more likely to have health problems. Poly drug use ($\chi^2= 19.16$, $p<0.001$), addiction ($\chi^2= 23.57$, $p<0.001$) and higher problematic drug use ($\chi^2= 10.43$, $p=0.001$) were more likely to be associated with presence of social problems. Health and social problems were reported in considerable amounts among incarcerated males with a history of drug use. Attention should be directed to address those problems through appropriate health and social interventions. Routine screening of prison inmates is recommended for early identification of health and social problems.

Keywords: *Health and social problems, Past illicit drug use, Male prison inmates*

***Corresponding Author:** ilandare@gmail.com

Language, Religion and Literature



Diverse Roles of ESL Teachers in Developing Learner Autonomy

S. Batuwatta^{1*}, S.A.A.K. Satharasinghe²

¹Department of English Language Teaching, Faculty of Humanities and Social Sciences
University of Ruhuna, Matara, Sri Lanka

²Department of English, Open University of Sri Lanka

Abstract

The concept of autonomy, which means an individual taking responsibility of one's own learning, has been a widely discussed topic in the field of Teaching English as a Second Language (ESL) education. The early researches on autonomy dates back to mid-1970s, which later gained more prominence through the studies of Henri Holec (1981). The objective of this review paper was to examine evolving roles of an ESL teacher in promoting learner autonomy. For this purpose, fifty-five research studies related to the topic, published in during the period 1995 to 2019 were taken into consideration and twenty were studied in depth and reviewed. Findings of this study reflect that there are various definitions given over time on teacher's role in enhancing learner autonomy. The selected research studies have given prominence to the teacher's role as a facilitator, counselor, resource supplier, evaluator, organizer, designer, manager, cooperater, inspirator, supporter, monitor, atmosphere creator, in promoting autonomy. The strikethrough literature reviewed further emphasize that collaboration between teacher and student is crucial to achieve a fruitful outcome of the effort. Thus, they point out both intrinsic and extrinsic motivation within the learners further encourage teachers in facilitating the development of autonomy. Based on the selected studies, it was also identified that socio-cultural reasons, institutional rules and regulations, students' varying proficiency levels within a classroom, lack of awareness about the concepts of autonomy, unfamiliarity in using strategies and activities are some of the major drawbacks that the teachers encountered in promoting this process. The outcome of the review also indicates that the use of technology in the classroom activities contributes largely to enhance learner autonomy. As reflected in the review, it can be concluded that multiple roles of teachers is an essential factor in promoting learner autonomy.

Keywords: *Autonomy, Collaboration, Motivation, Teachers' role*

***Corresponding Author:** saumyabatuwatta@gmail.com



ලේඛන හා භාෂණ සිංහලයේ අතීත ආබ්‍යාත අනුසර්ගක පදිම පිළිබඳ ප්‍රතිරෝධාත්මක අධ්‍යයනයක්

ඩබ්ලිව්. ඩී. නිලකරත්න, මොරකන්දේගොඩ අරියවංස හිමි*

සිංහල අධ්‍යයනාංශය, මානව ශාස්ත්‍ර හා සමාජීය විද්‍යා පීඨය, රුහුණ විශ්වවිද්‍යාලය, මාතර, ශ්‍රී ලංකාව

සංක්ෂේපය

අද්‍යයන සිංහල භාෂාවේ ලේඛනයන් භාෂණයන් අතර පවතින ප්‍රතිරෝධතාව හේතුවෙන් සිංහල භාෂාව හදාරන්නන්ට ගැටලු උද්ගත වන අවස්ථා ඇත. එවැනි ගැටලු මග හරවා ගනු සඳහා සිංහලයේ ලේඛනයන් භාෂණයන් අතර පවතින සමානතා-අසමානතා මූලික කර ගත් අධ්‍යයන පිටිවහලක් වෙයි. මෙහි දී සිංහල අතීත ආබ්‍යාතයෙහි අඩංගු අනුසර්ගක පදිම (Suffixes) ලේඛනයේ හා භාෂණයේ භාවිත අයුරු සංසන්දනාත්මක ව අධ්‍යයනය කරන ලදී. ලේඛන සිංහලයේ අතීත ආබ්‍යාතයක් ගොඩනැගීමෙහි ලා භාවිත අනුසර්ගක පදිම හඳුනා ගැනීමේ දී ලේඛන සිංහලය සම්බන්ධයෙන් මෙතෙක් සිදු වී ඇති ප්‍රාමාණික විද්වතුන්ගේ අධ්‍යයන උපයෝගී කර ගත් අතර භාෂණ සිංහලයේ භාවිත අතීත ආබ්‍යාත අනුසර්ගක හඳුනා ගැනීමේ දී ස්වභාෂිකයකු වශයෙන් ඇති දැනුමට අමතර ව සංවාද නිරීක්ෂණ හා අවිධිමත් සම්මුඛ සාකච්ඡා භාවිත කරන ලදී. අනුසර්ගක විශ්ලේෂණය කිරීමේ දී ප්‍රතිරෝධාත්මක වාග්විද්‍යාවේ සමානතා-අසමානතා සංකල්පය උපයෝගී කෙරිණි. සිංහලයේ ලේඛනය හා භාෂණය පිළිබඳ වූ මෙම අධ්‍යයනයෙන් සිංහලයේ භාවිත සම්පූර්ණ උත්සාහක අතීත ආබ්‍යාත අනුසර්ගක සංඛ්‍යාව 17ක් (-ඒ, -ආ, -ඊ, -ඕ, -භ, -ඵහි, -ඊහි, -ඵහු, -ඌහු, -ආහු, -අහු, -ඵමි, -ඊමි, -ඵමු, -ඌමු, -පි, -ල) හඳුනා ගැනිණි. එසේ ම ලේඛනයේ හා භාෂණයේ භාවිත නිරුත්සාහක අතීත ආබ්‍යාත අනුසර්ගක සංඛ්‍යාව (-ඉණි, -ඌණු, -ඉණිහි, -ඌණුහු, -ඉණිමි, -ඌණුමු, -ඌණා, -ඉච්චි වශයෙන්) 8ක් බව ද හඳුනා ගන්නා ලදී. ලේඛන වාක්‍යයක උක්තයෙහි පුරුෂ හා වචන හේදය මත තත් වාක්‍යයේ ආබ්‍යාතය යෙදෙන බැවින් භාවිත අනුසර්ගක සංඛ්‍යාව ප්‍රමාණයෙන් අධික අතර භාෂණමය වාක්‍යයක භාවිත අනුසර්ගක සංඛ්‍යාව ප්‍රමාණයෙන් අඩු ය. උත්සාහක කර්තෘකාරක අතීත ක්‍රියාවල භාවිත සම්පූර්ණ අනුසර්ගකවලින් ලේඛනයේ හා භාෂණයේ සමාන ව යෙදෙනුයේ /-ආ/ අනුසර්ගකය පමණි. සෙසු පදිම 16 ලේඛනයේත් භාෂණයේත් ප්‍රතිරෝධී ව යෙදෙනුයේ /-පි/ හා /-ල/ භාෂණයට පමණක් සීමා වෙමින් හා ඉතිරි අනුසර්ගක 14 ම ලේඛනයට පමණක් සීමා වෙමින් ය. එසේ ම නිරුත්සාහක අතීත ක්‍රියාවල භාවිත අනුසර්ගකවලින් ‘-ඌණා, -ඉච්චි’ භාෂණයට සීමිත අතර ඉතිරි අනුසර්ගක 6ම ලේඛනයට පමණක් සීමා වෙයි. මේ අනුව සිංහලයේ භාවිත සම්පූර්ණ අතීත ආබ්‍යාත අනුසර්ගක 25න් 1ක් පමණක් ලේඛනයටත් භාෂණයටත් රුපිය වශයෙන් සමාන අතර ඉතිරි අනුසර්ගක 24 (ලේඛනයට අනුසර්ගක 20ක් හා භාෂණයට අනුසර්ගක 4ක් සීමිත වෙමින්) ප්‍රතිරෝධී ව යෙදෙන බව පැහැදිලි විය.

ප්‍රමුඛ පද: අතීත ආබ්‍යාතය, අනුසර්ගක පදිම, ප්‍රතිරෝධතාව, භාෂණය, ලේඛනය

* සමායෝජක කර්තෘ: ariyawansamora@gmail.com



නූතන සිංහල කෙටි කවි විචාරයෙහිලා ක්ෂණික අන්තර් දෘෂ්ටි (Epiphany) සංකල්පයෙහි ඇති වැදගත්කම (තෝරාගත් කෙටි කාව්‍ය නිර්මාණ කිහිපයක් ඇසුරෙන්)

අපරැක්කේ සිරිසුධම්ම නිමි*

සිංහල අධ්‍යයනාංශය, මානව ශාස්ත්‍ර හා සමාජීය විද්‍යා පීඨය, රුහුණ විශ්වවිද්‍යාලය, මාතර, ශ්‍රී ලංකාව

සංක්ෂේපය

සංක්ෂිප්ත කවි, සැකෙව් කවි, සාර සංක්ෂිප්ත කවි හා කෙටි කවි යන පර්යාය නාමයන්ගෙන් යුත් මෙම කාව්‍ය ශාන්තරය නූතන සිංහල කවියේ වඩාත් කතාබහට ලක් වූවකි. කෙටි බව හා ඉතා අවම වචන සංඛ්‍යාවක් ස්වභාව කර ගත් මෙම කාව්‍ය ශාන්තරය සිංහල පාඨකයා හඹිකු කවි හා සාමාන්‍යවයෙහිලා විචාරයට පෙළඹුණත් කෙටි කාව්‍ය ආකෘතිය සිංහල කාව්‍ය සාහිත්‍යයෙහි සමාරම්භයෙහි පටන් සාක්ෂ්‍ය ඇතුළත් කාව්‍ය ආකෘතියක් බවද මෙහි දී සඳහන් කළ යුතු ය. එහෙත් සිවුපද, දෙපද, ගී වැනි කාව්‍ය ආකෘති හා දීර්ඝ කාව්‍ය නිර්මාණයකින් රසයක් බලාපොරොත්තු වන ඇතැම් සිංහල කවියෝ, විචාරකයෝ හා පාඨකයෝ මෙම කෙටි කවි හුදු කෙටි බවම උරුම කරගත් ශබ්දාර්ථය හීන කාව්‍ය ප්‍රභේදයක් ලෙස විවේචනය කරති. තව ද කෙටි කවි මතුපිටින් කියවන බොහෝ අය එහි ඇත්තේ හුදු ස්වභාව කථනයක් යැයි සිතා වැරදි වැටහීම් ඇති කර ගනිති. අන්තර්ගතය හා බැඳුණු ඇතුළු එළි දිගේලි නො කරති. එහෙත් චින්තරූපික බව, අනවශ්‍ය අලංකරණවලින් ඇත් වීම, වචනයේ සීමා සහිත බව, විවිධ අර්ථ ව්‍යුහ හා පාඨක අද්දැකීම් යටතේ කව්‍යාත්මයට සමීප වීම, අන්තර්දෘෂ්ටි කියවීම, අප්‍රකාශිත අර්ථ ව්‍යුහ ලිහා බැලීම, දාර්ශනික චින්තා අන්තර්ගතය ආදී කෙටි කවියේ ස්වභාව හා විශේෂතා වටහා ගැනීමට පාඨකයා සමත් විය යුතු ය. කෙටි කවියේ ඇති විශේෂත්වය වටහා ගැනීමට එඟිපති (Epiphany) සංකල්පය යොදා ගැනීම මෙම පර්යේෂණයේ අරමුණ යි. මෙම එඟිපති සංකල්පය ක්ෂණික අන්තර් දෘෂ්ටිය වශයෙන් සිංහලට පරිවර්තනය කළ හැකි ය. ක්ෂණික අන්තර් දෘෂ්ටිය යනු තර්ක බුද්ධියේ සීමා අතික්‍රමණය කරමින්, දෘෂ්ටිවාදවලින් ඉවත් වෙමින් ස්වාධීන ව සාහිත්‍ය භාවිත කරන්නේ කෙසේ ද යන කාරණයේ දී වැදගත් වන සංකල්පයකි. අන්තර් දෘෂ්ටියෙන් ලබා දෙන්නේ පාඨකයාට සාහිත්‍ය ශාන්තරය හා සමීප විය හැකි බුද්ධිමය ආලෝකයකි. එම ක්ෂණික බුද්ධිමය ආලෝකය පාඨකයාට සමාජය හා ජීවිතය දෙස දෘෂ්ටිගතයන්ගෙන් මිදී නිදහස් ව බැලීමට උගන්වයි. ඒ අනුව කෙටි කවි විචාරයට එඟිපති සංකල්පය යොදාගත හැක්කේ කෙසේ ද යන්න මෙහි පර්යේෂණ ගැටලුව යි. ඒ සඳහා ප්‍රාථමික මූලාශ්‍රය වශයෙන් නූතනයේ පළ වූ කෙටි කාව්‍ය සංග්‍රහවල තෝරාගත් කාව්‍ය නිර්මාණ යොදාගනු ලැබී ය. කාව්‍ය විචාරයෙහි කෙටි කවියේ උපයෝගීතාව සම්බන්ධයෙන් පවතින දුර්වල දුරලීම මෙම පර්යේෂණයේ වැදගත්කම යි.

ප්‍රමුඛ පද: අන්තර් දෘෂ්ටිය (Epiphany), කාව්‍ය විචාරය, කෙටි කවිය, දෘෂ්ටිවාද, බුද්ධිමය ආලෝකය

* සමායෝජක කර්තෘ: sudhaaparekke@gmail.com



**පාලි සංදේසයන්හි සංස්කෘත සංදේශ ලක්ෂණ කෙතෙක් දුරට විද්‍යාමාන වේ ද?:
තුලනාත්මක අධ්‍යයනයක්**

ඕපනායක උපේක්ෂා ධම්මධීරා මෙහෙණිය*

පාලි හා බෞද්ධ අධ්‍යයනාංගය, මානව ශාස්ත්‍ර හා සමාජීය විද්‍යා පීඨය, රුහුණ විශ්වවිද්‍යාලය,
මාතර, ශ්‍රී ලංකාව

සංක්ෂේපය

සංස්කෘත, පාලි, සිංහල සාහිත්‍යාවලීන්හි ජනප්‍රිය සාහිත්‍යාංගයක් වන සන්දේශ නම් ග්‍රන්ථහේදය සමුද්‍රේහය වන්නේ සංස්කෘත සාහිත්‍යයෙහි ය. තද් සාහිත්‍යයෙහි ‘දූතකාව්‍ය’ යන විශේෂණයෙන් සම්භාවිත මෙම ග්‍රන්ථ විශේෂයෙහි මුඛ්‍ය අරමුණ වන්නේ කිසියම් භාරකයකු මගින් වැදගත් පණිවුඩයක් ආවේදනය කිරීම යි. සංඛ්‍යාත්මක ව හා වෛෂයික ව පුළුල් වූ දූතකාව්‍ය විෂයෙහි නිශ්චිත ආකෘතියක් ද බිහිවිය. විශ්වනාථයන්ගේ සාහිත්‍යදර්පණයෙහි සංදර්ශිත එම ආකෘතිය පසුකාලීන ව දූතකාව්‍ය රචනා කළෝ නො මද ව ඇසුරු කළහ. මෙම සාහිත්‍යාංගය පාලි හා සිංහල සාහිත්‍යයට පැමිණීමේ දී ‘සංදේශ’ යන ප්‍රයෝගයෙන් නම් කර ඇත. ඒ අනුව සංස්කෘත ආභාසයෙන් සමාද්ධියට පත් ඉතා පොහොසත් සංදේශාවලියක් සිංහල සාහිත්‍යය සතු ය. අනෙකුත් සාහිත්‍යයන්ට සාපේක්ෂ ව පාලියෙහි විද්‍යාමාන වන්නේ සංදේස කිහිපයක් පමණි. මෙම පර්යේෂණයේ ප්‍රමුඛ අභිමතාර්ථය වනුයේ ඓතිහාසික ක්‍රමවේදය භාවිතයෙන් සංස්කෘත හා සිංහල සාහිත්‍යයන්හි ප්‍රකට දූත හෝ සංදේශ කාව්‍ය පිළිබඳ ව පාලි සාහිත්‍යයෙහි ආස්ථානය, අනන්‍යතාව හා ආභාසය විමසීම යි. ඒ අනුව අනුලෝමයෙන් වූ පාලි සංදේස ග්‍රන්ථාභ්‍යන්තර නිරීක්ෂණයේ දී සුවිශද වනුයේ සංදේශ පිළිබඳ සාම්ප්‍රදායික ආකෘතික ලක්ෂණ සම්බන්ධයෙන් සවිඤ්ඤාණික පාලි කතුවරුන් ස්වයන්තර ලක්ෂණ ස්වකීය ග්‍රන්ථයන්ගෙන් ප්‍රකට කිරීමට යත්ත දරා ඇති බව යි. දූතයකු විද්‍යාමාන වීම සංදේශ කාව්‍යයක අවශ්‍ය ම අංගයක් වුව ද ඇතැම් පාලි සංදේස දූතයකු යොදා නොගත් අවස්ථා ද දක්නට ලැබේ. මහානාගකුල හා චූත්තමාලා සංදේසයන්හි දූතයකු අප්‍රකට අතර සිරිරාම හා ගරුළ සංදේසයන්හි දූතකාර්යයෙහි නියුක්තිකයකු දැකගත හැකි ය. මෙයින් සිරිරාම සංදේසයෙහි දූතවර්ණනා හා ආශීර්වාදාදිය අවිද්‍යාමාන අතර මෙහි දූතකාර්යයෙහි නියැලෙන්නේ පුරුෂයකු බැවින් එහි ද විශේෂත්වයක් දැකිය හැකි ය. කථානායකයා පිළිබඳ සැලකීමේ දී පාලි සංදේසකරුවා සංස්කෘත දූතකාව්‍ය ලක්ෂණ අනුල්ලංඝනය කොට ඇත. පාලි සංදේස නිරීක්ෂණයේ දී නිගමනය කළ හැක්කේ මහානාගකුල හා චූත්තමාලා යන සංදේස පාලියට ම අනන්‍ය විශේෂ ලක්ෂණ දරන අතර සිරිරාම සංදේසය සංක්‍රාන්ති අවධියක් නියෝජනය කරන බව යි. ගරුළ සංදේසය වනාහි සංස්කෘත දූතකාව්‍ය සම්ප්‍රදාය අනුගමනය කිරීමේ ප්‍රයත්නයක් ලෙස හඳුනාගත හැකි ය.

**ප්‍රමුඛ පද: සංදේශ ආකෘතිය, සංස්කෘත සංදේශ, සාහිත්‍යදර්පණය, පාලි සංදේස,
ගරුළ සංදේසය**

* සමායෝජක කර්තෘ: o.u.dhammadheera@gmail.com



Is Threefold Vijñāna in Yogācāra Idealism an Innovative Concept?

A.A.R. Priyanka*

Department of Pali and Buddhist Studies, Faculty of Humanities and Social Sciences,
University of Ruhuna, Matara, Sri Lanka

Abstract

The world is controlled by the mind that is far-going and fore-running. The place given to the mind can be recognized with these explanations clearly and its role is of utmost importance. There are three technical terms in Buddhism to designate the concept of mind or consciousness. They are *citta*, *mano* and *viññāṇa*. However, these terms are confusingly translated into English as mind. The term ‘mind’ does not adequately convey the connotation of Pali terms *citta*, *mano* and *viññāṇa*. Moreover, philosophically and psychologically it has a variety of meanings. Besides, *Yogācāra* idealism is a philosophy as well as psychology that studies cognition, perception and consciousness. Threefold *vijñāna* is their fundamental teaching. It is depicted in *Trisīkāvijñaptikārikā* of *Vijñaptimātratāsiddhi* compiled by Ven. *Vasubandhu*. They are *Ālaya*, *Manana* and *Pravṛitti*. The research problem of this paper is to study whether the threefold *viññāṇa* in *Yogācāra* idealism is an innovative concept or the same teaching with reference to the *citta*, *mano* and *viññāṇa* in early Buddhism. This is a qualitative research based on literature and information that have been collected from the primary sources in Buddhism and the relevant secondary sources and articles related to the field. Findings revealed through the analysis of facts in early Buddhism and *Yogācāra* idealism indicate that threefold *viññāṇa* in *Yogācāra* idealism is very much similar to the *citta*, *mano* and *viññāṇa*. Therefore, threefold *viññāṇa* is not an innovative teaching and it has been introduced with the influence of early Buddhism.

Keywords: *Citta*, *Early Buddhism*, *Mano*, *Viññāṇa*, *Yogācāra idealism*

***Corresponding Author:** rpabeywardhana@gmail.com



සිංහල භාෂාවේ අනුරූප පද යෝජනය පිළිබඳ විමර්ශනයක්

මොරකන්දේගොඩ අරියවංස හිමි*

සිංහල අධ්‍යයනාංශය, මානව ශාස්ත්‍ර හා සමාජීය විද්‍යා පීඨය, රුහුණ විශ්වවිද්‍යාලය, මාතර,
ශ්‍රී ලංකාව

සංක්ෂේපය

දීර්ඝ ලිඛිත ඉතිහාසයක් ඇති ඉන්දු ආර්ය භාෂාවක් වන සිංහලයේ එකී ඓතිහාසිකත්වය නිසා ම විවිධ භාෂාත්මක සම්ප්‍රදායයන් මෙන් ම ජේක ප්‍රයෝග බිහි වී ඇත. අනුරූප පද භාවිතය නමැති සංකල්පය විරපරිචිත වූවක් නොවන අතර පුරාතනයෙහි මෙවැන්නක් දක්නට නො ලැබිණි. මෙවැන්නක ඡායා මාත්‍රයක් හෝ විණි නම් එය දක්නට ලැබුණේ කුමාරතුංග ප්‍රමුඛ හෙළ හවුලේ කතුවරුන්ගේ නිර්මාණවල පමණි. අනුරූප පද යෝජනය සම්බන්ධ මූලික සංකල්පය සිදත් සභරාවෙහි දැක්වෙන නිෂ්පන්න, තත්සම හා තද්භව පද සමඟ බැඳී පවතියි. නිෂ්පන්න හා නිෂ්පන්න පදත් තත්සම හා තත්සම පදත් තද්භව හා තද්භව පදත් සංයෝග වීම මෙකී අනුරූප වචන නිර්මාණයේ රීතිය සේ සැලකේ. සිංහලයේ නිරන්තරයෙන් දක්නට ලැබෙනුයේ තත්සම - තත්සම, තද්භව - තද්භව, තත්සම - තද්භව හෝ තද්භව - තත්සම එකට මිශ්‍ර ව භාවිතය යි. මෙහි ලා තත්සම පද වෙනත් තත්සම පද සමඟ හා තද්භව පද වෙනත් තද්භව පද සමඟ පමණක් එක් වීම සිංහලයෙහි දක්නට ලැබෙනුයේ කලාතුරකිනි. ප්‍රකට ව දක්නට ලැබෙනුයේ තත්සම - තද්භව හෝ තද්භව - තත්සම පද එකට මිශ්‍ර ව භාවිතය යි. කුමාරතුංග මේ තත්සම - තත්සම හා තද්භව - තද්භව පද අනුරූපී ව යෙදීම හඳුන්වනුයේ “සංසර්ගානුරූප ශබ්ද” යන නමිනි. විමල් ජී. බලගල්ල මේ “තත්සම - තද්භව පද එකට මිශ්‍ර ව භාවිත කිරීම “භාෂා ව්‍යතිමිශ්‍ර දෝෂ” යනුවෙන් හඳුන්වයි. මෙකී භාෂාත්මක ව්‍යවහාරයේ ඓතිහාසිකත්වය, සම්ප්‍රදායය, ආවශ්‍යකත්වය හා විදග්ධභාවය හඳුන්වාදීම මෙහි ලා අපේක්ෂිත ය. වර්තමාන ලේඛන කාර්යයේ දී මෙකී අනුරූප පද භාවිතයේ විදග්ධභාවය ගැන සැලකිලිමත් නොවීම පර්යේෂණ ගැටලුව සේ හඳුනා ගත හැකි ය. මේ පර්යේෂණයට දත්ත සම්පාදනයේ දී සම්භාව්‍ය සිංහල සාහිත්‍ය ග්‍රන්ථ හා විදග්ධ සිංහල ලේඛකයන්ගේ නිර්මාණ භාවිතයට ගැනෙන හෙයින් මෙය පුස්තකාල අධ්‍යයනයකි.

ප්‍රමුඛ පද: අනුරූප පද, තත්සම, තද්භව, ව්‍යතිමිශ්‍ර දෝෂ, සංසර්ගානුරූප ශබ්ද
* සමායෝජක කාර්තෘ: ariyawansamora@gmail.com

Management and Entrepreneurship



Ensuring Sustainable Competitive Advantage through Strategic Entrepreneurship: A Test of Ireland's Model of Strategic Entrepreneurship

M.C.K.H. Mallika^{1*}, M.G.S. Bagya² and H.M.N.N. Herath³

¹Department of Management and Entrepreneurship, Faculty of Management & Finance, University of Ruhuna, Sri Lanka; ²Department of Commerce & Financial Management, Faculty of Commerce & Management Studies, University of Kelaniya, Sri Lanka

³Department of Multi-Disciplinary Studies, Faculty of Technology, University of Ruhuna, Matara, Sri Lanka

Abstract

Although several ventures start in Sri Lanka annually a majority of them have a short life expectancy, for the lack of concern on their survival. Past studies found that lack of strategic orientation is one of the main reasons. Ireland's model stated that superior firm performance can be achieved through the opportunity-seeking behavior and advantage-seeking behavior. The logic behind this model is that the combination of opportunity-seeking and advantage-seeking behaviors imposes a great impact on the creation of competitive advantages and improving the wealth of a firm. Hence, this study was undertaken to test the possibility of applying the Ireland's model of Strategic Entrepreneurship in the Sri Lankan context and reveal how these dimensions are integrated to create competitive advantages. The research design entails across a sectional survey by selecting a sample of 100 Small and Medium Entrepreneurs (SMEs) from six districts in Sri Lanka. Opportunity-seeking and advantage-seeking behavior were the independent variables and competitive advantages were taken as the dependent variable of this study. Dimensions of opportunity-seeking behavior included self-efficacy, prior knowledge, social network, and opportunity recognition. Dimensions of advantage seeking behavior included core competition, competence, capability, and resources. Data was collected through a survey research method by using a self-administered questionnaire, and the correlation analysis was applied to measure the relationships of this model. Findings revealed that both the opportunity-seeking behavior and advantage-seeking behavior positively and significantly affect competitive advantages of a firm which leads to the long-term survival of a firm. Among all the sub-dimensions, self-efficacy and opportunity-seeking behavior show a high coefficient correlation value (R-value) of 0.422 at 0.000 significant level. Finally, it can be concluded that SMEs in the sample are practicing the opportunity-seeking behavior specifically while to a lesser extent practicing advantage-seeking behavior and both behaviors will help to create sustainable competitive advantages of these firms and also the survival in the long run.

Keywords: *Advantage-seeking behavior, Competitive advantage, Opportunity-seeking behavior, Strategic entrepreneurship*

*Corresponding Author: madhurachinthaka1990@gmail.com



The Impact of Human Resource Management Practices on Corporate Entrepreneurship

P.S.D. Punchihewa^{1*}, M.N. Maduwanthi² and G.T.W. Sriyani¹

¹Department of Management and Entrepreneurship, Faculty of Management & Finance, University of Ruhuna, Matara, Sri Lanka

²Department of Human Resource Management, Faculty of Management & Finance, University of Ruhuna, Matara, Sri Lanka

Abstract

Human Resource Management practices of any firm affect the ability of a firm to develop the diverse capabilities and competencies for differentiating its products or services in order to have a competitive edge over competitors. Hence, HRM practices play a vital role in fostering corporate entrepreneurship and this study focused on identifying the impact of HRM practices on corporate entrepreneurship. By using the Convenient Sampling Technique, 100 middle-level managers from five apparel manufacturing companies in the southern province of Sri Lanka were selected. The quantitative method was applied and data were collected through a structured questionnaire. Correlation Analysis and Multiple Regression Analysis were used in data analysis. As the independent variable, three most critical HRM practices (recruitment and selection, training and development, employee rewarding) and product and process innovations, and diversification efforts as the dimensions of the dependent variable of corporate entrepreneurship were selected. Results revealed that a positive and significant relationship exists between the three HRM practices on corporate entrepreneurship, respectively, recruitment and selection 0.649, training and development 0.572, and employee rewarding 0.729. Accordingly, employee rewarding shows the highest relationship. The partial regression coefficient of the regression model shows the three dimensions of HRM practices have a significant impact on corporate entrepreneurship and it was reported respectively as 0.164, 0.168 and 0.304 impact at $p < 0.005$. This further reveals that employee rewarding has the highest impact on corporate entrepreneurship of the selected companies. The predictive fit capacity is derived from the R^2 and it is reported as 0.409 for the model. It revealed that there was a 40.9% variation in the performance of corporate entrepreneurship from the three dimensions of the independent variable. Finally, it can be concluded that to retain the capable and competent employees with the firm to ensure the firm's competitiveness, attractive employee rewarding packages need to be practiced, while concentrating on other tested HRM practices. However, for generalization, the same study can be expanded to other business sectors also.

Keywords: *Corporate entrepreneurship, Human resource management practices, Recruitment and selection, Rewarding, Training and development*

*Corresponding Author: dilshanipunchihewa@gmail.com



Exploring the Effect of Internal and External Factors on the Business Growth of Small and Medium Scale Enterprises in Sri Lanka

G.T.W. Sriyani*

Department of Management and Entrepreneurship, Faculty of Management & Finance,
University of Ruhuna, Matara, Sri Lanka

Abstract

SMEs are very important for any country, including Sri Lanka. Due to this immense importance, the Sri Lankan government took many efforts to uplift this sector, however, a high failure rate was reported. Past studies focused on identifying the impact of owner-manager factors, internal and external factors on the SME growth. However, research that focuses on which factors differently affect low growth and high growth SMEs is lacking. Therefore, this study focused on revealing the significant difference in the impact of internal and external factors on the business growth between high and low growth SMEs. The survey method was applied by selecting a sample of 130 SMEs in the Southern Province of Sri Lanka and the Likert scale questionnaire was used to collect data. Four sub-dimensions of internal factors (management incapability, lack of entrepreneurial know-how and skills, poor product and process technology, lack of marketing efforts) and seven sub-dimensions of external factors (market difficulties, information barriers, credit barriers, infrastructure barriers, labour market issues, business rules and regulations, improper BDS services and networking) were used to measure the impact of internal and external factors on the business growth. High growth firms were defined as the enterprises with average annualized growth greater than 20 per cent per annum over three years and otherwise as a 'low growth firm.' Multiple Regression Analysis and Independent Sample T-Test were applied to analyze data. Findings revealed that two internal factors (lack of entrepreneurial know-how and skills and management incapability) and three external factors (information barriers, market difficulties, and labour market issues) significantly affect the business growth. Comparison of high and low growth SMEs reveals that external factors equally affect and significant difference exists in the impact of internal factors between high and low growth SMEs. It can be concluded that targeting a customized approach to growth in terms of internal factors and looking at the biggest picture regarding the external factors need to be applied for SME development.

Keywords: *Business growth, External factors, High-growth SMEs, Internal factor, Low-growth SMEs*

***Corresponding Author:** wsriyanigt@gmail.com



The Impact of Non-banking Activities towards Bank Performance: Special Reference to Domestic Licensed Commercial Banks in Sri Lanka

G.K.C. Jeewantha^{1*}, H.A.C. Jeewanthi² and J.K.A. Madushani

^{1&2} Department of Accounting and Finance, Faculty of Management & Finance,
University of Ruhuna, Matara, Sri Lanka

Abstract

Commercial banks in Sri Lanka have diversified their operations more into Non-Banking Activities (NBAs) to face high competition and diverse demands in the industry. Presently, fee-based NBAs like insurance commission, trading gains, and fees, net servicing fees, investment banking, and brokerage fees, net gain on asset sales, etc. generate more Non-Interest Income (NII) in the banks' business portfolio. Past studies revealed that banks can maximize their profitability through a higher level of revenue diversifications. Therefore, it requires to study why such deviations from traditional banking activities exist and do these NBAs affect significantly on the banks' performance. This study endeavored to study the impact of NBAs on bank performance by selecting 10 Domestic License Commercial Banks (two-state sector and eight private sector banks) in Sri Lanka from 2009 to 2018. Data were collected through annual reports of commercial banks and information published by the Central Bank of Sri Lanka. Panel regression and descriptive statistics were used for data analysis. Profitability was considered as the key indicator of bank performance and measured through Return on Equity (ROE). The size and risk of the banks were considered as the control variables of this study. Findings revealed that a statistically significant positive relationship exists between NBAs and ROE of all the banks and increasing of NBAs leads to enhance the performance of commercial banks. A remarkable finding of this study was that higher NII is related to higher volatility and comparatively with private sector banks, involvement in NBAs is high among the state sector commercial banks but most of the private sector commercial banks are performing well compared with state sector commercial banks. It indicates that the higher NII does not essentially direct for better performance in Sri Lankan commercial banks. Further, when bank size and risk are added to the model, bank size will have a positive significant impact on bank performance and there will be an insignificant impact between bank risk and bank performance.

Keywords: *Bank performance, Bank risk, Bank size, Commercial Bank, Non-banking activities, Non-interest income, Return on investment*

***Corresponding Author:** chirath@mgt.ruh.ac.lk



Relationship between Extrinsic Rewards and Employee Job Satisfaction of Operational Level Employees

R.M.D.D. Rathnayake*

Department of Human Resource Management, Faculty of Management & Finance,
University of Ruhuna, Matara, Sri Lanka

Abstract

Job satisfaction is a gain of pleasure and a positive feeling of job that originated due to job experience. Extrinsic rewards are playing an important role among operational level employees in any organization. Usually, extrinsic rewards are the physical ones that offer as a monetary value for the achievements of employees. Today, capable and competent employees specifically at the operational level, are considered as a unique resource of any organization and for retaining this unique human capital better rewarding is a must. Hence, the main purpose of this research is to identify the relationship between extrinsic rewards and job satisfaction of operational level employees in Sri Lanka. In the past literature, pay, promotion, supervisor support, the working environment have been considered as the most critical rewards when determining extrinsic rewards package. Four dimensions: pay, promotion, supervisor support, and working environment were used to measure the independent variable of extrinsic rewards and job satisfaction was considered as the dependent variable. This research was a cross-sectional, quantitative study and data were collected from 250 operational level employees in a leading paint company of Sri Lanka. The results revealed that there is a positive correlation (0.915) between extrinsic rewards and job satisfaction among operational level employees of the selected company. The relationship is statistically significant at $p < 0.01$ level (2 tailed). The company provides an exceptional package of extrinsic rewards to retain its valuable human capital and the results revealed that due to a higher level of job satisfaction, very talented and creative operational level employees retain for a long period with this firm. Therefore, findings revealed that distinctive extrinsic rewards are required for an organization to compete in the market by having capable and unique human resources that may not have with other competitive firms. However, for generalization purposes, it requires to repeat this study by using a large sample from diverse organizations in Sri Lanka.

Keywords: *Extrinsic rewards, Job satisfaction, Pay, Promotion, Supervisor support, Working environment*

***Corresponding Author:** dewapriyadeshbandu@gmail.com



Customer Engagement and Its Impact on Brand Loyalty with Special Reference to Young Consumers in Sri Lanka

A. B. Sirisena*

Department of Marketing, Faculty of Management & Finance, University of Ruhuna,
Matara, Sri Lanka

Abstract

The intensity of an individual's participation in and connection with an organization's offerings or activities is recognized as customer engagement. Customer engagement has received a lot of attention from marketing researchers as well as practitioners in recent years as a concept that replaces older concepts such as 'customer relationship' and 'customer equity'. The concept also has been receiving great attention in recent years as an important predictor of customer and brand loyalty. However, due to the limited amount of research available in the area to provide insights into the relationship, the nature and the extent of the relationship between brand engagement and brand loyalty remains less comprehensible. This is especially evident in Sri Lanka, where there is very little research available in this context. Therefore, the study aimed at identifying the impact of customer engagement on brand loyalty among mobile phone users in Sri Lanka. The study was quantitative and a questionnaire was administered using a survey instrument. The questionnaire included 19 Likert Scale questions, which aimed at measuring six variables: five independent variables (identification, enthusiasm, attention, absorption, and interaction), and one dependent variable (brand loyalty). The sample was selected using Convenience Sampling and comprised young students aged 20-25 and data was collected from 106 respondents. Regression Analysis was used to analyze the data. The results revealed that only attention and absorption significantly affected brand loyalty in the context of Sri Lankan smartphone users. The regression model is significant and the independent variables predict around 44% of the variation in the dependent variable. The results are interesting as the literature suggests all these variables as positive contributors to brand loyalty. The limited sample size, type of sampling coupled with the composition of the sample might have affected the findings and at the same time limits the generalizability of the findings. The research recommends more future studies to be addressed in this relatively lesser-known area.

Keywords: *Absorption, Attention, Brand loyalty, Customer engagement, Customer loyalty*

*Corresponding Author: amila@badm.ruh.ac.lk



The Impact of Market Orientation on Organizational Performance: “A Study of Small and Medium Scale Hotels in Tourism Industry in Southern Province of Sri Lanka”

U.K.B. Aravinda^{1*} and T.S.L.W. Gunawardana²

¹SDB Bank (Southern Province), Sri Lanka; ²Department of Marketing, Faculty of Management & Finance, University of Ruhuna, Matara, Sri Lanka

Abstract

Every business organization focuses on all business activities to maximize profitability and gain competitive advantages. Market orientation is an important phenomenon in achieving either strategic performance or financial performance or both. The purpose of this research was to identify the impact of market orientation on organizational performance in small and medium scale tourist hotels in the southern province of Sri Lanka. In this study, it has been identified and developed a new conceptual research framework, including the sub-variables of customer orientation, competitor orientation, inter-functional coordination, and social benefit orientation were included in the conceptual model. The research strategy of this study was the conclusive research design in the form of descriptive research where the necessary data are collected through a single cross-sectional design and the size of the sample was 110. This study used the Partial Least Squares (PLS) path modeling method to analyze the collected data. The reliable and valid measurement model permits an empirical evaluation of the hypotheses in the structural path model. The tested hypothesis on inter-functional coordination was not statistically significant and other three hypotheses on customer orientation, competitor orientation, and social benefit orientation were statistically significant and all the four hypotheses indicated a positive impact on organizational performance it says that there is a positive impact from all these behavioral components on organizational performance. This research is as such a response to the need for more empirical studies within this novel research area in terms of surveys. It thereby contributed to the existing body of literature and provided several insights for managers in the tourist hotel industry and hospitality services. This research also contributes to the on-going effort within customer orientation, competitor orientation, inter-functional coordination, and social benefit orientation. Moreover, this study discussed the expected relationship under each variable. Since this field of inquiry is fairly new, it also offers numerous alternatives for further studies.

Keywords: *Competitor orientation, Customer orientation, Inter-functional coordination, market orientation, Organizational performance, Social benefit orientation*

***Corresponding Author:** gunawardana@badm.ruh.ac.lk

Mathematics, Engineering and Technology



Modification of Soil Grading to Enhance the Properties of Compressed Stabilized Earth Blocks

S.N. Malkanthi^{1*} and A.A.D.A.J. Perera²

¹Department of Civil and Environmental Engineering, Faculty of Engineering, University of Ruhuna, Hapugala, Sri Lanka; ²Department of Civil Engineering, Faculty of Engineering, University of Moratuwa, Sri Lanka

Abstract

Earthen materials are the very basic and first used building materials in the world with different forms like mud, adobe, rammed earth and bricks. Compressed stabilized earth block (CSEB) is comparatively a new soil based material made with soil and stabilizing with different additives, including cement, fly ash, and lime. CSEB has been investigated by many researchers for their advantageous properties. The literature review established that compressive strength of CSEB significantly depends on the clay and silt content. Additionally, investigators have not considered the amounts of other large particles. This study mainly focuses on influence of soil grading with less clay and silt content for the improvement of CSEB properties. Soil grading refers to the combination of different-size particles in a soil mixture. The correct sizes in correct proportion of different particles in the soil mixer have to be identified to produce CSEB. Particle packing theories can be used to explain the required particle sizes and its proportion. Soil grading represented by those theoretical packing concepts was performed in this study. The theoretical concepts provide a continuous or well-graded particle size distribution, and the soil used for the experiments has a continuous particle size distribution. The selected soil with low clay and silt content was modified by adding different size particles to match the particle size distribution to the optimization curves as given in particle packing theories. Cement was used as the stabilizer in different percentages. The experimental results clearly show that the CSEB properties can be improved significantly by modifying the particle size distribution to fit the optimization curves. According to the results, 28-days dry and wet compressive strengths of CSEB could be improved by more than 50 % compared to the blocks made with un-modified soil. Significant improvements in the dry densities and water absorption ratios measured during the 28 days were observed with this particle size modification. All of these properties satisfied the requirements given in s SLS 1382: Specification for Cement Stabilized Earth Blocks.

Keywords: *Cement stabilized earth blocks, Improved properties, Optimization curves, Particle packing*

***Corresponding Author:** snmalkanthi@cee.ruh.ac.lk



Evaluation of the Feasibility to Develop a Bottom Ash Based Geopolymer Concrete

H.P. Sooriyaarachchi* and K. Dasanayaka

Department of Civil and Environmental Engineering, Faculty of Engineering, University of Ruhuna, Hapugala, Sri Lanka

Abstract

Construction industry and infrastructure development play a significant contribution toward the socio-economic growth of a country. However, the implications of infrastructure development on the natural resources and environment cannot be ignored. Production of Portland cement, one of the single materials mostly used in the construction industry is largely blamed for the excessive emission of greenhouse gases. Apart from the carbon emission, cement industry is also blamed as a high energy intensive industry which contributes for the depletion of natural resources affecting the environmental sustainability. Two strategies were identified as solutions to overcome socio-economic challenges in the construction industry; 1) Recycling old materials, 2) Developing new sustainable materials. Currently, geopolymer (or alkali activated materials), has shot to prominence as a potential material to replace conventional cement and concrete. Geopolymer cement can be derived through chemical reactions between industrial by-products or co-products and activating solutions. It is believed that calcination-free geopolymer cement enabled the construction industry to address the requirements of sustainable binding material with hazardous waste as the main raw material to replace conventional Portland cement. Most of the previous work related to the geopolymer industry were completed with Metakaolin, Fly ash & Granulated blast furnace slag as polymerizing agent. This study is focused to identify the feasibility of development of Geopolymer concrete based on bottom ash as polymerization agent. Unlike fly ash which has many uses, including the effective partial replacement of cement, bottom ash has relatively lesser known uses. This study was focused to utilize bottom ash as the main binder and mixer of Na_2SiO_3 and NaOH as the activator. During the study, three different binders: activator ratios were studied (0.6,0.8,1.0) with the mass ratio of Na_2SiO_3 : NaOH as 2.4: 1. Separate mixers were also identified to investigate the impact of bottom ash usage as fine aggregate and the role of CaO as a contributor to enhance the reaction kinetics of polymerization reaction. Compressive strength of GPC was tested at the age of 3 days. Rapid Chloride penetration, water absorption, water penetration and acid attack were the standard tests conducted to assess the durability performances of GPC. The results of the experimental investigation indicate that both mechanical and durability performances of GPC have improved with bottom ash compared to the baseline fly ash and conventional cement. Especially, the results of resistance against acidity and water penetration of bottom ash based geopolymer has been found to be significantly better than ordinary Portland cement products. The study also finds the use of bottom ash as a fine aggregate in bottom ash-based GPC produces better results than they are used as polymerization agent alone.

Keywords: Alkaline activation, Bottom ash, Durability, Geopolymerization, Sustainability

*Corresponding Author: harsha@cee.ruh.ac.lk



Performance of Repaired Concrete Elements with Corroded Reinforcement

T.M.M.B. Tennekoon and H.P. Sooriyaarachchi*

Department of Civil and Environmental Engineering, Faculty of Engineering, University of Ruhuna, Hapugala, Sri Lanka

Abstract

Corrosion of reinforcement in concrete structures is one of the major causes that reduces and limits the service life of buildings especially in the coastal belt. High chloride content in coastal environments is the main factor that induces corrosion in reinforcement in reinforced concrete structures. In the initial stages of corrosion damage pressure induced by accumulation of corrosion product around reinforcement can form cracks, which will expand with the intensity of corrosion. Removing the damage concrete around the reinforcement and replacing it with new concrete/special repair material with or without reinforcement known as mechanical repair is the first line of intervention for restoring the structural behaviour of corrosion damaged structures. This study investigates the impact of the method of application requirement of additional reinforcement to restore the structural behaviour of the corrosion damaged flexural elements. In term of application, the repair mortar conventional method of application of shotcrete to repair cavity is compared with the self-compacted concrete application where repair mortar is cast into cavities with holes drilled on the slab with conventional form work arrangements underneath. The results indicated that better results are possible with this novel repair technique and they are far superior in restoring the composite action between the repair mortar/concrete and parent concrete. The test results also indicate that the loss of significant amount of reinforcement area over and above the area due to corrosion is required to restore the structural capacities of the corroded elements.

Keywords: *Additional reinforcement, Corrosion of reinforcement, Mechanical repair, Self-compacting concrete, Structural performance*

***Corresponding Author:** harsha@cec.ruh.ac.lk



The Most Critical Factor Affecting the Workmanship and Its Availability in Sites in Practical Sense Derived Using Primary Data

U.D.P.M. Gunasinghe¹ and G.S.Y. De Silva^{2*}

¹National Water Supply and Drainage Board, Sri Lanka

²Department of Civil and Environmental Engineering, Faculty of Engineering,
University of Ruhuna, Hapugala, Sri Lanka

Abstract

Workmanship could be expressed as a human attribute relating to knowledge and skill of performing a task. Workmanship is also a quality given to a product. As the construction industry at present is one of the major value additions to the National Gross Domestic Production in Sri Lanka, a high standard of workmanship is to be maintained in construction works to satisfy the stake holders. Two main factors affecting the workmanship, namely the External Factors and the Internal Factors are identified with their sub categories. The influence level of the above mentioned factors on workmanship, are then ranked inviting the ideas of the Industrial Technical Staff using a five point Likert Scale. These factors are next arranged in their prioritisation order which affects the Workmanship and will be benefitted by the Construction Industry in future with necessary modifications. Subsequently, the availability level of each factor based on the given criteria, within the respondents' organisation is identified. The factor ranked most critical in the questionnaire survey is discussed with the said factor's availability in the respondents' sites.

Keywords: *Workmanship, Construction industry, Influencing factors, Priority factors, Workmanship*

***Corresponding Author:** sudhira@cee.ruh.ac.lk



Review of the Performance of Building Demolition Practices in Sri Lanka

N. Gamage^{1*}, G.S.Y. De Silva² and A. Karunawardena¹

¹National Building Research Organisation, Sri Lanka

²Department of Civil and Environmental Engineering, Faculty of Engineering,
University of Ruhuna, Hapugala, Sri Lanka

Abstract

In line with the global transformation, urban development in Sri Lanka has also shown a rapid increase of high rise/ high density buildings and developments especially in cities such as Colombo over the recent past. In order to cater to such demands within a context of high land scarcity, not only existing obsolete structures but also existing structures which are structurally and functionally acceptable, are being replaced by newly built structures. Unavailability of statutory technical guidelines, codes, safety standards or regulations and lack of involvement of relevant professionals in planning & direction, monitoring & supervision in ensuring safety of life and property, appeared to have been the main reasons for series of tragic incidents recently associated with building demolition work in Sri Lanka. Many countries have adopted latest technology into building demolition industry and minimize the risk involved with the demolition activities. For the adaptation of a desirable and cost effective demolition practice for local condition would need a critical review of present practices, and it would also need to identify the areas that can be improved. This paper presents such a detailed study carried out in Sri Lanka with respect to the building demolition work by means of field study on building demolition practices in Sri Lanka. The method of building demolition in Sri Lanka can be categorized into two sections as manual and mechanical method. Often, the top down method is used where demolition continues from top to bottom. A number of malpractices, problems were observed during the field studies. Specially, the safety of site personal was below standards. Remedial methods for the observed problems and malpractices have been suggested with the gathered data and the literature review.

Keywords: *Demolition, High rise building, Concrete, Safety, Demolition techniques*

***Corresponding Author:** tnawoda@gmail.com



Evaluation of the Effectiveness of Concrete Durability Indicators for Concrete Made with Supplementary Cementitious Materials under Different Curing Regimes

H.P. Sooriyaarachchi* and K. Dasanayaka

Department of Civil and Environmental Engineering, Faculty of Engineering, University of Ruhuna, Hapugala, Sri Lanka

Abstract

Durability of built environment is crucial for the maximum economic benefit for the development. Different codes and practices are being used to evaluate the durability of new/existing structures, but the test methods used to evaluate durability and corresponding requirements differ from country wise or even project wise. Therefore, having a common platform which enables relative advantages, disadvantages and limitations of different methods of evaluation of durability is considered enormously important to create durable structures. The fact that different durability indicators and test methods provide different assessments of durability performances of concrete mixes, especially when Supplementary Cementitious Materials (SCM) are used in the mix is a much talked topic in construction industry today. Therefore, this study is focused to evaluate the performance of most common durability indicators such as Initial Surface Absorption (ISAT), Rapid Chloride Penetration (RCPT), Surface resistivity, water penetration and water absorption of concrete with supplementary cementitious materials such as Fly ash, granulated blast furnace slag and limestone. Durability assessments were done on concrete with SCM at 56 days for all specified tests, including the compressive strength as means for comparing the performance of different durability indicators. Concrete mixes were prepared for three different water to cement ratios (w/c) 0.30, 0.50, 0.70 for concrete grades of C50, C40 & C25 respectively. The selected water to cement ratios represent different segments of the construction industry namely; high end industrial, low end industrial and domestic markets respectively. After analysing the gathered data from the test series, the effectiveness of different durability indicators were identified, and it is observed that the use of the SCM makes a clear variation in different durability indicators. It was found that water penetration and surface resistivity are better indicators of durability performance of concrete mixes and can be used with different types of cement as reliable indicators while RCPT may not be a good durability indicator for concrete having SCM. Water curing, another point of investigation, shows a significant strength development and durability performance improvements of the concrete having SCMs.

Keywords: *Compressive strength, Durability, RCPT, SCM, Water curing*

***Corresponding Author:** harsha@cee.ruh.ac.lk



Wireless Energy Transmission for Access Limited Underground Sensors

D.S. De Silva*

Department of Electrical and Information Engineering, Faculty of Engineering,
University of Ruhuna, Hapugala, Sri Lanka

Abstract

Insufficient information is transmitted from underground sensors or those need to be frequently replaced due to their low battery life. Also, dis functioning of few nodes might require re-organization of the sensor network. So, the power supply to these nodes directly influences the lifetime of the sensor network. In this project, we focus on designing an affordable device named PERFUSE (Power For Underground Sensors) to provide wireless power to access limited underground systems and devices. The PERFUSE system consists of a transmitter, receiver, charging circuit, and rechargeable battery. Wireless underground sensor networks are an enabling technology for the development of applications in various fields such as security applications, environmental applications and infrastructure maintenance. In this technology, wireless sensor nodes are located in the subsurface region of the soil. As a result, providing power to these sensors has become a very hard and high cost consuming task, especially in access limited areas. The most commonly used method to power these devices is using batteries. But, it has so many problems such as low battery life, high cost and difficulties of replacements in access limited areas. Also, recharging these batteries is not possible because those cannot be exploited to solar energy. Due to low battery life, these sensors need to be replaced frequently. It requires a huge cost and a huge effort when the sensors are located at access limited areas. In addition to that, it requires a huge cost to provide safety precautions in such operations. Therefore, we intend to provide a practical solution for above-mentioned problems by introducing our PERFUSE device which is specially designed to provide power for underground sensors located at access limited areas. Under this research work, strongly coupled inductive magnetic resonance (SCIMR) uses in order to efficiently transfer power wirelessly over mid-range distances. Strongly coupled systems are able to achieve more efficient energy transfer than other wireless power transfer systems.

Keywords: *Underground Wireless Power Transfer (UWPT), Inductive Coupling, Strongly Coupled Inductive Magnetic Resonance SCIMR), Magnetic Resonance*

*Corresponding Author: saman@eie.ruh.ac.lk



An Investigation of the Internal Combustion (IC) Engine Performance with Diesel Blended Liquid Fuel Extracted from Waste Polyethylene

E.P. Rohan, B. Sumith* and L.K.T. Simal

Department of Mechanical and Manufacturing Engineering, University of Ruhuna, Hapugala, Sri Lanka

Abstract

Waste polyethylene (PE) was converted into liquid hydrocarbon fuel through a pyrolysis process in a semi-batch reactor fabricated in the laboratory. Thermodynamic properties of extracted liquid were investigated and it was found to be similar to the properties of diesel fuel. In this work, a feasibility study of mixture of extracted liquid blended with diesel fuel to run an IC engine was conducted. The mixture blending of extracted liquid fuel with diesel varies from 10 % (10/B/PE/D, 10 % of PE derived fuel blended with diesel) to 70% by volume. The variation of brake specific fuel consumption (BSFC), brake power (BP) and brake thermal efficiency (BTE) at different loading (varying from 0 W to 5000 W by the steps of 1000 W) on the engine for pure diesel and blends were conducted. For the blended fuel mixtures, the BP was varied between 960 W and 920 W at the low load (1000 W) and between 4370 W and 3060 W at the high load (5000 W). Also, BP of 10/B/PE/D and 20/B/PE/D was slightly higher than that of diesel while the BP of 60/B/PE/D was slight lower than that of diesel. BP of 30/B/PE/D, 40/B/PE/D and 50/B/PE/D is almost similar to that of diesel. The BSFC was varied between 0.253 ml/kJ and 0.372 ml/kJ at low load and between 0.081 ml/kJ and 0.096 ml/kJ at high load. All blends showed comparatively low fuel consumption compared to diesel. The calculated BTE varied between 7.39 % and 10.87 % at low load and between 28.83 % and 33.24 % at high load. All blends showed comparatively high BTE compared to diesel. Whereas for diesel, BSFC was 0.300 ml/kJ at low load and 0.171 ml/kJ at high load, the BP was 960 W at low load and 4230 W at high load and the calculated BTE was 8.84 % at low load and 24.89 % at high load. It was observed that, the running behaviour of the engine with the blended mixtures up to 60/B/PE/D was similar to that of diesel fuel, but observed considerable variations with 70/B/PE/D blend. All mixtures up to 60/B/PE/D showed comparatively low fuel consumption and comparatively high BTE compared to diesel fuel. Therefore, all blends are most suitable for diesel engines in terms of having low BSFC and high BTE. BP of 10/B/PE/D and 20/B/PE/D is slightly higher than that of diesel while the BP of 60/B/PE/D is slightly lower than that of diesel. BP of 30/B/PE/D, 40/B/PE/D and 50/B/PE/D is almost similar to that of diesel. Therefore, the blended mixtures up to 50/B/PE/D are suitable for diesel engines in terms of having similar or slightly higher BP. Therefore, it can be concluded that 10/B/PE/D to 60/B/PE/D blends can be used in diesel engines in terms of having performances similar to diesel. However, cleanliness of waste PE derived fuel has to be improved to use as an alternative fuel in commercial vehicles.

Keywords: *Brake power, Brake specific fuel consumption, Brake thermal efficiency, Diesel engine, Waste polyethylene derived fuel.*

* **Corresponding Author:** sumithb@mme.ruh.ac.lk



The Opportunity of Reducing Life Cycle Cost of Boats in Sri Lanka by Integrating Alternative Consumables for Vacuum Assisted Resin Transfer Moulding (VARTM) Process

M.T.T. Ranjan, U.I.K. Galappaththi* and S. Baduge

Department of Mechanical and Manufacturing Engineering, Faculty of Engineering,
University of Ruhuna, Hapugala, Sri Lanka

Abstract

This research focuses on describing the opportunity of reducing the manufacturing cost of boats by using alternative consumable materials for Vacuum Assisted Resin Transfer Moulding Process (VARTM) and its succeeding contribution for the life cycle cost reduction of boats. Thus, the scope of the study was limited to identify alternative consumables for substituting the existing consumables used in VARTM process. The standard consumables for VARTM are vacuum bag, High-Density Polyethylene (HDPE) spiral tube, distribution medium, peel ply, T connectors, L connectors, sealant tape and HDPE clear tubes. Although these materials are specially manufactured consumables for VARTM, none of them are readily available in the Sri Lankan market and they should be imported. Consequently, the cost of manufacturing boats is high due to the excessive cost of imported consumables. This is negatively affected for motivating local boat builders to use VARTM. To address this situation and encouraging Sri Lankan boat builders to use available consumable materials in the country, a series of experiments were conducted to identify suitable alternative consumables for the VARTM process in the Sri Lankan market. Based on the experiment results, clear tube used in gas line piping, nylon fabric used in tailoring, spiral wrapping tube used in electric wiring, green mesh used in agricultural activities and reusable T connectors used in gas pipe installation were identified as alternative consumables for VARTM. The purchasing cost of identified five types of consumable materials and standard consumable materials were compared to estimate the cost reduction. The total life cycle cost distribution for the *Samanala* boat manufactured from VARTM in design phase, production phase, utilization phase and disposal phase were estimated in percentage as 1.09 %, 8.56 %, 90.11 % and 0.24 %. Then, it was estimated that the use of identified alternative consumables will create 1.54 % of cost reduction in production phase and it reduce 0.13% of total life cycle cost for a *Samanala* boat. Although, these cost saving percentages are showing a lesser value, it makes considerable impact for encouraging local boat builders to integrate VARTM in their boat manufacturing facilities. Consequently, it is recommended to undertake structural testing to identify, the effect of using alternative consumables for mechanical properties of composites.

Keywords: *Boat manufacturing, Life cycle cost, Alternative consumables, Vacuum assisted resin transfer moulding (VARTM)*

***Corresponding Author:** galappaththi@mme.ruh.ac.lk



Development of a Computationally Efficient Hybrid CPU and GPGPU based Numerical Model to Simulate Morphological Changes of a Fresh Single Plant Cell

A.K.C.I. Kodithuwakku¹, K.G.P. Hansani², S. Baduge¹ and H.C.P. Karunasena^{1*}

¹ Department of Mechanical and Manufacturing Engineering, Faculty of Engineering, University of Ruhuna, Hapugala, Sri Lanka

² Department of Mathematics, Faculty of Science, University of Ruhuna, Matara, Sri Lanka

Abstract

Food drying is a commonly used technique to minimise the spoilage of organic matters as a food preservation method. During this process, water content inside the plant cells or tissue tends to reduce and it is a multi-scale complex process. At the base line, with the aid of micro scale numerical modelling and simulation, fundamentals of this complex process can be understood. Accordingly, the understanding on the property changes of a cell or a tissue during drying can be used to develop new drying techniques targeting various food items. Currently, researchers are developing numerical models to simulate food cellular structural changes during drying, but the main problem is the conventional Central Processing Unit (CPU) based computer simulations leading to lower computational efficiency in terms of time and resources. This has been particularly critical in case if the highly flexible mesh free based numerical modelling techniques are used for the purpose. As an alternative, in this work, the General-Purpose Graphical Processing Unit (GPGPU) was used for simulations on a mesh free based single plant cell model to increase the computational efficiency, considering the inbuilt parallel processing capability of GPGPU. Accordingly, a conventional Smoothed Particle Hydrodynamics (SPH) based single plant cell model was upgraded to run on a hybrid mode utilising both CPU and GPGPU. There, an existing CPU running C++ code of a mesh free based single plant cell model was re-programmed by incorporating CUDA (Compute Unified Device Architecture) GPGPU programming language. This novel hybrid CPU-GPGPU numerical model resulted in a 73 % reduction of the computational time compared to the conventional CPU-only model, when run on the same computational environment. Therefore, the use of GPGPU can be recommended as a reliable means of improving the computational performance of mesh free based plant cellular models. Future work of this research will focus on further improvement of the computational performance through better workload distribution between GPGPU (device) and CPU (host), yielding further benefits, particularly in modelling and simulation large tissues and their complex physical mechanisms during processing.

Keywords: *Central Processing Unit, Compute Unified Device Architecture, General purpose Graphical Processing Unit, Parallel processing, Smoothed Particle Hydrodynamics*

*Corresponding Author: chaminda@mme.ruh.ac.lk



Three-dimensional Numerical Study on Fluid Dynamic Performance of Various Shaped Wave Energy Converter Flaps in a Wave Tank

N.H.D.S. Manawadu¹, I.D. Nissanka² and H.C.P. Karunasena^{3*}

¹Advanced Technological Institute, Galle; ²Department of Mechanical Engineering, Faculty of Engineering, University of Moratuwa, Sri Lanka; ³Department of Mechanical and Manufacturing Engineering, Faculty of Engineering, University of Ruhuna, Hapugala, Sri Lanka

Abstract

This paper presents a study on fluid dynamic forces generated by various shaped flaps on a wave energy converter (WEC) which are opposing the propagation of regular sea waves, artificially created on a wave tank. For this purpose, a numerical simulation tool: DualSPHysics which is based on Smoothed Particle Hydrodynamic (SPH) was used. DualSPHysics has been successfully used by previous researchers to model fluid dynamics of surface waves and their interactions with structures, proving its validity in the context of this research. In this work, fluid-solid interaction between the flap of the WEC and the waves were studied focusing on three basic flap shapes of a given WEC having a fixed width: square prismatic (1.2 m width; 1.2 m height, 0.6 m thick), semi-spherical (1.2 m diameter) and triangular prismatic flap (1.2 m base width; 1.2 m face width, 0.6 m height) which were placed fixed in a 3-D numerical wave tank. Based on the simulations, three-dimensional hydrodynamics forces on these three flaps in the X, Y and Z directions were analysed and the results were used to compare the performance of the flaps. It was found that when a wave of 0.25 Hz frequency and 0.5 m wave height interacts with the square prismatic flap of a WEC, the X, Y and Z directional forces are 6.5, 0.3 and 4.3 kN respectively, yielding 4.5, 0.2 and 3.0 kN/m² of force intensities on projected areas of the flap in respective directions. For the semi-spherical shape, the three forces were 3.6 kN, 0.08 kN and 3.4 kN, respectively and the force intensities were: 3.18, 0.07 and 3.00 kN/m². For the triangular prismatic flap, the forces were 5.0, 0.1 and 3.0 kN, respectively with the force intensities of 3.50, 0.06, 2.00 kN/m². According to these results, the square prismatic flap can be recommended as the best shape to be used for a WEC, since highest force intensities in the desired X and Z directions are obtained from that. However, a higher level of turbulence was observed as the waves interact with the square prismatic flap, implying that further fluid dynamic optimisations are to be done in order to ensure reliable performance of the WEC, if the rectangular flap is to be used. Based on the insights of the study, it can be concluded that DualSPHysics based simulation can be recommended as a reliable means of numerically studying the performance of WEC flaps in real sea conditions saving cost and time in the WEC development process.

Keywords: *DualSPHysics, Renewable Energy, Smoothed Particle Hydrodynamics (SPH), Solid-Fluid Interaction, Wave Energy Converters (WEC)*

*Corresponding Author: chaminda@mme.ruh.ac.lk



Prototyping and Experimental Design Validation of Soft Actuated Oral Physiotherapy Device for OSF Patients

K.J.C. Kumara^{1*}, I.V.T.P. Induruwa¹, W.A.M.S. Wijesekara¹, J.G.V. Priyanka¹, P. Peiries² and R. Jayasinghe²

¹Department of Mechanical & Manufacturing Engineering, Faculty of Engineering, University of Ruhuna, Hapugala, Sri Lanka

²Department of Oral Medicine and Periodontology, Faculty of Dental Science, University of Peradeniya, Sri Lanka

Abstract

Oral Sub-mucous Fibrosis (OSF) is a disease that mostly makes the opening of the oral cavity difficult and limited by affecting to all the activities of the mouth. Reported literature stressed that most South Asians have been suffering by OSF and it has a trend of spreading the same throughout Europe. Oral physiotherapy is broadly practiced rehabilitating OSF patients with or without prior to the surgical treatments. The oral physiotherapy assisted devices have been used so far found to be weakly addressed patience comfortability and shape of the oral cavity. Such devices are less efficient and do not provide required jaw lifting force to open the oral cavity gap. An innovative design developed based on the soft actuators was fabricated and load testing was carried out to validate the design specifications and simulation results of FEA. The experiments results are shown that the prototype (consisted of two symmetrical soft actuators, tubes, safety valve, and a hand bole) is capable enough to provide more than twice the jaw lifting force (required: 72N for men, our device: 150N), while maintaining the required oral cavity opening gap (optimum: 25~35mm, our device:15~20mm by its first stage and therefore within two stages/devices patient will achieve the goal) when it is placed between upper and lower jaws symmetrically. The completed device was moulded by using biomedical grade materials and consisted of patient friendly, self-feedback and safety mechanisms for the continuous operation with feedback for self-controlling of the pressure applied through the hand bole. The manufacturing technique has also been developed so that the material and manufacturing cost of the device is low, and it can easily be modified for patient's physical dimensions and recovery that are physiotherapeutically expected.

Keywords: *Jaw lifting, Oral-physiotherapy, Oral-submucous-fibrosis, Soft-actuators*

***Corresponding Author:** kumara@mme.ruh.ac.lk



Computationally Efficient Simulation of a Mesh Free Based Plant Cell Model Undergoing Indentation by External Probes

K.G.P. Hansani¹, A.K.C.I. Kodithuwakku², S. Baduge² and H.C.P. Karunasena^{2*}

¹Department of Mathematics, Faculty of Science, University of Ruhuna, Matara, Sri Lanka

²Department of Mechanical and Manufacturing Engineering, Faculty of Engineering, University of Ruhuna, Hapugala, Sri Lanka.

Abstract

Plant products are exposed to different environmental conditions and mechanical stresses where the cell structure get damaged, negatively impacting the commercial food production. Therefore, having a good understanding of plant cell mechanisms is important. Numerical modelling used in plant cell studies has become one of the popular areas of research in food engineering. Particularly, mesh free methods play a vital role when modelling realistic plant cell and tissue domains, but usually consume more computational time due to interaction calculation compared to grid based numerical modelling techniques. This study has focused on improving the computational efficiency of a two-dimensional mesh free based plant cell model simulating cell compression under external indentation. Here, the cell is vertically compressed by two parallel horizontal plates, where each plate has a small probe or cusp at the middle region in order to indent the cell during compression. To ensure efficient CPU based simulations, this study presents two alternative numerical techniques to handle the Nearest Neighbour Particle Searching (NNPS) requirement within the mesh free framework: Cell Linked List Algorithm (CLLA) and Adaptive Fixed Neighbourhood based Smooth Particle Hydrodynamics (AFN-SPH). The results were compared with the state of the art All Pair Searching (APS) algorithm used to perform NNPS conventionally. Using CLLA with a novel grid constant, 10% of computational time got reduced compared to the APS. With AFN-SPH, the respective time saving was 20%. Both techniques were tested for applicability in modelling large boundary deformation of the cell undergoing indentation. The findings imply that the CLLA and AFN-SPH can reliably be used for modelling large deformations with computationally efficiency than the state-of-the-art modelling with APS. The outcome of this research with observed higher computational efficiency would assist to predict food behaviour in real food processors, leading to minimised food wastage where the relevant researchers or new industries will make use of the findings for commercial food production. Since this study has basically focused on reducing computational time, improved versions of this model can be used to study the mechanical and behavioural changes under different indentation levels and to obtain several patterns of force-displacement curves under varying parameters to predict dynamic responses of cellular materials undergoing large deformations.

Keywords: *Adaptive Fixed Neighbourhood based Smooth Particle Hydrodynamics, All Pair Searching, Cell Linked List Algorithm, Meshfree, Nearest Neighbour Particle Searching*

***Corresponding Author:** chaminda@mme.ruh.ac.lk



Seismic Vulnerability Assessment Criteria: A Study on Available Methods as a Guide for Sri Lanka

N.G.R.K. Gunathunga^{1*}, G.S.Y. De Silva² and A. Karunawardena¹

¹National Building Research Organisation, Sri Lanka,

²Department of Civil and Environmental Engineering, Faculty of Engineering,
University of Ruhuna, Hapugala, Sri Lanka.

Abstract

Ground vibration can be either natural or manmade. Earthquake causes ground vibration which can vary in larger scale. Sri Lanka experienced minor earthquakes but according to the literature there is a possibility of occurring earthquakes in future. The earthquakes generate horizontal inertia forces by the ground acceleration which can cause collapse of buildings. Since the natural disasters cannot be prevented, the focus should be on reducing the risk to human lives by reduction of the vulnerability. The manmade vibration is due to the rock blasting, construction activities or equipment. The effect from the man made vibration will not be much critical to result a building collapse but it can cause unsuitable condition for living. In Sri Lanka, unreinforced masonry buildings are a popular type of building. These simple masonry structures are capable of carrying gravity loads but they are weak in carrying tension. The effect will be severe when the material and construction quality is lacking. The vulnerability assessment criteria shall be simple and user friendly so that anyone can predict the performance of their own house in a ground trimmer which will result the reduction of fatalities in a sudden earthquake. Also the general public and the local authorities will be aware about the appropriate strengthening techniques to be applied for new constructions as well as to retrofit the damaged structures. This paper presents a study of the existing seismic vulnerability assessment criteria in different countries around the world as a guide to develop vulnerability assessment criteria for Sri Lanka. According to the study, most of the countries are following the procedure developed by Federal Emergency Management Agency (FEMA) with or without modifications. Some countries like India have published their own methodology following the FEMA criteria because it is very transparent and any country can use the basis they have followed. Sri Lanka has low seismicity and therefore it is possible to use the procedure developed by FEMA for low seismicity regions as a guide for Sri Lanka. The modifications have to be done for the factors like soil conditions, material properties, etc to match the Sri Lankan conditions.

Keywords: *Earthquake, Ground vibration, Masonry buildings, Vulnerability assessment*

***Corresponding Author:** raneesha.kasunsi@gmail.com



Identification of Ancient Monuments and Ruins in Sri Lanka Using Image Processing Techniques

P.H.P.N. Laksiri*

Department of ICT, Faculty of Technology, University of Ruhuna, Kamburupitiya, Sri Lanka

Abstract

Sri Lanka is one of the best places for tourism. Ancient ruins and monuments are the most attractive places for tourists who are travelling around the country. Almost all the ancient ruins and monuments have a great history, interesting facts, stories and many things bound with them. To know about those interesting facts wrapped around them it is a must to identify the monument or ruin correctly. When tourists visit such ancient monuments and ruins, most of the time there are many monuments and ruins scattered around the same place, and some of them look similar to each other. In such situations, tourists are struggling to identify them. Though there are some small sign boards, they do not provide enough information at least to identify the ruins and monuments. There are few web sites which provide some static information, and there are some location-based services, but they do not provide real time identification or offline services. Hence, there is a lack of reliable and portable system for the identification of ancient monuments and ruins. The proposed Android mobile application uses a user input image to identify ancient monuments and ruins. The solution is based on the usage of combination of Bag of Visual Words (BOVW) and Exif metadata (GPS tag) of an image. The prediction model is built based on a set of features, which is used to represent an image as key points and descriptors extracted by Speed Up Robust Feature (SURF) and clustered using K-means. Prediction of user uploaded image was done through a combination of classification using Support Vector Machine (SVM), Exif data and nearest neighbour algorithms. A pilot project was conducted in *Atamasthana* area in Anuradhapura. With the test set it achieved nearly 90 % of accuracy when noise is low.

Keywords: *Ancient Monuments and ruins, Image processing, Android*

***Corresponding Author:** phpnlaksiri@ictec.ruh.ac.lk



Information Measures and Geometrical Properties of Normal and Lognormal Probability Density Functions

N. Yapage*

Department of Mathematics, Faculty of Science, University of Ruhuna, Matara, Sri Lanka

Abstract

The normal distribution plays a central role in Probability Theory, Statistics and other relevant fields in the Sciences as a tool for modelling different real world phenomena. The lognormal distribution on the other hand, although it gets less attention, has many applications in rainfall data modelling, financial modelling etc., where normal distribution is not much appropriated. Many authors have studied their distributional properties such as expectation, variance, skewness and kurtosis from a statistical point of view. However, information theoretical and geometrical properties have not been studied extensively. It has been understood that these properties are helpful in interpreting different statistical quantities. In this work, we investigate some information theoretical and geometrical properties of normal and lognormal distributions. More precisely, we use tools from information theory to derive formulae for Shannon entropies, relative entropies and Fisher information matrices of the two distributions and show that the two form exponential families using the concepts from information geometry. This is one reason for these distributions to have many rich properties from different points of view. It should be stated that the Fisher information turns out to be the unique Riemannian metric for the two statistical models. We brief on several basic statistical quantities of the normal distribution and its moment generating function is used to obtain the expectation and variance functions of the lognormal distribution. Although we are not focussing on the parameter estimation problem for the two cases, we derive Fisher information matrices as those are geometrically important and useful in testing the efficiency of the maximum likelihood estimators. It should be noted that the relative entropy which is used to measure the distance between two probability distributions is not a metric. The most important fact is that relative entropy is related to the Fisher information matrix and plays an important role in maximum likelihood estimation and the exponential family structure.

Keywords: *Normal and lognormal distributions, Information functionals, Mathematical statistics, Information theory, Information geometry*

*Corresponding Author: nihal@maths.ruh.ac.lk

Medicine and Allied Health Sciences



Subclinical Atherosclerosis in Patients with Type 2 Diabetes is Significantly Associated with Visceral Fat

C.M. Wickramatilake^{1*}, T.P. Weeraratna², I. Kodikara³ and G. Liyanage⁴

¹Department of Biochemistry, Faculty of Medicine, University of Ruhuna, Galle, Sri Lanka

²Department of Medicine, Faculty of Medicine, University of Ruhuna, Galle, Sri Lanka

³Department of Anatomy, Faculty of Medicine, University of Ruhuna, Galle, Sri Lanka

⁴Department of Pharmacology, Faculty of Medicine, University of Ruhuna, Galle, Sri Lanka

Abstract

Type 2 diabetes mellitus (T2DM) is a risk factor of atherosclerosis. Sub-clinical atherosclerosis is identified by measuring carotid artery intima media thickness (CAIMT) with ultrasound. This study describes the factors associated with CAIMT and cardiovascular disease (CVD) risk in patients with T2DM. There were total of 238 patients registered at the Diabetes Centre, Galle in Southern Sri Lanka during the period, but 212 was considered in the final analysis, excluding the patients with plaques in carotid arteries and patients with past history of CVD events. Details on demographic characteristics, anthropometry, fat mass, glycated hemoglobin (HbA1c) level and CAIMT of both common carotid arteries were collected. Relationship of the associated factors with CAIMT was elicited after adjusting CAIMT values for age using multiple regression. Comparison of continuous variables were done using the two-sample t-test. There were 98 males and 114 females with the mean age of 58±10 years. A majority of 146 (68.9%) of the sample had overweight and obesity. Poor glycemic control (HbA1c>7%) was detected in 164 (73.3%) patients. There were 166 (78.3%) patients with increased CVD risk (≥ 75th percentile CAIMT) based on age and gender specific values. Significant positive correlations were observed between mean CAIMT and mean age (r=0.308, p=0.001), age of initial detection of T2DM (r=0.180, p=0.008), duration of T2DM (r=0.228, p=0.001), mean HbA1c (r=0.206, p=0.003) and visceral adiposity (r=0.239, p=0.001). Males had significantly higher mean CAIMT (0.736±0.16 VS. 0.678±0.011, p=0.003) and visceral fat (12.3±5.0 VS. 9.9±3.9, p=0.001) than females. We conclude that, the majority of the patients had overweight and global obesity, poor glycemic control and were at increased risk of CVD. Aging, longer duration of T2DM, later age of diagnosis, higher visceral fat and poor glycemic control were associated with increased CAIMT in patients with T2DM. Males had higher CAIMT and visceral fat than females.

Keywords: *Atherosclerosis, Carotid arteries, Tunica intima, Glycemic control, Visceral fat*

***Corresponding Author:** chandimadhu@live.com



Skin Closure of Pfannestiel Incision in Lower Segment Caesarean Section: Comparison of Wound Outcome with Interrupted vs. Subcuticular Techniques

D.L.W. Dasanayake^{1*}, A.K. Jodhi², K.U.G.A. Roomadu² and G.K.R. Saumya²

¹Department of Obstetrics & Gynaecology, Faculty of Medicine, University of Ruhuna, Galle, Sri Lanka

²Faculty of Natural sciences, Department of Nursing, Open University of Sri Lanka

Abstract

Caesarean section is the most common surgical procedure performed throughout the world. A vast majority of the procedures are carried out by Pfannestiel incision. Different techniques and materials are used to approximate the skin for caesarean section. Each method has its own advantages and disadvantages. Surgical wound related morbidities are known to occur as complications. The objective of the study was to compare surgical wound outcome and overall women's satisfaction in Pfannestiel incision closure with interrupted vs. sub-cuticular suturing technique in caesarean sections. A prospective comparison study was carried out in 400 women who underwent lower segment caesarean section at first time. Age and body mass index (BMI) were matched in each group. Standard lower segment caesarean section was performed with assigning interrupted and sub-cuticular wound closure for 200 women in each group. Two arms were compared for wound complications, post-operative pain and overall satisfaction. Study participants and investigator were blinded for suturing techniques and post-op pain assessment. There were no statistical significant difference in both groups for base line characteristics: age, BMI and category of caesarean sections. According to visual analogue scale, 91% of women reported to have moderate to severe pain in interrupted group as compared to 80% in sub-cuticular group ($\chi^2 -10.5, p<0.05$). Wound complications were present in 8% of interrupted group vs 3% in sub-cuticular group ($\chi^2 27.4, p<0.001$). 64% of women were satisfied with sub-cuticular method vs. 28% in interrupted method ($\chi^2-53.5, p<0.001$). Women who had sub-cuticular suturing method had less post-operative pain, better wound outcome and more satisfaction as compared to interrupted methods.

Key Words: *Lower segment caesarean section, Pfannestiel incision, sub-cuticular suturing, interrupted suturing, post-operative outcome*

*Corresponding author- lanka.dasanayake@yahoo.com



Compared to Exercise and Metformin Alone, Combination of Treatment for Six Months for Patients with Pre-Diabetes Helps to Maintain Sustained Weight Loss

A.T.I.M. Amarasinghe^{1*}, S. Lekamwasam², T.P. Weeraratna²,
M. Sumanathillake³

¹Department of Pharmacology, Faculty of Medicine, University of Ruhuna, Galle, Sri Lanka

²Department of Medicine, Faculty of Medicine, University of Ruhuna, Galle, Sri Lanka

³National Hospital of Sri Lanka, Colombo, Sri Lanka

Abstract

Pre-diabetes is an asymptomatic dysglycemic condition, which can progress to diabetes mellitus. Weight control is one of the important steps to minimize the progression of pre-diabetes. We studied the effects of six month long pre-designed exercise program and metformin SR 500mg once daily treatment on body weight among individuals with pre-diabetes. A group of 120 subjects with pre-diabetes (IGT) were recruited to the study by 75gram oral glucose tolerance test (OGTT). 30 IGT subjects were treated with metformin SR 500mg once daily for six months (IGT-M). Another 30 IGT subjects were instructed to engage in 150 minutes moderate aerobic and 30 minutes vigorous aerobic activities per week for six months (IGT-E). Another 30 IGT subjects were treated with metformin and instructed to engage in the above exercise plan for six months (IGT-EM). Control group (IGT-C) did not receive specific advice on exercise and treatment. After six months, interventions were stopped and followed up for one year. Body weight was measured at baseline, at six months and at the end of one year follow-up period. At the end of 6 months, percentage changes of body weight in IGT-E, IGT-M and IGT-EM compared to IGT-C [{-3.50 vs-0.681, p=0.001} ;{-2.963vs -0.681, p=0.008}; {-4.873vs -0.681, p<0.001}] were significantly different. At the end of 18 months, percentage change of weight in IGT-EM compared to IGT-C {-3.238vs 0.059, p=0.001} was significantly different. Compared to IGT-C, percentage changes of body weight in IGT-E and IGT-M groups at the end of 18 months were not significantly different. At the end of 6 months 2hr OGTT was significantly reduced in all intervention groups while, it was significantly reduced in IGT-M and IGT-EM at 18 months. Both interventions reduce the body weight and blood sugar of pre-diabetes while on the intervention. But, combined arm (IGT-EM) helps to maintain the reduced body weight and blood sugar even after stopping the intervention for one year.

Keywords: *Exercise, Metformin, Pre-diabetes, Weight loss, Blood sugar*

***Corresponding Author:** amarasingheisuru@med.ruh.ac.lk



Effects of Metformin for Six Months on Glycaemic State, Lipid Profile and Anthropometry among Individuals with Pre-Diabetes

A.T.I.M. Amarasinghe^{1*}, S. Lekamwasam², T.P. Weerarathna², M. Sumanathillake³

¹Department of Pharmacology, Faculty of Medicine, University of Ruhuna, Galle, Sri Lanka

²Department of Medicine, Faculty of Medicine, University of Ruhuna, Galle, Sri Lanka

³National Hospital of Sri Lanka, Colombo, Sri Lanka

Abstract

Prevention of progression of pre-diabetes to diabetes mellitus is important to reduce the burden of diabetes in the country. We studied the effects of metformin 500 mg slow releasing (SR) preparation on anthropometry, lipid and glycaemic status among individuals with pre-diabetes. Sixty individuals with impaired glucose tolerance (IGT) determined by 75 g OGTT were enrolled to the study. Thirty subjects were treated with metformin SR 500 mg once daily (IGT-M) for six months and continued their normal diet, while control group (IGT-C) did not receive metformin or any specific advice on diet. Body weight, waist and hip circumference, blood pressure, fasting blood sugar (FBS), OGTT, glycosylated haemoglobin (HbA1c) and lipid profile were measured at the baseline and after six months. Mean (SD) age of IGT-C, IGT-M were 44 (9), 51 (8) years. By OGTT, 10 (33.3%) were converted to normoglycaemia in IGT-M after six months, while none of them progressed to diabetes. In the control group, 3.3% became normoglycaemic while 6.7% progressed to diabetes. All anthropometry measurements, lipid and glycemic indices improved after six months of metformin, but only the percentage differences of HbA1c{-2.11 vs 1.58 (p=0.001)}, OGTT {-9.94 vs -0.472 (p<0.001)}, BMI{-2.96 vs -0.681 (p=0.006)}, HDL{12.13 vs -2.92 (p=0.021)} and LDL{-8.67 vs 26.80 (p=0.004)} were significantly different in between IGT-M and IGT-C groups. The percentage difference of FBS, total cholesterol, triglyceride and blood pressure were not significantly different between the two groups. This study reveals that metformin 500 mg SR once daily for six months is effective in controlling glycaemic and lipid status of individuals with pre-diabetes and it prevents pre-diabetes progressing to diabetes and effectively reverts them to normoglycaemia.

Keywords: BMI, Lipid profile, Metformin, OGTT, Pre-diabetes.

*Corresponding Author: amarasingheisuru@med.ruh.ac.lk



An *in Vitro* study to Determine the Potential Ultraviolet Radiation Screening Capability of the Indigenous Medicinal Plant *Olox zeylanica* (Mella)

C.E. Liyanaarachchi¹, M. Napagoda^{1*}, S. Witharana² and L. Jayasinghe³

¹Department of Biochemistry, Faculty of Medicine, University of Ruhuna, Galle, Sri Lanka

²Faculty of Engineering, Higher Colleges of Technology, PO Box 4793, United Arab Emirates

³National Institute of Fundamental Studies, Kandy 20000, Sri Lanka

Abstract

Sunlight is the main energy source of the earth. Recent studies however have revealed that the ultra violet (UV) component of sunlight is a factor that causes acute or chronic photo damage to the human skin. Sunscreens are found to be the most effective strategy against UV radiation. Negative side of widely available synthetic sunscreen agents is, the synthetic molecules in them creating toxicity effects such as allergic reactions after the application. Therefore, current research is focused on the identification of UV blockers of natural origin with low toxicity. The work presented in this paper was carried out to determine the potential UV attenuating capability of herbal sunscreen formulations prepared from a methanolic extract of dried leaves of *Olox zeylanica*. Initially, different concentrations (i.e., 25%, 50% and 75%) of the extract was incorporated into an aqueous cream base. Then, initial *in vitro* UV barring capability of each formulation was evaluated by measuring the UV absorbance, followed by the calculation of sun protection factor (SPF). It was observed that, the formulation with 75% of the extract displayed the highest potential of attenuating UV radiation with an SPF value of 22.71 ± 0.07 , while the formulation with 25% of the extract displayed the lowest SPF value of 12.66 ± 0.06 . These SPF values were found to be better than the SPF value of the synthetic sunscreen agent used as the positive control (calculated SPF = 5.2, labelled SPF value = 15). Moreover, to determine the photo degradation of UV filters upon UV radiation exposure, the prepared sunscreen formulations were exposed to direct sunlight for three weeks and SPF values were calculated. The insignificant deviation of SPF values within the monitored time period confirmed the photochemical stability of the prepared sunscreen formulations. Despite the low SPF value, the synthetic sunscreen formulation also displayed a photo stability. These important and encouraging experimental results obtained so far, exhibit the potential to develop these formulations into commercial sunscreen products of natural origin.

Keywords: *Olox zeylanica*, Photodegradation, Sun protection factor, Sunscreens, Ultraviolet radiation

*Corresponding Author: mayurinapagoda@yahoo.com



Demographic Associations of Diabetes Status by Both Fasting Plasma Glucose Concentration and Glycated Haemoglobin in a Community Survey in Galle District, Sri Lanka

K.G.P. Wasana¹, A.P. Attanayake^{1*}, T.P. Weeraratna² and K.A.P.W. Jayatilaka¹

¹Department of Biochemistry, Faculty of Medicine, University of Ruhuna, Galle, Sri Lanka

²Department of Medicine, Faculty of Medicine, University of Ruhuna, Galle, Sri Lanka.

Abstract

The prevalence of diabetes mellitus (DM) has increased as an epidemic in Sri Lanka. The diagnostic tools as fasting plasma glucose (FPG), glycated haemoglobin (HbA1c) and oral glucose tolerance test (OGTT) are used in the diagnosis of DM. The present study was aimed to determine the demographic associations of diabetes status by both FPG and HbA1c in a community survey in Galle district, Sri Lanka. Data on age, gender, body mass index (BMI) and self-reported family history of DM among first degree relatives were obtained from 147 patients with newly diagnosed DM (30 - 60 years) based on FPG concentration. Patients who are suffering from complaints as renal, liver, cardiac, respiratory, other chronic or acute diseases, thyroid disorder, psychiatric problems and pregnant mothers were excluded from the study. The percentage of HbA1c was calculated in study subjects. Binary logistic regression was used to study the association between the demographic factors (independent variables) and the diabetes status by both $FPG \geq 126$ mg/dL and $HbA1c \geq 6.3$ % (dependent variable). Of the 147 study subjects, 38.1% were males and 61.9% were females. From all the subjects, 63.3% had a family history of diabetes among first degree relatives. Mean age of the study subjects was 48.4 ± 7.2 years and mean BMI was 25.1 ± 4.0 kg/m². Mean FPG and HbA1c were 139.4 ± 30.1 mg/dL and $6.4 \pm 0.7\%$, respectively. The prevalence of diabetes based on both tests of FPG and HbA1c was 55.1%. Regression analysis revealed significant of odds of having diabetes by both tests with rising BMI (OR=1.97, CI 1.15 – 3.36, p= 0.013) and family history among first degree relatives of diabetes (OR=7.95, CI 3.54– 17.88, p= 0.000). Rising BMI and having DM among first degree relatives are strongly associated with diabetes status diagnosed by both FPG and HbA1c.

Keywords: *Body mass index, Diabetes mellitus, Fasting plasma glucose, Glycated haemoglobin*

*Corresponding Author: anoja715@yahoo.com



Reliability and Validity of the Brief COPE Scale into the Sri Lankan Context

E. Weeratunga^{1*}, C. Senadheera², M. Hettiarachchi³, U. Ekanayaka⁴ and B. Perera⁵

¹Department of Nursing, Faculty of Allied Health Sciences, University of Ruhuna, Matara, Sri Lanka

²Department of Psychiatry, Faculty of Medicine, University of Ruhuna, Galle, Sri Lanka

³Nuclear Medicine Unit, Faculty of Medicine, University of Ruhuna, Galle, Sri Lanka

⁴Teaching Hospital, Karapitiya, Galle, Sri Lanka

⁵Department of Community Medicine, Faculty of Medicine, University of Ruhuna, Galle, Sri Lanka

Abstract

Coping strategies play an integral part in patients with cancer. This refers to the specific efforts; both behavioural and psychological that minimizes the negative effects of stressful events. In Sri Lanka, validated scales to measure coping are scarce. This study examined the Sinhala version of the Brief COPE Scale for its psychometric properties. This scale is a self-administered 28 item scale; consists of both constructive (adaptive) and destructive (maladaptive) coping. Items are divided into following (14) subscales: active coping, self-blame, use of instrumental support, denial, positive reframing, religion, self-distraction, acceptance, behavioural disengagement, use of emotional support, substance use, humour, venting, and planning. Each subscale has two items. Cancer patients (n=40) were registered 'first come - first serve' basis using their appointment register at the Radiotherapy Unit, Teaching Hospital, Karapitiya. They were requested to complete a Sinhala version of three scales; the Brief COPE, the Centre for Epidemiological Studies – Depression (CES-D) and the World Health Organization-Quality of Life-Brief (WHOQOL-BREF), and demographic details. To test-retest reliability, the same subjects were asked to fill the same scales two weeks later. Results were regarded as statistically significant if $p < 0.05$. Ethical approval was granted. The mean (\pm SD) age was 61(\pm 12) years. The mean overall coping (\pm SD) was 63.50 (\pm 7.22). The Sinhala-Brief COPE was found to have a negative correlation with the CES-D (divergent validity) but was positively correlated with the WHOQOL-BREF (convergent validity). The internal consistency of the overall scale was good (Cronbach's alpha - 0.81). Adaptive and maladaptive coping showed a high Cronbach's alpha (0.793 and 0.788). The test-retest reliability was 0.66. The Sinhala version of the Brief COPE is a reliable and valid tool to assess coping strategies; this could be used to gain an understanding of both adaptive and maladaptive coping among patients with cancer in Sri Lanka.

Keywords: Coping, Brief COPE, Validity – Reliability, Cancer

*Corresponding Author: eranthiw@ahs.ruh.ac.lk



Development and Cross-validation of Anthropometric Predictive Equations to Estimate Total Body Fat Percentage in Adult Women in Sri Lanka

N. Rathnayake^{1*}, G. Alwis², J. Lenora³ and S. Lekamwasam⁴

¹Department of Nursing, Faculty of Allied Health Sciences, University of Ruhuna, Matara, Sri Lanka

²Department of Anatomy, Faculty of Medicine, University of Ruhuna, Galle, Sri Lanka

³Department of Physiology, Faculty of Medicine, University of Ruhuna, Galle, Sri Lanka

⁴Department of Medicine, Faculty of Medicine, University of Ruhuna, Galle, Sri Lanka

Abstract

Attempts have been made to estimate body fat using anthropometric indices and most of them are country-specific. This study was designed to develop and cross-validate anthropometric predictive equations to estimate the total body fat percentage (TBFP) of Sri Lankan adult women. A cross-sectional study was conducted in Galle, Sri Lanka with two groups; Group A (group for equation development) and B (validation group) (n=175 each) of randomly selected healthy adult women aged 30-60 years. TBFP (%) was quantified with total body DXA (TBFP_{DXA}). Height (m), weight (kg), skin-fold-thickness (SFT, mm) at six sites and circumferences (cm) at five sites were measured. In the 1st step, four anthropometric equations were developed based on the data obtained from multiple regression analyses (TBFP_{DXA}=dependent variable and AIs and age=independent variables) with Group A. They were developed based on circumferences (TBFP1), SFTs (TBFP2), circumferences and SFTs (TBFP3) and highly significant circumferences and SFTs; $r \geq 0.6$ (TBFP4). In the 2nd step, the newly developed equations were cross-validated using Group B. Three equations (TBFP1, TBFP2, and TBFP4) showed the agreement with cross-validation criteria. There were no differences between TBFP_{DXA} and TBFP estimated by these equations ($p > 0.05$). They showed higher measurement concordance with TBFP_{DXA}; correlation between measured TBFP with DXA and estimated with TBFP1, TBFP2 and TBFP4 respectively were 0.80 ($R^2=0.65$, $SEE=3.10$), 0.83 ($R^2=0.69$, $SEE=2.93$) and 0.84 ($R^2=0.72$, $SEE=2.78$). Three anthropometric predictive equations developed and cross-validated satisfactorily estimate the TBFP in adult women.

Keywords: Anthropometry, Body fat, Cross-validation, Predictive equations, Sri Lankan Women

*Corresponding Author: nirmala.priyanthi@gmail.com



Relationship between Pattern of Physical Activity and Bone Mineral Density, Bone Mineral Content in a Group of Postmenopausal Women in Sri Lanka

N. Rathnayake^{1*}, G. Alwis², J. Lenora³, S. Lekamwasam⁴

¹Department of Nursing, Faculty of Allied Health Sciences, University of Ruhuna, Galle, Sri Lanka

²Department of Anatomy, Faculty of Medicine, University of Ruhuna, Galle, Sri Lanka

³Department of Physiology, Faculty of Medicine, University of Ruhuna, Galle, Sri Lanka

⁴Department of Medicine, Faculty of Medicine, University of Ruhuna, Galle, Sri Lanka

Abstract

Physical activity (PA) has been proven to improve bone mineral density (BMD) and bone mineral content (BMC); however, local data in this context are scarce in relation to postmenopausal women (PMW). This cross-sectional study was aimed to evaluate the relationship between PA pattern and BMD, BMC in a group of PMW from Sri Lanka. A group of healthy community-dwelling PMW, aged 45-60 years (n=166) were studied. They were selected by a multi-stage random sampling method from Bope-Poddala Medical Officer of Health area, Galle, Sri Lanka. PA pattern was evaluated using the international PA questionnaire (IPAQ) short version, which evaluates walking, moderate and vigorous intensity PAs and total PA score (MET-min/week). Total spine (TS), total hip (TH) and femoral neck (FN) BMD (g/cm²) and BMC (g) were evaluated with total body DXA scans. The mean (SD) age of PMW was 55.8±3.8 years. Only the walking activity score correlated with BMDs at TS (r; 0.17, p=0.02), TH (r; 0.16, p=0.03) and FN (r; 0.19, p=0.01). Similarly, BMCs measured at TS (r; 0.18, p=0.01), TH (r; 0.15, p=0.04) and FN (r; 0.14, p=0.04) correlated with walking activity score. Other types of PA scores were correlated neither with BMD nor BMC (p>0.05). The correlations remain unchanged when the possible confounders; age, time since menopause, age at menopause, energy consumption and socio-demographic status were controlled with adjusted partial correlation. The significant correlation between walking and BMD, BMC was observed. It indicates that the habitual walking promotes healthy aging in PMW by maintaining skeletal integrity in their later lives compared to the other types of PAs.

Keywords: *Bone mineral content, Bone mineral density, Physical activity, Postmenopausal women relationship*

*Corresponding Author: nirmala.priyanthi@gmail.com



Nutritional and Psychosocial Factors Affecting Cognitive Function of Early Female Adolescent School Children in Galle Educational Zone: A Cross Sectional Study

**H.J.H. Madhushanthi^{1*}, S.W. Wimalasekera², C.S.E. Goonewardena³,
A.A.T.D. Amarasekara⁴ and J. Lenora⁵**

¹ Department of Nursing, Faculty of Allied Health Sciences, University of Ruhuna, Galle, Sri Lanka

² Department of Physiology, Faculty of Medical Sciences, University of Sri Jayewardenepura, Sri Lanka

³ Department of Community Medicine, Faculty of Medical Sciences, University of Sri Jayewardenepura, Sri Lanka

⁴ Department of Nursing & Midwifery, Faculty of Allied Health Sciences, University of Sri Jayewardenepura, Sri Lanka

⁵ Department of Physiology, Faculty of Medicine, University of Ruhuna, Galle, Sri Lanka

Abstract

The early adolescence period is characterized by significant physical, psychological, social and cognitive transformations. The present study aimed to determine the nutritional and psychosocial factors affecting the cognitive function of female adolescents in Galle educational zone. A school -based descriptive cross- sectional study was conducted on 218 female adolescents aged between 11 - 14 years. Psychosocial Adversity Scale and Adolescent Stress Questionnaire (ASQ) were administered to assess the psychosocial well-being of adolescents. The Body Mass Index, waist-hip ratio, waist height ratio, and fat percentage were calculated to assess the nutritional status. Cognitive function was assessed using the Wechsler Intelligence Scale for Children (WISC) IVth version. The normal nutritional state was observed in 118 (54.1%) while 65 (29.8%) and 35(16.1%) adolescents were underweight and overweight respectively. Most of the adolescents were [72.5% (n=158)] stressed and [27.5% (n=60)] were not stressed as determined by the ASQ. The scores Verbal Comprehension Index (VCI), Processing Speed Index (PSI), Working Memory Index (WMI) and Estimated Full-Scale IQ (EFSIQ) of WISC are significantly lower in underweight, overweight groups when compared to the normal nutritional group. The mean VCI, PRI, and WMI of stressed group adolescents were significantly low compared to non-stressed group adolescents ($p<0.05$). The findings further confirmed that adverse psychosocial state and impaired nutritional state are associated with poor cognitive test performance.

Keywords: *Nutritional and Psychosocial factors, cognitive function, early female adolescents, Galle educational zone.*

***Corresponding Author:** madhushani122@email.com



Association between Physical Activity and Executive Functions of Institutionalized Physically Independent Elderly People of Southern Province in Sri Lanka

M.W.K. Gamage^{1*}, D.C. Hewage² and K.D. Pathirana³

¹ Department of Nursing, Faculty of Allied Health Sciences, University of Ruhuna

² Department of Physiology, Faculty of Medical Sciences, University of Sri Jayewardenepura

³ Department of Medicine, Faculty of Medicine, University of Ruhuna

Abstract

Sri Lanka witnessed a growth in the elderly population with an increase in the number of elders moving to elderly care institutions (ECIs). Executive functions (EFs) are vital for the independent living of the elderly. According to literature, though physical activity (PA) plays an important role in preserving EFs, studies assessing this association among the elderly under the institutional care are lacking. The present study aimed to assess the association between PA and EFs of institutionalized elderly in Southern Province. A descriptive, cross-sectional study was carried out involving 297 elderly people, recruited using probability proportional sampling method in Galle and Matara Districts. EFs were assessed using computerized tasks. Under EFs, working memory (WM) was assessed using verbal working memory (VWM) task and visuospatial working memory (VSWM) task and ability to inhibit interferences were assessed using colour word Stroop (CWS) task. International PA questionnaire-Elderly (IPAQ-E) was utilized to assess the PA level which is a validated questionnaire to Sri Lanka. Correlations were assessed using Spearman correlation. Regression analysis was performed to assess associations. The significant level was kept at $p < 0.05$. Out of 297 subjects, 65% were females with a mean (SD) age of 71.3 ± 6.4 years. Mean (SD) number of years of education was 8.2 ± 3.8 years. The mean (SD) total PA score was 1757.8 ± 828.8 MET-minutes/week. The mean VSWM and VWM task scores were 11.8 ± 5.5 and 4.0 ± 1.8 respectively. Incorrect naming of colour in incongruent words in the CWS task was 8.9 ± 3.9 . PA correlated with VWM ($r = 0.32$), VSWM ($r = 0.25$) and ability to inhibit interferences ($r = -0.25$) ($p < 0.05$). PA score significantly predicted the VWM ($F_{(1,295)} = 37.71$, $p < 0.001$, $R^2 = 0.113$), VSWM ($F_{(1,295)} = 26.86$, $p < 0.001$, $R^2 = 0.083$) and the ability to inhibit interferences ($F_{(1,295)} = 21.97$, $p < 0.001$, $R^2 = 0.069$). PA predicted VWM, VSWM, ability to inhibit interferences when controlled for covariates as age and education. There is a significant association between PA and EFs of elderly people living in ECIs which need to consider when planning out health care delivery to institutionalized elders in Sri Lanka.

Keywords: *Executive functions, Physical activity, Elderly, Elderly care institutions*

***Corresponding Author:** mkgamage@yahoo.com



Local Stability Properties of a Delayed HIV– I Dynamics Model with Beddington-DeAngelis Functional Response

B.G.S.A. Pradeep^{1*}, N.S. Rathnayaka² and M.P.A. Wijayasiri¹

¹Department of Mathematics, Faculty of Science, University of Ruhuna, Matara, Sri Lanka

²Department of Mathematics, General Sir John Kothelawala Defence University, Sri Lanka

Abstract

In the recent years, many researchers have been paying their attention on mathematical modelling in biology and it is essential for drug producers to make highly effective drugs for patients in order to get relief because of the time delay involved in controlling infections such as HIV. Therefore, this study investigates the local asymptotic stability properties of a class of two delays differential equation for HIV-I infection, including a Beddington – DeAngelis type functional response and absorption effect. Compared with typical HIV-I mathematical models, in the proposed model we have included four significant and unique features. Since the facts regarding delayed processes are biologically significant, to provide a more elaborated and particularized infection process, two time delays, namely intracellular time delay and maturation time delay are incorporated in this dynamics model. Moreover, the nonlinear functional response and the absorption effect have also been consisted to this dynamics model to make the processes biologically sensible. The characteristic equations of the model are constructed in the presence and the absence of the time delays. The equations are analysed separately and the local stability behaviours of the infection free equilibrium and the chronic infection equilibrium are established. When the delays are absent the mathematical analysis by means of Ruth Hurwitz stability criterion shows that the basic reproduction number of the model is solely responsible for its stability properties. Furthermore, the relationships between the Reproductions Number and the time delays are analysed for future reference for drug production practices. Additionally, with the intention of validating the theoretical results, the numerical simulations are also demonstrated.

Keywords: *Characteristic equations, Mathematical model, Reproduction number, Stability, Time delay.*

***Corresponding Author:** sampath@maths.ruh.ac.lk

Science, Fisheries and Aquatic Sciences



Heterogeneous Fenton Catalyst for the Treatment of Textile Wastewater

D.S.M. Kumari and S. Wanniarachchi*

Department of Chemistry, Faculty of Science, University of Ruhuna, Matara, Sri Lanka

Abstract

Treatment of textile wastewater containing reactive dyes is highly important as dyes and their breakdown products are highly toxic. Reactive Black 5 is one of the most widely used Azo dyes that causes severe impact on environment and aquatic life. Fenton oxidation is widely used to treat textile effluents. Formation of iron containing sludge and the requirement of excessive amount of Fe(II) salt are the major disadvantages of homogeneous Fenton process. Therefore alternative treatment method is necessary. In this study, decolourization of synthetic textile wastewater containing Reactive Black 5 (RB5) dye was investigated in laboratory scale using Fe impregnated ball clay as a heterogeneous catalyst. Fe-ball clay (Fe-BC) catalyst was prepared by stirring $(\text{NH}_4)_2\text{Fe}(\text{SO}_4)_2 \cdot 6\text{H}_2\text{O}$ solution with ball clay and successfully used to decolourize the wastewater. The catalyst was characterized by XRD, FTIR and SEM measurements. An iron loading of 0.72 wt per cent on ball clay (BC) was achieved in the catalytic preparation. Optimum Fenton reaction conditions for the decolourization of 100 mL of 100 ppm RB5 dye solution was determined as 0.5 g of the catalyst with an initial pH of 3.0, $[\text{H}_2\text{O}_2]$ of 6.4 mM, at 600 rpm stirring rate at temperature 30°C . Under these conditions, 98.2% decolourization efficiency of RB5 dye was achieved within 60 minutes reaction time. Re-usage studies showed an effective decolourization efficiency up to five repeated cycles with more than 90 per cent colour reduction. Results of the current study indicate the suitability of Fe-ball clay catalytic system as a heterogeneous Fenton catalyst for the decolourization of RB5 dye in an aqueous solution.

Keywords: *Ball clay, Fenton reaction, Heterogeneous catalyst, Reactive Black 5*

***Corresponding Author:** sarathwan@chem.ruh.ac.lk



An Analysis of Temperature Distribution along the Receiver Tube of a Parabolic Trough Reflector and Non-concentrated Solar Radiation

E.M. Ranatunga^{1*}, N.K. Hettiarachchi² and M.K. Abeyratne³

¹Department of Physics, Faculty of Science, University of Ruhuna, Matara, Sri Lanka

²Department of Mechanical and Manufacturing Engineering, Faculty of Engineering, University of Ruhuna, Hapugala, Sri Lanka

³Department of Mathematics, Faculty of Science, University of Ruhuna, Matara, Sri Lanka

Abstract

Parabolic trough is an optical system that concentrates solar energy for conversion into usable energy. The characteristics of the receiver tube used in Parabolic Trough Reflectors (PTR) are crucial factors in the efficiency of solar concentrating systems. Although researchers have developed mathematical models for the temperature distribution along the receiver tubes used in the PTR for specific cases, experimental verifications are relatively rare in the literature. In this study, the temperature distribution along the receiver tube was measured by fixing six DS18B20 digital temperature sensors inside the tube. The test was conducted for the receiver of a PTR and for Non-concentrated Solar Radiation. A 1.4 m long evacuated receiver tube used in domestic solar hot water systems was used in this study. The experimental results show that the temperatures of both the temperature sensors placed at the open end and the closed end of the receiver tube increased following different paths and then approached to the boiling temperature at different time levels. However, after reaching that equilibrium state, the values of the temperature sensor placed at the closed end of the receiver tube showed an unusual behaviour, which needs further studies with a systematic analysis covering the nature of two phase flows. Moreover, the temperature distribution along the receiver tube highly depends on environmental factors, especially on cloud conditions. The structural breaks of the temperature distribution curve can be explained by the variation in the solar insolation data in the simultaneous time interval. The shapes of the temperature distribution curves are quite similar in both concentrated and non-concentrated cases when the sun is not covered with thick clouds, except for longer time taken (~8 times by concentrated case) to reach the equilibrium condition in the non-concentrated case.

Keywords: *Concentrated solar power, Evacuated tube, Parabolic trough, Solar radiation*

***Corresponding Author:** ranatung@phy.ruh.ac.lk



Removal of Fluoride from Drinking Water Using Heat Treated pellets of Eggshell Powder and Clay Mixture

W.P.I.S. Wikramanayaka, R.A. Maithreepala*, and A. D. Jayasinghe

Department of Limnology and Water Technology, Faculty of Fisheries and Marine Sciences & Technology, University of Ruhuna, Matara, Sri Lanka

Abstract

CaCO₃ containing minerals and animal bones have been reported as low cost absorption material to remove Fluoride in water but it might cause hygienic problems. Also, because of religious and ethical issues, animal bones cannot be used as fluoride absorbers in Sri Lanka. This study investigated the potential removal of Fluoride from water by using heat treated clay mixed eggshell powder in the form of pellets in packed column. The study revealed that the fluoride removal efficiency depends on the ratio of clay to eggshell powder in pellets, temperature used for heat-treatment of powder pellets, adsorbent dose, initial pH of water, contact time, and initial concentration of fluoride in water. The removal efficiencies were 84.06 % at pH 6.5 ± 0.1, during 72 hours contact, with adsorbent dose of 70 gL⁻¹ at the initial concentration of 2 mgL⁻¹ of fluoride. The first reported research work showed only 6 % of removal of fluoride by un-heated eggshell alone as an absorber and therefore this study shows more than 10 times increase in efficiency. During the process, the pH of the water increased. The optimize temperature for treatment of pellets was 500 °C. The increase of number of eggshells in pellets increased the F⁻ removal efficiency. The effect of initial pH value of the water on F⁻ removal efficiency was studied and both high and low pH values decreased the de-fluorination efficiencies and the highest efficiency was reported at 6.5 pH. Fluoride removal efficiency was also increased with extending contact time and was decreased when adsorbent material was re-used. Low efficiencies of F⁻ removal at high initial F⁻ concentration and at low adsorbent dose could be observed. The decrease the flow rate and use of small sized pellet make higher efficiency of fluoride removal from drinking water. Considering all the findings it can be concluded that fluoride absorption on clay-eggshell powder pellets could be an effective method for the removal of fluoride from drinking water.

Keywords: Fluoride, Absorption, Eggshell, Clay.

*Corresponding Author: maithree@fish.ruh.ac.lk



Anomalous Propagation of the Sri Lanka Dome during 2014: Forcing Mechanisms

G. Pathirana^{1*}, G. Chen², M.K. Abeyratne³, D. Wang², T. Priyadarshana⁴

¹ Department of Oceanography and Marine Geology, Faculty of Fisheries and Marine Sciences & Technology, University of Ruhuna, Matara, Sri Lanka

² State Key Laboratory of Tropical Oceanography, South China Sea Institute of Oceanology, China

³ Department of Mathematics, Faculty of Science, University of Ruhuna, Matara, Sri Lanka

⁴ Department of Limnology and Water Technology, Faculty of Fisheries and Marine Sciences & Technology, University of Ruhuna, Matara, Sri Lanka

Abstract

During Southwest monsoon, a cold dome referred to as the Sri Lanka Dome (SLD) appears east of Sri Lanka in response to the cyclonic curl in the local wind field. In general, the SLD forms around May/June and decays during September. However, satellite altimetry data revealed an anomalous propagation pattern of the SLD with a lifetime of more than six months in the Southwestern region of the Bay of Bengal (BoB) during 2014. This study was carried out to explain the plausible forcing factors which produced this anomalous event using satellite altimetry, surface currents and wind data. Previous studies have shown that in general, the SLD propagates westward and then northward from its initial center. In 2014, the SLD was first appeared in the East of Sri Lanka around 6.5-7.5° N, 83-84° E and propagated eastward/ northeastward from its initial center (7.1018° N, 83.7111° E) with the forcing from wind-stress and Summer Monsoon Current (SMC). During early August it started to propagate westward until mid-October with the support of westward geostrophic flow and upwelling Rossby waves, noted between 10-12°N latitudes in the BoB. Then the Western Boundary Currents (WBC) in the BoB further facilitated the trajectory of the SLD and guided it towards the Arabian Sea (AS), which disappeared, from the South of India (4.5474° N, 78.0223°E) late December 2014. Thus, we show that the stronger winds and SMC existed during 2014 in the BoB, had guided the SLD eastward/northeastward compared to its general trajectory, and that allowed the SLD to undergo the forcing from westward geostrophic flow, upwelling Rossby waves and WBC.

Keywords: *Sri Lanka Dome, Wind-stress, Summer monsoon current, Rossby waves, Western boundary currents.*

***Corresponding Author:** upgpathirana@gmail.com



Effects of Particle Size of Feather Meal on Growth Performance and Feed Utilization of Nile tilapia (*Oreochromis niloticus*)

S.S. Herath^{1*} and A. Yakupitiyage²

¹ Department of Fisheries and Aquaculture, Faculty of Fisheries and Marine Sciences & Technology, University of Ruhuna, Matara, Sri Lanka

² Asian Institute of Technology, Bangkok, Thailand

Abstract

This study was conducted to evaluate the effects of particle size of enzyme treated feather meal (EFM) on growth and feed utilization performance of Nile tilapia (*Oreochromis niloticus*). EFM of three particle sizes (un-sieved, particle sizes of $>850\mu$ and $> 425\mu$) were used for this study. Four isoproteic diets containing 32 % crude protein were formulated. The control diet had 10 % of fishmeal and the three test diets contained 10 % of one of the three particle size groups of EFM coded EFM (un-sieved), EFM850 and EFM425. Twelve (12) concrete circular tanks (200 L) connected to a water recirculating system were used for this study, and each diet with three replicates was randomly allocated into a complete randomized design. Initial mean weight of fish was 6.0 ± 0.1 g and stocking density was 20 fingerlings/ tank. The study lasted eight weeks and fish were fed twice a day to near satiety. Planned contrasts in SPSS were used to compare the growth and feed utilization performance of fish fed fishmeal-based control diet with three EFM based diets. Comparison of the control treatment with each test treatment showed particle size reduction had significant effects on growth performances and nutrient utilization efficiency. Fish fed diets containing EFM425 had higher final mean weight (65.23 ± 2.50 g) than the control diet (49.83 ± 6.44 g) and all the other growth parameters also showed the similar trend. Significantly lower Feed Conversion Ratio (1.20 ± 0.00) and higher protein efficiency ratio (2.55 ± 0.03) was also observed in fish fed EFM425 than that of control (1.37 ± 0.06 and 2.27 ± 0.11 respectively). Reduction in particle size of EFM had no effect on survival rates of fish. However, further improvement of digestibility of EFM is required to use as a complete replacement for fishmeal.

Keywords: Feather meal, Feed utilization efficiency, Growth performance, Nile tilapia particle size

*Corresponding Author: sakunthala@fish.ruh.ac.lk



Heat Shock Stress Induced Oxidative Damage in Submerged Macrophytes

C. Chalanika¹, T. Asaeda¹ and K. Sanjaya^{2*}

¹Department of Environmental Science, Saitama University, Sakura-ku, Saitama, Japan

²Department of Limnology and Water Technology, Faculty of Fisheries and Marine Sciences & Technology, University of Ruhuna, Matara, Sri Lanka

Abstract

Plants respond to temperature oscillations utilizing different strategies. However, the species-specific oxidative damage induced by temperature fluctuations is largely unknown for submerged macrophytes. Therefore, this study aimed to fill the above information gap. Shoot elongation rate (SER), photosynthetic pigments, reactive oxygen species (ROSs), and total protein (TP) were studied in *Elodea nuttallii*, *Potamogeton crispus* and *Vallisneria asiatica*. Plants (~5cm) were rooted in PVC pots comprising river sand, and were incubated for one week. Then plants were shifted to microcosms with specific temperatures; 25°C (Control), 30°C and 35°C. The plant responses were statistically compared using One-way ANOVA. SER was decreased in *E. nuttallii* with increasing temperature but the decline was insignificant. However, a significant reduction in SER was observed for *P. crispus* (F=15.952, $p < 0.05$) and *V. asiatica* (F=33.870, $p < 0.05$) at 35 °C compared to control. There was a significant increase (F=15.756, $p < 0.05$) of chl-a of *E. nuttallii* under 30°C, while it was significantly decreased (F=40.719, $p < 0.05$) under 35°C. The chl-a concentration of *P. crispus* and *V. asiatica* significantly reduced from the control (25°C) towards high temperature (F=432.968, $p < 0.05$ and F=22.588, $p < 0.05$ for *P. crispus* and *V. asiatica*, respectively). The chl-b showed a significant decline, whereas the total carotenoids increased from 25 to 35 °C for all species. H₂O₂ was significantly increased in all three species (*E. nuttallii*, F=193.79, $p < 0.05$; *P. crispus*, F=55.96, $p < 0.05$; and *V. asiatica*, F=285.59, $p < 0.05$). TP was significantly increased in *E. nuttallii* from 30 °C to 35 °C, while it was reduced in both *P. crispus* and *V. asiatica*. Our results denoted that, *E. nuttallii* showed thermotolerance by increasing the growth rate and Chl-a at moderate temperature while this species has capability to evade the damage to cellular proteins at high temperature. By contrast, *P. crispus* and *V. asiatica* were greatly vulnerable to both the heat-stress-induced oxidative stress and the denaturation of cellular proteins within the studied temperatures.

Keywords: Heat stress, Oxidative damage, Hydrogen peroxide, Total protein, Heat shock proteins

*Corresponding Author: hlksanjaya@yahoo.com



Biochemical Responses of Aquatic Macrophytes against Mechanical Stress of Water Turbulence

K.S.S. Atapaththu^{1*} and T. Asaeda^{2&3}

¹ Department of Limnology and Water Technology, Faculty of Fisheries and Marine Sciences & Technology, University of Ruhuna, Matara, Sri Lanka

² Hydro Technology Institute, Shiroyama Trust Tower, 4-3-1 Toranomom, Minato, Tokyo, Japan

³ Department of Environmental Science, Saitama University, Sakura Saitama, Japan

Abstract

Aquatic plants face an array of stresses within the environment, while the water movements play a significant role in this regard. Although, velocity of flow and water level fluctuations has been extensively studied, turbulence driven impacts are yet to be explored. Thus, this study evaluated the turbulence induced stress response of aquatic macrophytes in a small shallow stream, Moto Arakawa, a tributary of the Arakawa River, Japan. Velocity fluctuations in macrophyte patches were measured in six sites (L1-L6) using a two dimensional electromagnetic current meter. After measuring flow velocity, plant samples were collected for biochemical analysis. Fresh plant shoots were extracted either by using an ice cold phosphate buffer that contained polyvinylpyrrolidone or distilled water. Biochemical assay was performed using the antioxidant activity of Catalase (CAT), Ascorbic Peroxidase (APX), concentrations of H₂O₂ and Indole Acetic Acid (IAA) following the standard methods. In terms of turbulence velocity, these sites were significantly different from each other ($p < 0.05$). Except L1, water turbulence was comparatively higher in outside of the plant patches than that of inside. Four macrophyte species were found in study sites, *Myriophyllum spicatum*, *Elodea nuttallii*, *Sparganium erectum* and *Vallisneria spiralis*. Antioxidant productions were significantly higher in plants exposed to high turbulence and the responses of plants against turbulence were species specific. For example, *E. nuttallii* showed comparatively high concentration of H₂O₂ compared to other species, within the same site. Further, CAT activity of *E. nuttallii* was also higher than that of *M. spicatum*. The most common species; *M. spicatum* exhibited significant correlations with the turbulence and antioxidant enzymes APX ($r^2 = 0.76$, $p < 0.05$). Similarly, the linear relationship between H₂O₂ production was positively correlated to the turbulence ($r^2 = 0.70$ $p < 0.05$) while it was negative for IAA production ($r^2 = -0.73$, $p < 0.05$). Present study revealed that, water turbulence causes a significant impact on aquatic plants as an abiotic stress factor.

Keywords: Water movements, Mechanical stress, Antioxidant enzymes, H₂O₂

*Corresponding Author: keerthi@fish.ruh.ac.lk



List of Reviewers 17th Academic Sessions

Snr. Prof. Lasantha Manawadu, University of Colombo
Snr. Prof. Sanath Hettiarachchi, Rajarata University of Sri Lanka
Snr. Prof. Ranjith Dissanayake, University of Peradeniya
Rev. Prof. Miriswatte Wimalagnana, Postgraduate Institute of Pali and
Buddhist Studies
Prof. A. de S. Nagahawatte, University of Ruhuna
Prof. A.D.L.C. Perera, University of Peradeniya
Prof. Abhaya Balasooriya, Rajarata University of Sri Lanka
Prof. Achini De Silva, Sabaragamuwa University of Sri Lanka
Prof. Dunesh Gunathilaka, University of Sri Jayewardenepura
Prof. H.M.S.P. Madawala, University of Peradeniya
Prof. J. Lenora, University of Ruhuna
Prof. K. Disanayake, University of Colombo
Prof. K.G. Somasiri, University of Ruhuna
Prof. K.M.G. Gehan Jayasuriya, University of Peradeniya
Prof. L. Vidanaarachchi, Sabaragamuwa University of Sri Lanka
Prof. Liyanage Amarakeerthi, University of Peradeniya
Prof. M. Esham, Sabaragamuwa University of Sri Lanka
Prof. M.B. Ranthilake, University of Peradeniya
Prof. M.P.K.S.K. de Silva, University of Ruhuna
Prof. Nirosch Jayaweera, University of Moratuwa
Prof. P. I. N. Fernando, Uwa Wellassa University of Sri Lanka
Prof. P.P.A.W. Athukorala, University of Peradeniya
Prof. Pubudu Samarasekara, University of Peradeniya
Prof. R.M.K. Ratnayake, University of Sri Jayewardenepura
Prof. Ranjana U.K. Piyadasa, University of Colombo
Prof. S. Gunawardhana, University of Ruhuna
Prof. Sandagomi Coparahewa, University of Colombo
Prof. Sunethra Thennakoon, University of Sri Jayewardenepura
Prof. Susima Weligamage, University of Kelaniya
Prof. T.C. Yahathugoda, University of Ruhuna
Prof. Tharaka Disanayake, University of Peradeniya
Prof. Tilak Hewawasam, University of Peradeniya
Prof. Yasanjalee Jayathilake, University of Sri Jayewardenepura
Dr. A.G. Amarasingha, University of Kelaniya
Dr. A.G.T. Sugathapala, University of Moratuwa



Dr. A.L.A.K. Ranaweera, University of Moratuwa
Dr. A.S.T. Rajapakse, University of Peradeniya
Dr. Adeesha Wijayasiri, University of Moratuwa
Dr. Arunoda Basnayake, University of Ruhuna
Dr. Athambawa Sarjoon, University of Peradeniya
Dr. Athula Samarakoon, Open University of Sri Lanka
Dr. B. Nishantha, University of Colombo
Dr. B.W.R. Damayanthi, University of Sri Jayewardenepura
Dr. Bihesh Indika Sampath, University of Kelaniya
Dr. Buddhika P. Jayasekara, University of Moratuwa
Dr. C. Egodawatta, Rajarata University of Sri Lanka
Dr. C.S. Lewangamage, University of Moratuwa
Dr. C.S.A. Siriwardana, University of Moratuwa
Dr. C.T. Wannige, University of Ruhuna
Dr. Chamaru De Alwis, University of Kelaniya
Dr. Chaminda S. Bandara, University of Peradeniya
Dr. Chandana Hewage, University of Sri Jayewardenepura
Dr. Chandima D. Pathirana, University of Moratuwa
Dr. Chathura Ranasinghe, University of Moratuwa
Dr. Chatura Seneviratne, University of Ruhuna
Dr. D.H.S. Maithripala, University of Peradeniya
Dr. D.T. Udagedara, Uva Wellassa University of Sri Lanka
Dr. Damith Chathuranga, University of Moratuwa
Dr. Dhanuja Mahesh Base Hospital, Tangalle
Dr. Dinuka Wijethunga, University of Colombo
Dr. Dunusinghe G. Dharmarathna, Sabaragamuwa University of Sri Lanka
Dr. E.I. Waidyarathne, University of Ruhuna
Dr. G.A.S.I. Abeygunawardena, University of Kelaniya
Dr. Ganila Nuwan Paranawithana, Open University of Sri Lanka
Dr. H.G.H. Damruwan, University of Moratuwa
Dr. H.G.J.C. Pushpakumari, University of Moratuwa
Dr. H.M. Mahinda Herath, University of Peradeniya
Dr. Harun Or Rashid, Bangladesh Agricultural University
Dr. Iromi Ariyaratne, Postgraduate Institute of Pali and Buddhist Studies
Dr. J. Rajapaksha, Ocean of University Sri Lanka
Dr. J. Siyambalapitiya, Uva Wellassa University of Sri Lanka
Dr. J.M.R.S. Appuhamy, University of Ruhuna
Dr. Janaka Perera, Sri Lanka Institute of Information Technology
Dr. Janaka Rajaguru, University of Peradeniya



Dr. Jinendrika Weliwita, University of Peradeniya,
Dr. Jump Noratat, Institute of Technology Ladkrabang
Dr. K. Baskaran, University of Moratuwa
Dr. K. Kajendra, University of Colombo
Dr. K. M. I. U. Ranaweera, University of Ruhuna
Dr. K. Masakorala, University of Ruhuna
Dr. K.A. Nisantha, University of Ruhuna.
Dr. K.I.C. Amarasinghe, Open University of Sri Lanka
Dr. K.K.L.B. Adikaram, University of Ruhuna
Dr. K.K.S. Atapaththu, University of Ruhuna
Dr. K.P.L. Nishantha, Sabaragamuwa University of Sri Lanka
Dr. Kanchuka Dharmasiri, University of Peradeniya
Dr. Kapila Dissanayake, Sabaragamuwa University of Sri Lanka
Dr. Kokila Gunasekara, Open University of Sri Lanka
Dr. Kumudika Boyagoda, University of Colombo
Dr. L. L. Ekanayake, University of Moratuwa
Dr. L. Prabodha, University of Ruhuna
Dr. Lahiru Silva, Southern Alberta Institute of Technology, Canada
Dr. Lalith Ananda, University of Sri Jayewardenepura
Dr. M. Mahees, University of Colombo
Dr. M.K.D.L. Meegoda, University of Sri Jayewardenepura
Dr. Mim Hilal, South Eastern University of Sri Lanka
Dr. N.M.Wagarachchi, University of Ruhuna
Dr. P.L.Nugapitiya, University of Peradeniya
Dr. Pradeep Peiris, University of Colombo
Dr. Pradeepika Saputhanthri, University of Colombo
Dr. Prasad Serasinghe, University of Colombo
Dr. R. Ramesh, University of Peradeniya
Dr. R.A. Sudath Weerasiri, University of Kelaniya
Dr. R.P. Wanigatunga, University of Kelaniya
Dr. R.P.S. Chandrasena, University of Ruhuna
Dr. Rangajeewa Rathnayake, University of Moratuwa
Dr. Ratnasiri Ratnayaka, Postgraduate Institute of Pali and Buddhist Studies
Dr. Ruwan pradeepika, Sabaragamuwa University of Sri Lanka
Dr. S. Jeevasuthan, University of Jaffna
Dr. S.L.J. Fernando, University of Ruhuna
Dr. S.S. Herath, University of Ruhuna
Dr. Sanjeeva Wickramaratne, Lanka Hydraulic Institute
Dr. Sarath Amarasinghe, University of Ruhuna



Dr. Sudesh Manthilake, University of Peradeniya
Dr. Sugandima Vidanagamachchi, University of Ruhuna
Dr. Sujeewa Hettiarachchi, University of Sri Jayewardenepura
Dr. Sunanda Premasiri, University of Peradeniya
Dr. T. M. W. J. Bandara, University of Peradeniya,
Dr. T.W.K. Osantha Nayanapriya, University of Kelaniya
Dr. Tissa Ravindra Perera, University of Colombo.
Dr. Udeni P. Nawagamuwa, University of Moratuwa
Dr. Vidura Vithana, University of Ruhuna
Dr. W. M. C. B. Wanninayake, University of Kelaniya
Dr. W. S. S. Gunathilake, University of Peradeniya,
Dr. W.A. Indika, University of Ruhuna
Dr. W.P.D. Fernando, University of Peradeniya
Dr. Wimal Hewamanage, University of Colombo
Rev. Dr. Homagama Dhammananda, Buddhist and Pali University of Sri
Lanka
Rev. Dr. Wadinagala Pannaloka, Postgraduate Institute of Pali and Buddhist
Studies
Mr. A.L. Kulasekera, University of Moratuwa
Mr. G.A. Gamini, University of Sri Jayewardenepura
Mr. Krishantha Fredricks, University of Colombo
Mr. M.A. Siriwardhana University of Sri Jayewardenepura
Mr. Nuwan Liyanage, Uva Wellassa University of Sri Lanka
Mr. Priyantha Jinadasa, Ocean of University Sri Lanka
Mr. R.K.P.S. Ranaweera, University of Moratuwa
Ms. M. A. L. Kalyani, University of Ruhuna
Ms. M. Samaraweera, Uva Wellassa University of Sri Lanka



Author Index**A**

Abeyratne, MK	70, 72
Alwis, G	64, 65
Amarasekara, AATD	66
Amarasinghe, ATIM	59, 60
Amarasinghe, SR	10
Aravinda, UKB	40
Asaeda, T	74, 75
Atapaththu, KSS	75
Atapattu, D	17
Atapattu, NSBM	5
Attanayake, AP	62

B

Baduge, S	49, 50, 53
Bagya, MGS	34
Bandara, WAAM	12
Batuwatta, S	28

C

Chalanika, C	74
Chen, G	72
Cooray, PLIM	3

D

Dahanayake, N	13
Dahanayake, TTD	11
Damayanthi, MPGC	1
Darshana, ILAN	27
Dasanayaka, DLW	58
Dasanayaka, K	42, 46
Dayalatha, WKV	20
De Silva, DS	47
De Silva, GSY	44, 45, 54
De Silva, WN	12
De Zoysa, HLS	15

Dehigaspitiya, P	8
Dissanayake, NP	3
Douglas, T	3

E

Ekanayaka, U	63
--------------	----

F

Fernando, KMC	6
Fernando, PWS	23
Fukai, S	11

G

Galappaththi, UIK	49
Gamage, D	8
Gamage, MWK	67
Gamage, N	45
Geekiyanage, S	11
Goonawardena, CSE	66
Gunasekara, S	15
Gunasinghe, UDPM	44
Gunatunga, NGRK	54
Gunawardana, TSLW	40

H

Hansani, KGP	50, 53
Hansika, KAS	4
Hemakumara, GPTS	16
Herath, HMNN	34
Herath, SS	73
Hettiarachchi, M	63
Hettiarachchi, NK	70
Hewage, DC	67
Hewage, P	16, 24
Hirimuthugoda, NY	9
Hirotsu, N	8



I		M	
Induruwa, IVTP	52	Madhushani, JAT	24
		Madhushanthi, HJH	66
J		Madushani, JKA	37
Jayasena, HAH	14	Maduwanthi, MN	35
Jayasinghe, AD	71	Maithreepala, RA	71
Jayasinghe, DBC	16	Malkanathi, SN	41
Jayasinghe, L	61	Mallika, MCKH	34
Jayasinghe, R	52	Manawadu, NHDS	51
Jayatilake, L	62		
Jayatissa, LP	3, 4	N	
Jeewantha, GKC	37	Napagoda, N	61
Jeewanthi, HAC	37	Navarathna, NMSD	13
Jeewanthi, WPM	23	Nissanka, ID	51
Jodhi, AK	58		
		P	
K		Pathirana, G	72
Karunasena, HCP	50, 51, 53	Pathirana, KD	67
Karunawardena, A	45	Peiris, P	52
Kaushalya, NKN	2	Perera, AADAJ	41
Keembiyahetti, N	22, 25	Perera, B	63
Kodikara, I	57	Perera, PWA	9
Kodikara, KAS	3, 4	Pradeep, BGSA	68
Kodituwakku, AKCI	50, 53	Prathibha, JKPN	7
Kumara, KJC	52	Premarathne, U	14
Kumara, MP	3	Priyadarshana, T	72
Kumari, DSM	69	Priyanka, AAR	32
Kuranawardena, A	54	Priyanka, JGV	52
		Priyatharshani, K	5
L		Punchihewa, PSD	35
Lakamwasam, S	59, 60, 64, 65		
Lakmali, KH	21	R	
Laksiri, PHPN	55	Rajapakse, W	9
Leelamanie, DAL	7	Ranatunga, EM	70
Lenora, J	64, 65, 66	Ranaweera, GKMMK	13
Liyanaarachchi, CE	61	Ranjan, MTT	49
Liyanaage, G	57	Rathnayaka, NS	68



Rathnayake, N	64, 65	Sumanarathne, BM	17
Rathnayake, RMDD	38	Sumanthillake, M	59, 60
Ratnavel, S	9	Sumith, B	48
Ratnayake, NP	14	Sutherland, M	8
Rohan, EP	48		
Roomadu, KUGA	58	T	
Ruben, R	27	Tennekoon, TMMB	43
		Thompson, M	8
S			
Samarakoon, A	19	W	
Samarasinghe, KN	22	Wang, E	72
Samaraweera, GC	10	Wanniarachchi, S	69
Samarawickrama, UI	7	Wasana, KGP	62
Sandamali, HMK	12	Weerarathna, TP	57, 59, 60, 62
Sanjaya, K	74	Weeratunga, E	63
Sarath, HK	17, 25	Wibowo, C	6
Satharasinghe, SAAK	28	Wickramasinghe, RDK	24
Saumya, GKR	58	Wickramanayaka, WPIS	71
Senadheera, C	63	Wickramatilake, CN	57
Senanayake, G	4	Wijayasiri, MPA	68
Senaratna, D	5	Wijeratne, S	1, 2
Seneweera, S	8	Wijesekara, WAMS	52
Silva, LNS	13	Wijesinghe, CJ	27
Sirisena, AB	39	Wijesinghe, KGG	4
Sooriyaarachch, HP	42, 43, 46	Wijeweera, AA	4
Sparkes, DL	6	Wimalasekara, SW	66
Srimal, LKT	48	Witharana, S	61
Sripal, DDN	3	Yakupitiyage, A	73
Sriyani, GTW	35, 36	Yapa, YMSM	13
Sugunasiri, G. Ven	26	Yapage, N	56
අතපත්තු, ඩී.	18	සිරිසුධම්ම හිමි, අපරාක්කේ	30
අරියවංස හිමි, මොරකන්දේගොඩ	29, 33	සුමනරත්න, බී.එම්.	18
තිලකරත්න, ඩබ්ලිව්. ඕ.	29		
ධම්මධීරා මෙහෙණිය, ඩී. උපේක්ෂා	31		
සරත්, එච්.කේ.	18		