Conference Proceedings

International Conference on Social and Cultural Nexus of Science and Technology Development (SCST)

Colombo, Sri Lanka

October 3-4, 2019

NATIONAL SCIENCE FOUNDATION

International Conference on Social and Cultural Nexus of Science and Technology Development (SCST) Colombo, Sri Lanka

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Message from the Chairman

National Science Foundation, Sri Lanka

Dr A. M. Mubarak

The ultimate driving force of research is the search for new knowledge. Research is essential for long-term competitiveness, economic growth and sustainable development of nations. The Fourth Industrial Revolution (4IR) fusing the physical, digital and biological worlds, is certain to alter the way the human race lives, works, and relates to one another. A number of technological fields will see major advances over the next few years that will affect all disciplines, economies and industries. These fields include, among others, robotics, artificial intelligence, automation, nanotechnology, quantum computing, biotechnology, the Internet of Things, 3D printing, autonomous vehicles and Big Data Analytics.

On the other hand, the social and cultural nexus of science and technology development is a neglected area in policy discussions. However, there is ample evidence to prove that many social and cultural factors either facilitate or slow down the S&T development process. Hence, identification and analysis of such factors is becoming increasingly important to shape the development process and to minimize adverse impacts on health, environment and humans.

The two-day International Conference on 'Social and Cultural Nexus of Science and Technology Development' organized by the NSF is therefore, timely and gives an opportunity to a corpus of multidisciplinary scholars to present their work on varied fields such as Social and Cultural aspects, Gender perspectives, Science Literacy, Science Diplomacy, Science Policy and Ethics in Science.

We are fortunate to have with us experts from India in this important field backed by a competent group of national experts who will share their knowledge on current developments in these areas. I am confident that this Conference will generate a great deal of interest and invite all the participants to actively participate during the Conference.

I take this opportunity to extend my sincere gratitude to the Indian Council of Social Science Research (ICSSR), our collaborating partner from India, for their fullest support in organizing this event. In conclusion, I wish to thank Prof. Sirimevan Colombage, Chairman and Members of the Working Committee on Social Sciences for their advice, support and guidance, Prof. Ananda Jayawardane, Director General and the staff of the Science and Technology Policy Research Division (STPRD) for their dedication and hard work in organizing this Conference.

I wish you all a very successful and fruitful Conference.

Message from the Director General

National Science Foundation, Sri Lanka

Prof. Ananda Jayawardane

Promoting scientific culture has become an essential element in public policy dialogues today as empirics provide strong evidence on how Science, Technology and Innovation contributed to rapid economic growth in many advanced and emerging economies. In addition to the nature of technology, there are many other factors that have an influence on technological adoption, such as societal receptiveness, government policies and many other socio-cultural factors. The notable difference in technological adoption observed in developed and developing countries can be attributed not only to economic and technological factors but also to socio-cultural factors. Therefore, understanding of the complex relationships between scientific and technological progress and socio-cultural factors are important for policymakers and technocrats for successful implementation of public policies.

In order to fulfill this objective, the NSF Working Committee on Social Sciences (WCSS) was instrumental in organizing this important International Conference on 'Social and Cultural Nexus of Science and Technology Development'. I believe that the areas addressed in this Conference, such as: Social and economic context of S&T development, Risks and benefits of the modern technology, Media and S&T development, Public understanding of science and scientific literacy, Role of private sector, Education, State policy in S&T development etc. will provide a great opportunity for scholars and policymakers in the region to learn from each other.

I take this opportunity to extend my sincere thanks to the Chief Guest, Keynote Speaker, Chairmen of Technical Sessions, Resource Persons, Referees and the Paper Presenters for their invaluable contribution rendered. I thank the NSF Board of Management, the Chairman and the members of the NSF Working Committee on Social Sciences for their great support and close guidance provided. I wish to congratulate the Head and staff of the Science and Technology Policy Research Division (STPRD) of the NSF for their commitment, dedication and hard work towards organizing this important event. With the array of high quality papers and deliberations, I have no doubt that the Conference will be a great success and I wish all the participants a fruitful and enjoyable Conference.

Message from the Chairman

NSF Working Committee on Social Sciences

Prof. Sirimevan Colombage
Emeritus Professor, The Open University of Sri Lanka

It is indeed a great honour and privilege for me to extend my wholehearted welcome to all the delegates and paper presenters for the International Conference on 'Social and Cultural Nexus of Science and Technology Development' (SCST) organized by the National Science Foundation (NSF) through its Working Committee on Social Sciences.

Science and Technology (S&T) have proven to be the key drivers of socioeconomic progress in modern times. Breakthroughs in health and education that could be materialized by means of S&T enable emerging economies to accelerate economic growth through application of human capital, mainly in the form of knowledge inputs, and to be competitive in the global market. In this regard, it is imperative to evolve a knowledge economy that creates, disseminates, and uses knowledge to enhance economic growth and development. While Sri Lanka has been recognized for many decades as an ideal developing economy that has achieved impressive human development indicators comparable with some of the developed economies, she has lagged behind in terms of knowledge economy indicators due to certain gaps in the education system, research and development (R&D), and technology and innovation-related policies.

Although there are ample studies linking S&T to productivity and economic growth in different parts of the world, research on the interaction between socio-cultural factors and S&T is rather limited. While the economic benefits of S&T are quantifiable and well known, the socio-cultural issues related to S&T are not so obvious. Social, psychological and cultural factors may facilitate or restrain S&T development in particular social and cultural contexts. Traditional cultural values, for instance, could hinder transfer of technology, use of technology and spread of technological culture exerting adverse socioeconomic implications. There are also risks associated with modern technology including cyber security, threats to personal well-being and safety, increasing sense of social isolation, relational problems and over-dependence on technology. Going beyond the economic considerations, therefore, this Conference aims at covering a wide spectrum of S&T-related issues including socio-cultural dimensions, gender perspectives, scientific literacy, education, media, indigenous knowledge, private sector involvement, state policy and ethics.

I am confident that the Conference will provide profuse opportunities to participants to exchange their knowledge and experience to harness the benefits of S&T development for betterment of the society. I wish the Conference all the success.

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Cultural Embeddedness of Science

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Member Secretary, Institutional Ethics Review Board, Jawaharlal Nehru University New Delhi

Science, to be appropriate should be able to absorb dynamic social relationships from the living and non-living around it. Traditional societies which were hierarchical, orthodox, fatalistic and believers in supernatural forces, offered little space for modern science to flourish. It had been hard for science to justify itself from Galileo to the 19th century discoveries of magnetism and electricity into Maxwell equations. This journey had been much tougher as science started distancing itself from a holistic social relevance to the one focussing on increased productivity and control, as was the case from the industrial revolution till the advent of new Republics and Constitutional democratic societies. Nonetheless, a scientist continues to be more absorbed in contesting inventions within one's laboratory in complete obliviousness of the much complex social world around it. The question that most students in a social science classroom are perplexed about is, why Einstein got the Noble Prize when his invention destroyed the world? One interesting Paul Halpern's Science narrative published in 2015 'Einstein's Dice and Schrodinger's Cat: How Two Great Minds Battled Quantum Randomness to Create a Unified Theory of Physics' reveals to our dismay the fact that scientists give so much priority to winning the right scientific algorithm that the world around is lost out.

At a time when most Asian countries are making efforts to move into a more scientific society so that they could reap benefits in a competitive global mainstream of production and progress, the dangers and also the wastefulness of inappropriate science may turn counterproductive. Take for example, a recent initiative of the Government of India for launching a Scheme for the Promotion of Culture of Science (SPOCS) admits that for the promotion of Science, a congenial and adaptable social environment is important without which a Culture of Science (or blossoming of Science and scientific environment) will remain stifled. Everyone seems to be asking one question in science, 'how the universe would unfold itself and how would human beings be better positioned to predict this unfolding?' Can this be left to scientists without a social conscience?

This presentation and paper would explain how society shapes scientific discoveries in many different ways. Scientists are directly influenced by dominant interests and the prescriptive global funding but they are also immensely instructed by their own or their society's cultural framework embedded in their individual morality, their values, beliefs and community ethics. There have been many scientists like Joseph Rotblat who withdrew from the Manhattan Project in 1939 as he believed that such weapons of mass destruction should be avoided due to their catastrophic impact upon humanity. He preferred to receive a Noble Prize for Peace rather than for Physics as Einstein did. Similarly Harvard's Richard Levine preferred to work for

strengthening socialism in societies and agricultural sciences. The most astounding is the case of Henrietta Leavitt who in 1900 joined the Harvard College Observatory for Edward Pickering. She made some far reaching astronomical revelations such as the slower moving stars being more luminous through which the size of galaxy and much more on the study of variable stars could have been discovered. However, the culture of keeping women out of mainstream science was so strong in that period of America, that the world wasted many years to reach through to male scientists, what this, woman had already discovered.

The needs, requirements, capacities and acceptability patterns of every culture are different. Science shapes society and so does the society impact upon science. Once a scientist is aware of cultural frames of a particular society, not only would science be more acceptable but also more relevant and a catalyst for any society's progress.

Social and Economic Context of Science and Technology Development

Prof. P. Kanagasabapathi
Council Member, Indian Council of Social Science Research

Science, Technology and Innovation play a critical role in the development of countries. Appropriate technologies are being developed and used successfully in fast-emerging economies such as India. They are cheap and used at different levels with the local societies making them on their own to suit their requirements for a wide variety of purposes. With the result, the Indian usage 'Juggad' has recently entered in to the technological dictionary. Besides, there are also technologies that are used to fulfil the needs of the masses in good numbers. Prahalad and Mashelkar call them as "Gandhian technologies."

Field studies in different industrial and business clusters in India reveal that social and cultural factors have a huge impact on the development of Science and Technology. Clusters in India have been playing a major role in taking the Indian economy forward during the last seventy years after independence. Almost all these clusters are founded by the local societies and are completely driven by them, with many of them dominating different sectors at the national and the international levels. They are into diverse technical and engineering fields, making pioneering contributions to the economy. Innovations and improvisations have been continuously taking place in many of these centres with absolutely no help from academic and scientific establishments.

Studies show that local societies have natural tendencies to innovate and improve their lives. Family base, society orientation, along with strong cultural and traditional backgrounds, have a strong impact on Innovation and Technology. However, unfortunately, the academia and the policy makers have a poor understanding of the functioning realities. Proper understanding and initiatives for encouragement at the policy-making levels are urgently required for using the fundamental strengths that the societies possess.

It is possible to take the nations forward by recognising the gaps and taking steps to address them. Experiences in different places prove this.

SESSION A

Sub Themes:

- **Education and S & T Development**
- **Social and Economic Context of Science and Technology Development**

Senior Engineers' Ethical Responsibility in Training Junior Engineers for the Sustainable Use of Technology in Sri Lanka

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Technology is the knowledge of manipulating of nature for human purposes. From the ancient time, technology has been the life blood of engineers. Hence, the sustainable use of technology by engineers is an essential requirement in the wealth creation journey of a developing country like Sri Lanka. Consequently, engineers cannot neglect their ethical responsibility to enhance the knowledge and experience of junior engineers who work under their guidance in the field of technology. In this research paper, 07 incidents where senior engineers neglect such responsibilities when serving in senior engineering positions in Sri Lankan engineering firms are presented. This research uses the qualitative approach for data collection and analysis. A single question was given for 200 final year engineering undergraduates of a state university in Sri Lanka to describe any ethical violations observed by them in their training places in order to identify the incidents where senior engineers neglected to properly guide junior engineers. Supporting the professional development of junior engineers is a major point highlighted in most of the engineering codes of ethics. Incidents which violate only this category were thematically analyzed to identify the emerging themes to support the purpose of this study. Only 30% had reported about incidents regarding less support of their senior engineers' during their undergraduate training. Thematic analysis of those responses reveals the emergence of 4 major themes. They are the senior engineers' unwillingness to guide and share experiences, assigning inappropriate tasks, unnecessarily blaming and negligence of training schedules. Junior engineers, poorly guided on technical and professional matters will create harmful consequences to the sustainable development of any country. The major limitation of this research is one sided data collection. Further investigations can be carried out to identify the possible reasons behind senior engineers neglecting the ethical responsibilities by having a few interviews with selected senior engineers. The results of this research are expected to raise awareness among senior engineers about their ethical responsibility in monitoring junior engineers to reduce consequences of improper use of technology.

Keywords: *Engineers, training, ethicalr, Sri Lanka*

Content based Problems in Science in the G.C.E. Ordinary Level that Impact Access to Science Stream in G.C.E. Advanced Level in Sri Lanka

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There is a vast disparity among the number of students admitted to the four subject streams in the G.C.E A/L classes in Sri Lanka. Approximately 52% of students choose Arts and Technology streams and 27% choose Commerce, while only 21% choose Maths and Science. Broad variety of courses are available in Science than other streams at tertiary level. Employment opportunities for Science graduates are also better than those for Arts and Commerce graduates, even though the number of students enrolling in Science and Maths streams are comparatively low. Good achievements in G.C.E. O/L Science is a prerequisite to be admitted to the Science stream in the G.C.E. A/L. This study investigated the problems faced by the students in selecting Science stream at the G.C.E A/L. A cross sectional survey was done among the students in the G.C.E. O/L classes of the Nothern Province to identify the prevailing conditions that influence the access to the Science stream. It aimed to understand the impact of subject content related difficulties in Science as an integrated subject in the G.C.E. O/L in selection of the Science stream for G.C.E. A/L. The factors that cause the difficulty in specific subject contents were also identified through the analysis of data. This study employed data collected through a survey by the Provincial Department of Education of Nothern Province in 2018. A total of 5,529 students from 100 schools were selected from 12 education zones of the Nothern Province. The third term examination achievements in specific subject contents in Science were analysed. The levels of difficulty felt by students in six content units of the Science exam paper were measured through the analysis of their performance. A questionnaire was used to investigate the perceptions of students and interviews were held with teachers in the Science stream. The analyses showed that 47% of students have difficulty with contents in Chemistry. 39% of students in Physics, 21% in Biology and 20% in Botany. Approximately 82% of students are unable to follow the Science stream due to specific content related difficulties they have in Science. They stated that the weaknesses found in the teaching of some specific subject content areas in Science in G.C.E. O/L cause difficulty in their learning. During interviews with the teachers it was revealed that they are not facilitated with guidance and support to teach the diverse content areas. Graduate teachers agreed that some content areas were convenient for them to teach as they have specialized in them in their degrees. Some teachers stated that the students have to employ some specific set of skills for different content areas of Science. 60% of teachers had the tendency of spending more time and concentrated on teaching certain content areas which were convenient to them, neglecting some parts of the Science syllabus. During teaching all areas of the subject were not equally focused which causes the difference in students' mastering the learning of Science as an integrated subject at the G.C.E. O/L. This study recommends provision of special training to teachers on identified content areas in Science. The students should be given guidance to identify the difficult content areas and obtain facilitation from appropriate sources to augment their learning.

Key words: *Science stream, content topics, content related difficulty, integrated subject*

Challenges in Blended Learning for Local Undergraduates: a Case Study Based on the Social Sciences Undergraduates of a State University in Sri Lanka

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Science and Technology have become vital in the education sphere in the contemporary society. As a result, there has been a transformation in education where the focus has shifted from traditional teacher centered learning to virtual learning models. In this setting, in the Sri Lankan context, one of the popular models is the blended learning model. Blended learning can be viewed as a mode of learning in which a number of delivery methods are utilized to optimize achievement of the programme and its objectives. While blended learning is implemented in many Sri Lankan universities, this requires more Information Technology (IT) literacy, infrastructural facilities and linguistic competencies.

This study attempted to engage in understanding the challenges in blended learning for local undergraduates through a case study of the usage of the Learning Management System (LMS) in a chosen faculty of a state university in Sri Lanka. The study investigated academic and infrastructural challenges faced by the undergraduates through a cross-sectional study. A mixed method approach was used where both primary and secondary data were utilized. Secondary data was gathered under the thematic orientation of blended learning. In selecting the primary data, a simple random sample of 10% of each undergraduate batch (four batches representing the total population of the Faculty in the four years) was selected for a survey. This was followed by structured interviews with 40 undergraduates through a purposive sampling method to gain more qualitative data on the said topic. The findings can be classified based on the two tiers identified through the research questions, namely, academic and infrastructural. Key findings included the infrastructural challenges such as lack of infrastructural facilities beyond the perimeters of the university and the lack of awareness of the existing faculty facilities. In relation to challenges in academic activities, lack of linguistic competencies and IT literacy, disinterest among majority of undergraduates in engaging with activities on the LMS platform, resistance towards active learning via LMS due to the preference and familiarity of traditional learning, were identified.

Keywords: *Blended learning, learning management systems (LMS), traditional learning, virtual learning*

Indigenous Knowledge in Traditional Varieties of Paddy Cultivation: Constraints, Potentials and Economic Value

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Indigenous Knowledge (IK) is a precious national resource that can facilitate agricultural production in cost-effective and sustainable ways. There is an increasing trend of integrating IK with modern science and technology. Therefore, the objectives of the research were to identify constraints and barriers faced by farmers in practicing IK, level of adaptation and estimate economic value of IK practices in paddy cultivation. Purposive sampling technique was employed to select 60 rice farmers, representing 12 districts of Sri Lanka with the highest cultivation extent. The study revealed that farmers applied IK in each stage of paddy cultivation and there is a growing interest to use traditional pest management practices in paddy cultivation.

However, the water distribution mechanism currently practiced by the government in irrigated areas does not fulfill the agricultural water requirements of traditional rice cultivation. Further, the farmer organizations are not consulted before the water distribution plans are made. The water management techniques used as weed controlling methods cannot be performed in most of the areas surveyed. IK practices are still existing in some rural communities in Sri Lanka. However, the adaptation rate among the new generation is low, even though the cost of production is significantly low. The main reasons are the comparatively low yield per unit land area being a long - aged rice variety, unavailability of good quality seeds on time, lack of labour and lack of knowledge among the young generation on traditional methods of farming, difficulties in finding animal power and unavailability of plant - based materials that are used for traditional cultivation methods.

According to economic estimation, the percent share of labor cost in the total cost for paddy cultivation using IK accounted for 66.7%. Paddy cultivation using IK has an insignificant requirement for inorganic pesticides and weedicides as input. However, the average yield of traditional rice varieties is comparatively low, the farm gate price is four -folds high when compared to the new improved rice varieties. The paddy cultivation using IK practices has an economic value of 110,263.04 LKR per ac., as a result of high price gain at farm gate due to the high market demand and comparatively low supply of traditional rice varieties in the open market. R&D for popularizing IK, regulation of water distribution mechanisms by the government in irrigated areas as a mean of promoting traditional rice cultivation are recommended.

Keywords: *Indigenous knowledge, paddy cultivation, economic value*

SESSION B

Sub Theme:
Risks and Benefits of Modern Technology

Glyphosate Ban: Socio-economic Impact and Behavioural and Attitudinal Response of the Farming Community in the Dry Zone of Sri Lanka

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With the Green Revolution, usage of agrochemicals and improved crop varieties have led to drastic productivity improvements in the agriculture sector. Consequently, some of these agrochemicals have been damaging the balance and sustainability of natural eco-systems. Glyphosate is one of the most popular weedicides among farmers worldwide. Mainly considering a hypothetical link between Glyphosate and Chronic Kidney Diseases of unknown (CKDu) etiology, the Sri Lankan government banned the importation and use of Glyphosate in June 2015. This study was designed with the objective of identifying the socio-economic impact and the behavioral and attitudinal response of the farming community to the Glyphosate ban. Altogether, a total of 210 randomly selected farmers from the Mahaillupallama Block of the Mahaweli irrigation system-H in the Dry Zone of Sri Lanka were interviewed using a structured interview schedule. Data were analyzed descriptively and inferentially. Results revealed that the majority of farmers (92%) used Glyphosate as a systemic weedicide before had the ban. Currently, as alternative practices, they use manual weeding (30%), grass cutters (16%), deep ploughing (5%) and also use other weedicides (25%). The majority (59%) of respondents stated that Glyphosate is available in the market illegally at exorbitant prices but the quality is not up to the standard. A majority of the respondents (82%) claimed that the Glyphosate ban has led to an increase in the cost of weed control and thereby, the cost of production. There was no effect on the quality of the harvest as perceived by farmers. Some respondents (12%) stated that there is a positive impact on eco-systems as they noted some indigenous medicinal plants and leafy vegetables in their fields and roadsides. Further, most of the small-scale farmers (land extent < 2.5 acres) stated that they could adopt alternative weed control practices. However, the large-scale farmers claimed that they were? struggling with labor scarcity and that has increased the cost of weed control. Moreover, as stated by the majority (78%), the government did not provide any training and awareness programmes for farmers on the Glyphosate ban and alternative practices for weed control. It is recommended to carry out proper cost-benefit analysis to identify the impact of the Glyphosate ban, monitor and control illegal marketing and also provide possible alternatives to the farmers.

Keywords: *Glyphosate ban, socio-economic impact, farming community, dry zone, Sri Lanka*

Usage of Information Communication Technology Services and its Impact on Service Quality of Government Hospitals in Sri Lanka

(Case studies on government based hospitals in the Western Province in Sri Lanka)

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Usage of technology initiatives all over the world endeavor to integrate Information Communication Technology (ICT) to transform delivery of government services to stakeholders by improving quality of services, accountability and efficiency in every sector. Sri Lanka is and remains a high performer in health status terms, with better health indicators than other low-income and lower-middle-income countries. This study investigated usage of ICT services and its impact on service quality of government hospitals in Sri Lanka. This paper explored background related literature and proposed research methodology. ICT applications have been implemented in government hospitals in order to improve service quality that they provide for their patients. According to the literature, service quality is the comparison to the extent of after receiving and expectation perceived by patients. Previous research suggests identifying dimensions of ICT; leadership, customer focus, human resource focus, information analysis and process improvement focus of reliability, responsiveness, assurance, empathy and tangibility. As the research methodology, this study incorporates Quantitative and Qualitative approach (Mix method). Research will be conducted as a survey. Convenience sampling technique will be used to collect quantitative data from patients of government based hospitals in Western province in Sri Lanka, their satisfaction levels and meaning of service quality, which were substituted in the SERVQUAL model. Using multiple regression analysis, the result of an empirical study based on Survey. In addition, this study provides insight into how service qualities are influenced by the variables of SERVQUAL model. Implication of study could suggest the hospital management to justify the element of ICT implementation in order to maximize the service quality as perceived by patients. The study evaluated literature of previous research studies and research methodology and explores the service quality of two types of hospitals, which are, base hospitals with and without ICT implementation.

Key words: *Information communication technology (ICT), service quality, government base hospitals, SERVQUAL model*

Emerging Issues and Challenges of Ageing Population of Sri Lanka: the Role of Science and Technology for Developing a Smart Ageing Society

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The population of Sri Lanka is ageing and the share of the older population (age 60 years and over) is about 13%, while the median age exceeded 30 years in 2012. By 2050, approximately, one in every four people in Sri Lanka is projected to be aged over 60 years. 'Smart Ageing' is identified as one of the effective models used in developed countries in addressing the demographic shift and associated implications in the 21st century. The 'Smart Ageing' refers to the use of technology and innovation in both the public and private sectors to produce goods and services, solutions, interventions and systems to improve the quality of life and wellbeing of older people. Though an increasing trend in ageing population in Sri Lanka has been evident, very little is known about how science and technology could be used in addressing emerging issues and challenges of the ageing population. This paper aims to examine the problems faced by elderly people in Sri Lanka and to discuss its challenges towards developing a smart ageing society. The study used data from the Population and Housing Census (2012) and National Survey on Self-reported Health in Sri Lanka conducted by the Department of Census and Statistics, Sri Lanka. The study is further backed by empirical literature done through a systematic desk review to understand how the nexus between ageing and technology had been evident in different socio-economic contexts. The results reveal that nearly half of the older population had experienced non-communicable diseases (NCDs). About 60% of the oldest - old persons (age 80 and over) had experienced at least one disability, while one third of them had suffered from three or more number of difficulties, reflecting that the severity of disability is prevalent among the oldest - old population. The prevalence of disability among young - old (age 60-69) and middle-old (70-79) persons were 25% and 43% respectively. Majority of the older population had experienced difficulties in seeing, hearing, walking and difficulties related to cognition. The analysis of literature proves that old-age vulnerabilities could be reduced with the adaptation of smart technologies such as mobile devices, sensors, remote monitoring systems and assistive devices. Such solutions could contribute to enhance the safety and security, health and functional monitoring, as well as social interactions and participation among older population, while helping them to live independently and safely. These results suggest that as the population ages considerable attention should be given to strengthen the social, physical and technological connectivity in order to improve the inability to use science and technology, access geriatric health care services as well as to ensure their social, political and economic participation.

Keywords: *Ageing population, smart ageing, geriatric health care, ageing and technology, Sri Lanka's elderly*

SESSION C

Sub Themes:

- **State Policy and S&T Development**
- **Role of Private Sector in S&T Development**

Status of Policy Implementation on Municipal Solid Waste Management in Delhi, India

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The world is falling short of resources and sufficient systems to handle the waste generated by the human population at present. Solid Waste Management (SWM) in India is a service that is lacking infrastructural and policy level efficiency to manage the enormous amount of waste that is generated. This research focused on the current situation of waste management and the status of implementation of different policies related to waste management. It is mostly based on analytical and exploratory study of both qualitative and quantitative data. Available government reports were analyzed for the purpose of examining implementation of policies on SWM. The work of different urban local bodies in Delhi was assessed on the basis of a list of recommendations and directions given in the Municipal Solid Waste Management and Handling Rules, 2016. This paper also examines the hierarchy of sustainable solid waste management technologies and how it is being followed in the study area. Currently, the technologies used do not seem to solve the problem at its core. It is essential to have better technologies and proper implementation through advanced technology transfer processess to efficiently deal with the issue. The study shows that the authorities have failed to follow sustainable ways of waste management and use unsustainable methods such as waste to energy conversion and landfilling. Waste to energy technology is being promoted but it cannot be the long-term solution for waste management in terms of environmental viability where proper safety measures for emissions are unavailable. While studying the policies and rules governing municipal waste management, the loopholes between policies and their implementation were evident. Delhi has the worst conditions regarding waste management in contemporary times, where authorities do not seem to be competent enough to tackle the problem. The landfills are required but only for discarding the inert waste. The potential for developing compost techniques is high in Delhi as more than 50 % of its waste is biodegradable. The key to sustainable solid waste management for the city would be Public-Private-People-Partnerships (PPPP), and not just Public-Private-Partnerships (PPP).

Keywords: *Solid waste management, public-private-people-partnerships, public-private-partnerships, India*

State Policy on S&T Development: an Overview on Research and Development in Sri Lanka

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Science, Technology and Innovation (ST&I) plays a key role in the development strategies of a country. In Sri Lanka, the National Science Council (NSC) took the initiative in formulating a national S&T Policy by developing the first policy statement in 1969. Later, the S&T Development Act was passed in 1994 giving rise to the National Science and Technology Commission (NASTEC) which formulated a comprehensive S&T policy document in 2009 with 10 policy objectives. One of the key elements of a state policy on S&T is its focus on scientific research. Therefore, this study concentrated on R&D in Sri Lanka over the period 2004 – 2015 with regard to S&T policy. Data were collected from Sri Lanka Science and technology Statistical Handbooks published by National Science Foundation in 2004, 2006, 2013, 2015 and literature review was done through a comprehensive desk review. Correlation analysis was conducted using SPSS statistical software. Results showed that the Gross Expenditure on R&D (GERD) as a percentage of GDP has a decreasing trend (Pearson r = -0.835, p =0.019) with a mean of approximately 0.14%, which is well-below the country`s expected level of 1.5%. Both the government (Gov) and higher education (HE) sectors showed a decreasing trend (Gov: r = -0.626, p = 0.132; HE: r = -0.364, p = 0.423) in their R&D expenditure. However, the contribution of business enterprise sector has increased (r = 0.833, p = 0.020), although the values are considerably lower compared to newly industrialized countries. Basic and applied research showed decreasing trends while experimental developments showed an increasing trend; a promising trend for a developing country like Sri Lanka. Allocation of R&D for Natural Sciences, Engineering and Agriculture disciplines showed a non-significant increasing trend (Natural: r = 0.613, p = 0.143; Eng: r = 0.536, p = 0.215; Agri: r = 0.600, p = 0.155). In contrast, Social and Medical Sciences showed a decreasing trend (Social: r = -0.719, p = 0.069; Medical: r = -0.718, p=0.069). The number of R&D scientists has increased by 1.32 folds in 2015, compared to 2004. Researchers-per-million-population also showed an increasing trend (r = 0.896, p = 0.040) but still lies below global averages. Direct impact of research outputs on GDP is hardly measured. Output comprises scientific papers, patents, postgraduate degrees, etc. Accordingly, there were 396 publications in SCI-journals in 2015 and 84% of them had foreign co-authorships. In conclusion, it is evident that GERD as a percentage of GDP is inadequate, and hence must be increased to transform Sri Lanka into a knowledge-based-economy. Intensifying ground-breaking research, serving industrial needs, commercializing research outputs through international collaborations and private-public-partnerships may be beneficial in the long run. Revision of existing policies aligning with the country's development plans is also recommended.

Keywords: *GERD, research and development, S&T policy, Sri Lanka*

Role of Private Sector in S&T Development: a Case of Two South Indian States

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The greatest merit of technology is that it is scale neutral and the rich and poor alike can have equal access. In the Millennium Development Goals (MDGs), Goal VIII deals with 'Develop Global Partneship for Development: Co-operation with Private Sector to make available the benefits of ICT (Information and Communication Technology). It aims at the involvement of the private sector in accessing the benefits of new technologies, especially in the areas of information and communication. Another significant merit is that the spread of such technologies is expected to augment productivity, and contribute to the quality of life of the people. These technological advances could enhance the outreach of information and knowledge to people in remote areas. IT use in the field of education and medicine has reduced the costs of service even while ensuring high quality in delivery of these services. The spread of Internet use (along with mobile phones) among the educated and communication technology even among the common people during the last few decades has been remarkable. These technologies have facilitated the improved access of people to information (relating to both market and development) and thereby to various opportunities. It is interesting to observe that socio-economic and cultural factors, though very important, are not coming in the way of spreading these technologies as these technologies are scale neutral. This paper discusses the access and spread of ICT, in particular, access to mobile phones and Internet in two South Indian States (Andhra Pradesh and Telangana) with robust data sets. The data was accessed from the Telecom Regulation Authority of India (TRAI) which provides reliable data on this indicator of tele-density among various socio-economic groups and various regions (Rural-Urban). MDG (now it is SDG) framework has suggested five indicators to assess with the performance with regard to this goal. There are number of telecom subscribers, high rural-urban teledensity, telephones; (fixed and mobile per 100 persons), number of internet subscribers and laptops per 100 persons. The paper is supported by the empirical data that discuss the progress of the above mentioned indicators in the South Indian states of Andhra Pradesh and Telangana. The analysis of the data reveals that these two states have made significant progress in the adoption of ICT and these could penetrate even into remote villages. Further, the results revealed that partnerships with the private sector have been established and would be strenghtened further, to ensure greater transparency and accountability in public governance.

Keywords: *Private sector, millennium development goals, science & technology, information communication technology*

Green Adoption in a Manufacturing Company from Actor Network Perspective: a Case Study

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Adopting green practices in manufacturing industry is well emphasized under the 2030 Agenda for Sustainable Development adopted by world leaders in 2015. Despite numerous attempts made by global organizations, national governments and local non-government organizations in promoting and popularizing green practices, the existing knowledge reveals several challenges encountered by manufacturing entities in developing countries when adopting green practices. Such challenges have been related to the influences emanating from diverse set of actors in the environments. Even though the problems of green adoption have been extensively researched, particular actors and the nature of their influential processes have not been examined in depth and clearly defined. Identification of diverse actors, their networks and the influential processes is beneficial for overcoming barriers in green adoption. This paper aims to explore the process of introducing and implementing green practices in a large-scale apparel manufacturing company in Sri Lanka, in order for unveiling who in which manner exert influences on green adoption. Guided by the actor network theory, this study uses the theoretical underpinnings of the sociology of translation (i.e. problematization, interessement, enrolment and mobilization) in examining the process of green adoption in a single case study. This is a qualitative enquiry. We use multiple data sources including primary data obtained from the key informants through interviews and discussions and secondary data of the case site available publicly. The enquiry is guided by the process of sociology of translation. The results reveal that introduction of green practices in a large-scale company is not a top-down or bottom-up linear process, but it is an idea generation-to-endorsement process that runs between top and bottom levels in a zig-zag pattern. Further it reveals that pioneering any mechanisms for green adoption (problematization) is taken place as and when such a need is recognized by any relevant stakeholders in the network. The construction of the interface between the interests of various actors (interessement) is performed mainly by the management. Different mechanisms have been used for building up agreements and for continuous monitoring of the interests of diverse actors in the green adoption in the organization. The study finds that green adoption in the case organization depicts a reaction-compliance process in which the organization attempts to positively react to several (external) pressure groups while complying with the (internal) requirements. We conclude that there needs a strong impulsion from the regulatory environment for large-scale organizations in developing countries to be pushed for green adoption.

Keywords: *Actor network theory, green practices, manufacturing organization, sociology of translation*

SESSION D

Sub Themes:

- **Media and S&T Development**
- **Public Understanding of Science and Scientific Literacy**

Replacing the Chemical Fertilizer through Eco-Friendly Technologies Developed: are Paddy Farmers Willing-To-Pay for Slow Release Urea?

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Heavy usage of agrochemicals has created numerous vulnerabilities to the general public, including the adverse health and environmental effects. In the light of these, introduction of "Eco-Friendly Technologies" (EFTs) has become a necessity to inhibit such vulnerabilities. This is much important in rice cultivation as it is considered as the crop which utilizes the highest proportion of agrochemicals imported to Sri Lanka, but with low fertilizer use efficiency. This study explored the "role of economics" in adoption of such EFTs using the special case of an EFT under invention, i.e. 'Slow release urea using rice husk biochar' – formulated by using a pyrolysis technique. On the understanding that the farmer's decision to adopt an innovative technology depends, amongst others, highly on profits over the expenses, this study was carried out as a Choice Experiment to estimate their Willingness-to-Pay (WTP) for various attributes associated with use of this EFT.

Data were collected through face-to-face interviews supported by a structured-questionnaire. The sample was a set of paddy farmers (n=120) registered with the project from Kurunegala and Anuradhapura Districts during August to September 2018. The outcome of Conditional Logit model used in this respect revealed that attributes of: 'Health and Environmental Damage' (i.e. the highest value of Rs. 145 per acre), 'Land Productivity' (Rs. 131 per acre), and 'Soil Fertility Improvement' (Rs. 114 per acre) possess a significant and positive relationship with farmers' WTP for this invention. Since this fertilizer consists of a high number of pores in the structure, it seems to be having superior slow release properties compared to currently commercialized 'urea'. On the other hand, farmers require Rs. 8 per acre as a compensation to purchase fertilizer through 'Private Markets'. By and large, the outcome of the analysis highlights that, at the ground level, farmers are more concerned about the social and environmental benefits to the society associated with moving into adoption of such technologies. In light of this, establishment of properly managed EFT production, distribution and promotion activities would lead to enhance the use of EFT. At the same time, it is important to use the findings of the study to conduct a benefit analysis so the public regulatory institutions and others stands for fertilizer management would generate both short-term and direct private and market-based incentives, over and above their counterpart, for farmers to shift into EFTs of this nature.

Keywords: *Choice experiment, eco-friendly technologies, fertilizer use, marginal willingness-to-pay*

Bio-degradable Waste Management; Public Perception on Utilization of Black Soldier Fly Larvae (BSFL; *Hermetia illucens*)

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An incredible amount of Municipal Solid Waste (MSW) is produced in Sri Lanka and elsewhere in the world. With the daily accumulation of approximately 6 million tons of garbage in the planet, massive pollution in oceans, water bodies, land and air is inevitable. Consequently, effective and sustainable waste management systems should be adopted in order to minimize negative consequences of garbage accumulation. The current study was conducted as a part of the World Bank funded project (2019-2022), "From waste to animal protein; Black Soldier Fly Larvae (BSFL; *Hermetia illucens*) production as a method of waste management and feed grade protein production". The objective of the study was to determine the public perception of management of bio-degradable waste on non-urbanized sectors of the country. The specific objectives were to evaluate the current domestic waste management methods, waste collection systems, disposal, public perception for processing of waste through BSFL, public awareness on solid waste management, patronage and willingness to pay for waste management services, as well as their views on income generation from their own waste management system based on BSFL technology. Collection of data was based on direct questionnaire administration and personal interviews with the members of the focus group. Household waste was randomly collected (n=100) from the university and surrounding community at Belihuloya. Among the waste categories collected, biodegradable kitchen waste amounted up to 85%, compared to non-degradable and other degradable wastes. It was reported that 95% of kitchen waste was subjected to burying or dumping, while burning was practiced for almost 95% of other degradable wastes. Burning (70%) and recycling (20%) are reported as the way of managing non-degradable waste among the tested group. Waste separation was practiced by a majority of the people (more than 65%) and more than 90% among the tested sample preferred compost preparation with proposed domestic bins. Poor response for waste separation resulted due to the lack of market information on recycling and negative attitudes towards waste separation. However, a majority of (80%) people were not aware of BSFL based bio-waste decomposition process. Findings from the survey showed that 65% of the people preferred producing BSFL at the range of Rs.301-400 per kg. BSFL based community tipping point, taking a leading role with public engagement in household waste management. Reduction of waste at the source through campaigns conducted in a scientific manner in order to create awareness among the individuals as very much needed for making cities clean. Utilization of the end product from BSFL as organic fertilizer further strengthens the sustainability of the entire agro-animal system. The results of this study were used to understand, strengthen, and implement appropriate strategies to increase utilization of BSFL as a sustainable alternative method for bio-degradable waste treatment in Sri Lanka.

Keywords: *Biodegradable, back soldier fly larvae, hermetia illucens, municipal solid waste, waste management*

Urban Consumers' Attitude towards Organic Food: the Case of Sri Lanka

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Organic food consumption is gradually increasing among Sri Lankan consumers due to the widespread awareness of healthy food. While many countries conduct research related to this aspect, studies of this nature are rare in Sri Lanka. Hence, the purpose of this study was to investigate the attitude of urban consumers towards organic food and the factors affecting their attitude. A market survey was conducted for a sample of 600 consumers in main cities of six districts of the country, from November 2016 to May 2018, using a pre-tested questionnaire. Descriptive statistics, factor analysis and multiple linear regression were used as statistical methods for data analysis. Results revealed that the majority of respondents were in the 18 to 40 years age category and have received education up to Advanced Level. Most of them were married and their average monthly income ranged from 58,000 to 85,000 LKR. Concerning the knowledge about organic food, majority of the respondents (75.2%) were aware of organic food, while only 19.5% were well-versed about the subject. As per the mean analysis, typically, consumers had a positive attitude towards most aspects of organic food. According to factor analysis, four factors (environmental, quality, health and marketing) were extracted. Results of multiple linear regression analysis revealed a positive relationship between consumers' attitude and the extracted four factors. Main problems faced by consumers when buying organic food were the high price, unavailability of organic foods, lack of trust and lack of market information on organic food. It can be concluded that consumers can be motivated towards buying organic food by creating proper marketing facilities, increasing trust about organic food, and providing necessary facilities for quality production. Marketers and policymakers need to develop proper methods to market organic food while highlighting the values and benefits of organic food products.

Keywords: *Attitude, organic food, regression analysis, Sri Lanka, urban consumers*

Impact of New Media in the Communication of Pre- Disaster Warnings to the Public in Sri Lanka

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Sri Lanka has been facing natural disasters like floods, landslides etc. for a long time. Ancient people could find out disasters by observing the sky or environmental changes or behavior of the animals. In recent times, the Department of Meteorology issues early warning to the public using modern media (TV, Radio) before disasters occur. There was a dramatic turnaround of pre-disaster warnings following the Tsunami which hit Sri Lanka in 2004. Now although the Disaster Management Center is using new media technology for sharp communication, people do not have enough knowledge about those new media equipment and technologies like Early Warning Towers, GPS equipment, VSAT, Mobile Phones (Cell Broadcasting/SMS) and Computers (Web sites). Preparedness is the best way to avoid the disasters. The main purpose of this research is to study about new media equipment and to find out what the weaknesses and the potentialities are, when issuing early warning to the public in Sri Lanka through the new media. This research attempts to find out the potential of new media in the communication of pre-disaster warnings to the public. It also attempts to find out to what extent new media technology has spread in Sri Lanka. Methods like questionnaire, Interviews and Participatory Observation have been used to achieve these objectives. The samples represents 100 people who live in both rural and urban areas of the country with different education levels, the age groups and occupations. The sample was selected from Colombo, Galle and Kandy districts. Qualitative, quantitative and mixed methods were used for data analysis.

So far the early warning messages had been sent targeting only the key persons. Therefore, the overall purpose of this research is to find out how this method can be expanded, to send messages to the community as a whole. During the research it could be-understood that people had lack of knowledge about early warning systems and these technologies had not reached the society effectively. The main stream media has a powerful impact towards global liberal economic and contribute to the disaster communication. The mobile phones became the first priority among the communication system recently.

Key Words: *Disaster, early warning, message, communication, new media*

POSTER SESSION

Analysis of Factors Influencing the Virtual Learning Environment in a Selected University

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A system called Virtual Learning Environment (VLE) can be used to maintain a good relationship in teaching and learning activities among the students and university academic staff members. A VLE system was designed for the students and university academic staff to encourage a positive approach in knowledge achievement and to support active learning within the university. This study was carried out to analyze the factors influencing the VLE system and to explore the effective of the relationship between the students and university academic staff on the VLE system. Twenty Five factors influencing VLE were identified through the literature review and the interviews conducted among the university academic staff and the industry experts. A paper-based questionnaire survey was carried out among the students and university academic staff in order to measure the severity of the factors influencing the VLE system. The respondents chosen for this study were the undergraduate students and university academic staff from the Vavuniya Campus of the University of Jaffna, who used the created VLE system. There were 120 responses from the students and 30 responses from the university academic staff. The severity of each factor was identified based on its Relative Importance Index (RII) value. The factors were ranked based on their severity, and Spearman's rank correlation coefficient was calculated. The students stated that infrastructure, time saving, collaborative learning and use of media are the most significant factors influencing the VLE system. Collaborative learning, learning practice, evaluation of teaching capability, flexible learning and frequent feedback were identified as the most significant factors for the university academic staff members. It was found that there was 26.9% of positive degree of agreement between the students and university academic staff members on the VLE system.

Keywords: *Virtual learning environment, learning management systems, learning tools*

Contribution of Daily Newspapers on Disseminating Science and Technology Knowledge to the Public – a Comparative Study in the Jaffna District

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Daily newspapers could play a vital role in knowledge dissemination to the public, especially people who are living in rural remote areas. There are four daily newspapers in Tamil language published in the Northern province at present. This study considered all four newspapers and their contribution to disseminate Science and Technology (S&T) knowledge to the public. All the above newspapers have special editions twice a week in different fields. This study calculated the number of articles and feature articles published in the newspapers in the field of S&T and other fields in 2018. There were only few articles published in the field of S&T compared to the areas of literature, politics, cinema and social issues. The articles in S&T accounted for less than 10% of the total number of feature articles published.

The newspaper editors stated that it is difficult to find scholastic writers for the columns in the field of S&T, with the ability to write articles easily understood by readers. Around 60% of the scholars in the field of S&T mentioned that the newspaper editors are reluctant to publish S&T articles written in academic style. About 52% of scholars mentioned that they had difficulties in writing articles in Tamil language in a simple manner to be understood by all the newspaper readers and it is difficult to find the proper terminology in Tamil.

Following an interview conducted among the readers, 82% reported that the newspapers give priority to political news. The Jaffna Science Association and Jaffna Medical Association provide assistance to the newspapers to obtain articles and feature articles in the field of S&T and Medicine. It is observed that only a very few academics from the University of Jaffna contribute with S&T articles to the local newspapers. The contribution of newspapers does not meet an adequate level to disseminate S&T knowledge to the public. It is recommended to introduce an award scheme at University and Institution levels for publication of S&T articles in local newspapers

Key words: *Science and technology, articles and feature articles, dissemination of knowledge*

Multi-level Closed-loop Control Model for Blended Learning– an Innovative approach in Systematic Continual Quality Improvements and Assurance

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Bringing Blended Learning approach into the timelight is a need of the modern day education. Blended Learning is currently well-known among the academia. It is defined as "Combination of face-to-face and online learning" and this can be considered as the popular notion. As blended learning approach has become the "New Normal Move" in education, the educators have been trying out different models based on the contextual contingencies and experiences during two decades. Few models can be found in the literature on blended learning. A closer scrutiny reveals that the existing models lack two aspects. Firstly, they focus only on the content delivery aspects. Setting Intended Learning Outcomes (ILOs), Design and delivery of instructional activities, and assessing the Learning Outcomes and process (LOs) are the basic elements of any teaching-learning process. To maintain effective learning, these elements should be aligned in the education approaches. The output of LO may be inconsistent with the desired outcome, unless the process elements are appropriately aligned. Secondly, with the absence of proper control measures, the system does not go through continuous improvements and developments, conversely with the presence of controls over the elements included in the system, the deficiencies can be easily arrested and timely remedies can be introduced. The objective of this study was to introduce a new model for blended learning which could support the maintenance of Quality Improvements (QI), Quality Assurance (QA), and Quality Management (QM). Once these aspects are introduced into the blended learning approach, the process may be accelerated. The effect of controls can be best understood with the science and technology developments. Engineering systems embed controls to maintain the quality standards and aspects. Proposed blended learning model is schematically configured in par with the Closed-loop Control System in engineering science and is educationally based on Constructivism.

Keywords: *Blended learning, models, constructivism, constructive alignment*

Analysis of the Coastal Setback Policy in Sri Lanka

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With the increasing concerns over coastal disasters, the concept of coastal setback standards has become prominent in controlling new developments in the coastal zone. Having recognized the frequent failures of 'hard' defenses, 'setback' is emerging as a preferred 'soft' engineering solution to site development away from the vulnerable coast. In order to formulate rationalized setback standards or buffer areas, the coastal erosion, sea level rise and vulnerability factors should be built into a calculation procedure concerning both development and conservation points of view. Literature on coastal setback delineations in various countries shows that the above factors have not been addressed in setback delineations and arbitrarily fixed figures are being used as setback standards. In Sri Lanka, despite the pre-existent Coast Conservation Act No. 57 of 1981 and the newly published Coastal Zone and Coastal Resource Management Plan-2018, there are new developments happening in the coastal zone, with prolonged confusion and uncertainty regarding land use rights and adherence to setback standards. This research study to reviewed the existing coastal setback policy in Sri Lanka as given in the Sri Lanka Coastal Zone and Coastal Resource Management Plan 2018 (CZ&CRMP 2018) and to develop criteria to formulate more rationalized setback standards. The existing setback standard formulation method as well as specific conditions applied in delineating the setback standards were reviewed in detail. A mathematical equation to determine setback standards is proposed by reviewing reliable sources in different countries where coastal setback standards have been implemented. Taking a stretch of the coastal boundary in Galle, Kalutara, Batticaloa and Jaffna, a sample calculation of the setback standards was done using secondary data as well as site-specific factors. Based on this analysis, a calculation procedure was developed, and the setback standards over the selected coastal stretch was determined with justification. Finally, a set of recommendations to be used in future revisions of setback standards in Sri Lanka is proposed.

***Keywords**: Setback standards, policy, development, setback calculation, Sri Lanka*

AUTHOR INDEX

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