



**SRI LANKA ECONOMICS RESEARCH CONFERENCE  
SLERC-2014**

**PROCEEDINGS**

of  
**The 3<sup>rd</sup> International Economics Research Conference  
of the Sri Lanka Forum of University Economists**

**Volume III**

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## **MESSAGE FROM THE VICE CHANCELLOR**

### **University of Ruhuna**

After two successful Conferences on Economics, the Sri Lanka Forum of University Economists (SLFUE) is now planning to hold the 3rd International Conference on Sri Lanka Economic Research in 2014 with the patronage of Department of Economics, University of Ruhuna. The theme of this Conference is “Emerging Trends in Post-Conflict Societies: Challenges and the Way Forward”. Therefore it is my great pleasure to write this message to the proceedings of the conference. First of all, I, as the Vice Chancellor of University of Ruhuna, wish to offer my heartiest congratulations to the Head of the Department of Economics of the University of Ruhuna and the organizers of conference for their efforts to make this event a success.

Conferences provide an opportunity for transmission of knowledge based on latest research and are considered as an essential part of academic programmes of all good universities. As the Vice Chancellor, I am happy to see that the University of Ruhuna through organizing this type of conferences, is now working according to the professional norms of an academic institute. I am also glad to learn that many economists from different universities in Sri Lanka are participating in this conference.

The role of the knowledge on economics in the development of modern societies is widely accepted. It is important to know about emerging economic trends not only for economists, but also for policy makers and decision makers. Particularly in discussing Sri Lankan post-conflict economy it is essential to pay attention to the subthemes such as knowledge economy, resource sharing, infrastructure development economic modeling etc. Therefore, I consider this Conference provides an appropriate and well-timed platform for the university academics to present their findings and exchange ideas on different topics related to the theme.

Organizing an International Conference is always a big challenge and I am confident that the Department of Economics would hold this conference to the expectations of the Sri Lankan academic community. I extend my congratulations to the organizers of the Conference and wish them all success.

Prof. Gamini Senanayake  
Vice Chancellor  
University of Ruhuna

**MESSAGE FROM THE DEAN**  
**Faculty of Humanities and Social Sciences, University of Ruhuna**

It is with great pleasure that I write this message to the proceedings of the 3<sup>rd</sup> International Economics Research Conference of the Sri Lanka Forum of University Economists.

I am happy to learn that the conference theme “Emerging Trends in Post-Conflict Societies: Challenges and the Way Forward” is a timely topic that gives birth to creative ideas of Sri Lankan economists to reconsider economic policies that have been in practice in the past and to be practiced in the future. This will undoubtedly create a platform for the young economists to exchange their ideas, share new knowledge gained through innovative research, and have a healthy dialogue on policy implications.

Also I am pleased to congratulate the Department of Economics that has been elected to the chair of Sri Lanka Forum of University Economists for year 2014. The opportunity of hosting an international conference of this nature is indeed a privilege not only to the Department of Economics but also to the Faculty of Humanities and Social Sciences.

Hosting an international conference is not an easy task. I greatly appreciate the dedication of the organizing committee of this conference, sponsors and well-wishers.

Finally, let me warmly welcome all paper presenters, reviewers and participants from overseas and the entire university system of Sri Lanka, who are spending productive two days with us in Ruhuna.

I wish the conference all success!

Prof. Sumanasiri Wawwage  
Dean, Faculty of Humanities and Social Sciences  
University of Ruhuna

## **MESSAGE FROM THE CHAIRPERSON**

### **Sri Lanka Forum of University Economists (SLFUE)**

It is a great pleasure for me to issues a message for the 3<sup>rd</sup> Sri Lanka Economic Research Conference of the Sri Lanka Forum of University Economists (SLFUE). This is Sri Lanka's largest annual event devoted to the research of economics, and it will give researches and participants an intellectual platform to exchange ideas and broaden their knowledge. The theme of the Sri Lanka Economic Research conference – 2014 is “Emerging Trends in Post Conflict Societies: Challenges and the Way Forward” and it is hoped that it will broadly cover all disciplines of economics while highlighting socio-economic issues and challenges of post conflict societies.

On behalf of the organizing committee I am delighted to welcome you all to the Sri Lanka Economic Research Conference – 2014 which brings together scholars and academics from different fields. We are pleased to have Emeritus Professor D. Atapattu and Professor Sumanasiri Liyanage as the plenary speakers. I particularly express my gratitude to senior Professor Gamini Senanayake, our Vice – Chancellor who contributed and helped in numerous ways to make this conference a success. I would also like to acknowledge the tremendous efforts of the coordinator of this conference Dr. A.J.M. Chandradasa and the conference secretary Mrs. K.T. Udari Niranjala who for their hard work and diligence in organizing this conference. The success of this conference would have not been possible without the dedication and efforts of the members of the organizing committee. They deserve a lot of thanks.

I also take this opportunity to thank all our sponsors. The invaluable financial support given by University of Ruhuna, Bank of Ceylon Southern Regional Office, Peoples Bank –Matara Uyanwatta Branch, Chief Minister of the Southern Provincial Council, and Chartered Institute of Management Accountants (CIMA) is thankfully acknowledged. It is my honour to warmly welcome you all to this conference. I hope that this conference will be stimulating and informative to all who attend it.

**Dr. B.M. Sumanaratne**

Head of the Department of Economics-University of Ruhuna

Chairman-Sri Lanka Forum of University Economists

## **Editorial Preface**

It is with great pleasure that I welcome you to the 3<sup>rd</sup> International Conference on Sri Lanka Economic Research organized by the Sri Lanka Forum of University Economists held from 19<sup>th</sup> - 20<sup>th</sup> of December 2014 at the Department of Economics, University of Ruhuna. The SLFUE was formed in 2012 at the University of Colombo aiming at inculcating a research culture among university economists whilst contributing to the national development process of the country. Organising an annual international conference is an important activity which will enable the members to share professional and research experience. The previous Sri Lanka Economic Research Conferences were a chain of intellectual forums which addressed emerging issues pertaining to contemporary developing economies. The themes of the 1<sup>st</sup> international conference of SLFUE: *“Global economic outlook and challenges to developing economies”* and the 2<sup>nd</sup> conference *“Growth pole shift towards Asia: Opportunities and Challenges”* clearly proved this.

The theme “Emerging Trends in Post-conflict Societies: Challenges and the Way Forward” was selected for the 3<sup>rd</sup> Conference as the present social, economic and political conditions which are in a dilemma, needs a comprehensive review and analysis to direct the country on a correct path.

Responding to the announcement which appeared in the poster and the web sites a total of 85 extended abstracts were submitted by researchers who hail from various disciplines. They not only represented economics but also hailed from various other fields. The independent double-blind review process retained 49 submissions for minor corrections by authors and finally, this publication of conference proceedings contains 33 extended abstracts. Due to the diversity of the contents represented in the extended abstracts, 8 specific sub themes were identified for parallel technical sessions.

I extended my sincere thanks to all members of the editorial committee who sacrificed their time to make this publication a reality today.

Hope that this conference will be a great success!

Dr. A.J.M.Chandradasa  
Senior Lecturer  
Department of Economics  
University of Ruhuna  
Chief Editor and Coordinator of SLFUE 2014

**SRI LANKA ECONOMICS RESEARCH CONFERENCE (SLERC) -2014**

**The 3<sup>rd</sup> International Economics Research Conference of the Sri Lanka  
Forum of University Economists**

Organized by

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**Session-1**  
**Agriculture and**  
**Food Security**



[S1/01] **Maize Contract Farming in Sri Lanka; Adoption, Impact and Policy Implication**

**Champika,P.A.J<sup>a</sup>, AbeywickramaL.M<sup>b</sup>**

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**Abstract**

*This paper attempted to examine the existing maize Contract Farming (CF) system in Anuradhapura district of Sri Lanka as a strategy of market stabilization through public - private partnership (PPP). Study applied principal component analysis (PCA) to explain the factors affected in adoption. It was revealed that full time farmers who have higher proportion of agricultural income, higher agricultural land holdings as well as agricultural experience and family labour participation were more prominent in adopting the contract farming system. Moreover, statistically significant higher yield by maize contract farmers over non - contract farmers was believed to be achieved due to efficient input delivery mechanism of the buyer. Further, adopters have earned about two times higher agricultural income than non-adopters. Inability to sell the whole harvest through CF system was the main obstacle faced by the contract farmers. Among the constraints faced by contract farmers, price instability was not a significant problem. In contrast, non-contract farmers have mentioned price instability as the most critical problem they have encountered. Therefore, it appears that, contract farming system has been effective as a market based instrument of price stabilization, in the context of maize contract farming in Sri Lanka. Further, it was revealed that unavailability of an authorized body to regulate the contract farming process and lack of a crop insurance scheme have slowed down the progress of spreading the contract farming system throughout the country.*

**Keywords:** *Contract farming, Principal Component Analysis, Price Stabilization,*

## **Introduction and research problem**

The key advantages of market-based instruments over price stabilization schemes were providence of certainty of future revenues, comparatively low cost of implementation and shifting the risks to traders in industrialized countries who are willing to take the price risk (Varangis, P. and Larson, D. (1996). The Contract Farming (CF) has been implemented widely in developing countries as a means to reduce risks related to price and quality and as a way to reduce coordination costs within the food supply. As an alternative to the conventional government intervention in agricultural marketing, the Central Bank of Sri Lanka (CBSL), introduced Forward Sales Contracts (FSCs) under the ‘*Govi-Sahanaya*’ purchasing/pledge loan scheme in 1999. A forward sales contract (FSC) is an agreement between the seller and buyer to deliver a specified quantity of a commodity to the buyer at some time in the future for a specified price or in accordance with a specified pricing formula (Kang, G. M. and Nayan, M. 2006). A Forward contract can be either extended to contract farming system by delivering inputs and extension service or confined to forward contract as it is. (Eaton, C. and Shepherd, A.W. 2001). The CBSL facilitated and monitored the implementation of FSCs process at the initial stage. After completion of ten years’ direct involvement of the CBSL ended in 2009 and the system was left to its own operation, without further involvement of the CBSL. Since then, FSCs between farmers and buyers have altered to different forms and shapes and a few have developed to CF System. With this background the present study focuses on evaluating the critical success and failures of the existing CF system and to assess the factors affecting the adoption of CF in the

selected area. Further, this research study is an attempt to fill the gaps in an effective future policy direction in planning of CF as a strategy of market stabilization through public private partnership.

## **Methodology**

A questionnaire survey of randomly selected farmers of both categories, who adopted CF (n=75) and independent growers of maize in selected divisional secretariat divisions (DSDs) of Anuradhapura district (n = 50) was carried out when collecting primary data. DSDs were selected purposively, based on the prevalence of the long lasting CF system. Next, number of farmers who adopted the CF were selected randomly, based on the farmers' list obtained through buyers. Farmers' list of the independent growers was obtained from the Agrarian Services' Division office and farmers were selected randomly from the list. Study applied the *chi*-square test to find the association between categorical variables and student-*t* test to compare the two groups of farmers' adopters and non-adopters.

Further, Principal component analysis (PCA) with *varimax* rotation (Williams *et al.* 2012) was applied to assess the underlying factors affecting the adopted decision. First, suitability of the data set for factor analysis was evaluated by carrying Bartlett's Test of sphericity. As the P value was less than 0.05, (P=0.000, P<0.05), it was concluded that valid factor analysis can be performed with the data. (Williams, B, *et al.*, (2012). Next, possibility of carrying out meaningful factor analysis was assured as number of moderate correlations (correlation

coefficients in the range of 0.2 - 0.8) were observed between selected variables in the communalities tables.

## **Results and findings**

There was a significant difference between adopters and non-adopters in relation to experience (in years,  $t$  value = 4.448,  $P < 0.05$ ), agricultural income (Rs/month,  $t$  value = 7.201,  $P < 0.05$ ), average yield (Kg/Ac,  $t$  value = 4.631,  $P < 0.05$ ) and extension services (Number of visits/season,  $t$  value = 13.43,  $P < 0.05$ ). Further, there was a significant difference between adopted farmers and non-adopted farmers in relation to the level of education, where reported chi-square value (7.724,  $P < 0.05$ ) was significant at 5% level. Majority of adopted farmers have attained secondary education while, majority of non-adopters had only primary education. The major constrain faced by CFs (59.1\* percent) was, non-procurement of the whole harvest. Difficulty in obtaining formal credit facilities (47.7\* percent) was the second most important bottleneck, which CFs have faced. Regarding non contract farmers, the most critical problem they faced (61.2\* percent) was the uncertainty of obtaining reasonable price in the next season. Both contracted and non-contracted farmers (36.3\* and 35.1\*percent respectively) mentioned lack of crop insurance scheme as a main constrain they faced. (\*Multiple responses hence cumulative % can be above 100). The results of the principal component analysis showed that full time farmers who gained more agricultural experience, supported by more family labour participation were more prominent in adopting contract farming system.

## **Conclusions, implications and significance**

It seemed that the interaction of package of service provided by the buyer, such as input and extension have positively and significantly affected for the higher productivity (Yield/Ac) achieved by the contract farmers. Even though it was found out that the contractual agreement had increased access for formal credits in other developing countries, the impact was not much beneficial for the Sri Lankan context. The results of the principal component analysis showed that full time farmers who gained more agricultural experience and supported by more family labour participation were more prominent in adopting the contract farming system. Among the constraints faced by contract farmers, price instability was not a significant problem. In contrast, non-contract farmers have mentioned price instability as the most critical problem they have encountered. Therefore, it appears that, contract farming system has been effective as a market based instrument of price stabilization, in the context of maize contract farming in Sri Lanka. As the CF agreement is developed based on mutual understanding of farmers and buyers, development of specific legislation and guidelines for contract farming practices in Sri Lanka is a prerequisite for further spreading of the system.

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[S1/02] **Economics of Climate Change Adaptation: A Case with Three Rural Communities in Dry Zone, Sri Lanka**

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**Abstract**

*Climate change is one of the most pressing problems affecting mankind today. Climate change Adaptation is the most promising option in minimizing costs of climate change in the context of the developing world. Agriculture, fisheries and forestry are earmarked as the most vulnerable sectors in relation to climate change. Against this backdrop, the objective of the study was to capture the local context of adaptation of the rural communities namely Thambapanni, Maradankalla and Rathriwewa in North western, North central and Uva province respectively. Data was collected from 450 households. More specifically the study identifies the factors influencing climate change adaptation and cultivation choices. A Binomial logistic model and a multinomial logistic model were estimated to identify the variables affecting climate change adaptation and cultivation choices respectively.*

*Results revealed changing patterns of rain fall, drought, warming and deepening of ground water level were major climate problems and majority perceived present situation is worse compared to last 10 years. Food self-sufficiency, income, education, land ownership and social capital were found as significantly affecting factors for adaptation. Estimation of Multinomial logistic model revealed that majority shift to non-agricultural activities during dry season. Conversely, the farmers rich in market access, education and social capital were found as more likely to cultivate OFC depicting higher level of adaptation.*

*The study emphasizes mainstreaming adaptation is important as rural communities are at higher vulnerability. Food self-sufficiency, income, education, strengthening social capital, improving market access should prioritize in implementing strategies to enhance adaption.*

**Keywords:**     *Adaptation, Climate change, Cultivation choices, Social capital*

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### **Introduction and research problem**

Climate change is one of the most pressing problems affecting mankind today. More specifically, primary production sectors such as agriculture, fisheries and forestry are earmarked as most vulnerable sectors to its consequences (IPCC, 2007b). Climate change adaptation, making adjustments in natural or human systems in response to actual or expected climate stimuli is appearing as the best and most viable option to minimize the costs of climate change especially in the context of the developing world since climate change mitigation cannot be considered as promising and applicable solution.

Tackling environmental challenges and climate change has also been highlighted as a key socio-economic policy area which has to be addressed immediately by all South Asian countries (6<sup>th</sup> South Asian Economic Summit, 2013). Although a number of studies have been conducted at global level on climate change adaptation, vulnerability

and adaptation are the least studied areas in the local context and dearth of knowledge in adaptation results in inefficient policy formulation (Eriyagama, 2009).

Against this backdrop, the objective of the study was to capture the local context of adaptation of rural communities namely Thambapanni, Maradankalla and Rathriwewa in North western, North central and Uva province respectively, representing dry zone, Sri Lanka. More specifically the study identifies the factors influencing climate change adaptation and cultivation choices.

## **Methodology**

The study was based on data collected from 450 respondents for Seasonal climate forecasting and food security base line survey, 2013. Data were collected on demographic and socio-economic variables, perceptions and experiences to climate change and their adaptation strategies. A comparison of demographic and socio-economic status of the three rural communities was done using descriptive statistics. One-way ANOVA test was employed to compare the mean income levels of the households. Kruskal-Wallis test was used to identify the major climate related problems faced by three rural communities and also to identify perceptions of villagers on climate related problems.

Further a Binomial logistic model was estimated to establish the relationship between wealth, capital, food self-sufficiency and climate change adaptation. Basis of crop selection, a binary variable (climate or non-climate basis) was considered as a proxy for climate change adaptation (Seo and Mendelsohn, 2008). The dichotomous response

variable was equal to 1, if the crop selection is based on climate related variables such as anticipated rains or drought, water availability in the tanks etc. The dichotomous variable was equal to 0, if the crop selection is based on non-climate related variables such as profits, market conditions, community decision or agreements with buyers. Accordingly, if a farmer relies on climate related variables for crop selection, he/she is considered as less adapted to climate change whereas if a farmer relies on non-climate related variables for crop selection he/she is considered as highly adapted to climate change.

In addition, a Multinomial logistic model was estimated to analyze cultivation choices of farmers at a changing climate scenario since crop choice can be considered as a proxy for adaptation (Kurukulasuriya and Ajwad, 2007). Three crop choices of not-to-cultivate, cultivate paddy and cultivate Other Field Crops (OFC) in the dry season were treated as the dependent variable (three options are mutually exclusive) and independent variables were input variables, market access, human capital, social capital and demographic variables.

## **Results and findings**

Results of the descriptive analysis revealed that majority of farmers in the study area were full time farmers. i.e Maradakalla 71.62%, Rathriwewa 84.62% and Thambapanni 68.42%. Raring livestock was not a popular activity among the farmers. On average farmers were in their middle forties and had education up to primary or secondary level. Mean income level was LKR 11,087 which was higher than the official poverty line (LKR 3567.25) of the survey period. Food self-

sufficiency was measured by number of months that the household can meet their food demand by crop production and it was 11 (10.84) months. On average around 15% of farmers were entitled to the *Samurdhi* program which can be considered as a safety net. With respect to social capital, farmers were active members of at least 3 community level organizations on average.

According to the results, climate related problems, drought, warming and deepening of ground water levels were appeared as the major problems. All three rural communities perceived situation of changing rain fall pattern, drought, floods, pest and disease problems were worst compared to the situation prevailed 10 years ago.

62% of farmers relied on climate related variables to make the decision on crop selection whereas 38% relied on non-climate related variables. Accordingly highest percentage of farmers in the community showed less adaptation to climate change. Results of the Binomial logistic model revealed that food self-sufficiency, monthly income, land ownership and social capital were the factors significantly affecting for basis of crop selection. Respondents with higher levels of food self-sufficiency, monthly income and social capital were more likely to depend on non-climate variables for basis of crop selection, depicting higher level of climate change adaptation. In contrast, higher land ownership exhibited less likely for adaptation.

**Equation 01:** Binomial logistic model

$$\text{logit}(P_i) = \log \left( \frac{P_i}{1 - P_i} \right) = \sum_{i=0}^{10} \beta_i X_i + +U_i \dots \dots \dots (1)$$

**Table 01:Maximum Likelihood estimates for Binomial logistic model**

Independent Variable	Parameter	Co-efficient	Marginal Effects
Constant	$\beta_0$	5.32(1.42)***	
Samurdhi	$\beta_1$	-0.16(0.34)	-0.04(0.08)
Food Self-sufficiency(Months)	$\beta_2$	-0.26(0.09)***	-0.06(0.02)
Total expenditure(LKR)	$\beta_3$	-0.00(0.00)***	-0.00(0.00)
Land ownership(Acres)	$\beta_4$	0.20(0.07)**	0.04(0.02)
No of memberships	$\beta_5$	-0.22(0.11)	-0.05(0.02)
Age(Years)	$\beta_6$	-0.01(0.01)	-0.00(0.00)
Education above secondary level	$\beta_7$	-0.60(0.36)	-0.42(0.22)
Secondary education	$\beta_8$	-0.32(0.46)	-0.14(0.20)
Primary education	$\beta_9$	1.13(0.93)	0.24(0.18)
Livestock index	$\beta_{10}$	0.12(0.47)	0.03(0.11)

\*\*\* for significance at 1%, \*\* for significance at 5%

Standard errors are in parenthesis.

Marginal effect for discrete change of dummy variable from 0-1

Log likelihood= -125.2521, Likelihood ratio chi2 (9) =89.17, Prob>chi2=0.0000, Pseudo R<sup>2</sup>=0.2625

Estimation of Multinomial logistic model revealed majority shift to non-agricultural activities during dry season. 78.36% of farmers decided not-to-cultivate during dry season, 13.46% decided to cultivate Other Field Crops and 8.18% decided on paddy farming. However, the respondents rich in market access, education and social capital were found as more likely to cultivate paddy and OFC during dry spells.

**Equation 02:** Multinomial logistic model

$$\text{logit}(P_i) = \log\left(\frac{P_i}{1-P_i}\right) + \sum_{i=1}^{12} \gamma_i X_i + \text{fi} \dots \dots \dots (2)$$

**Table 02: Maximum likelihood estimates for parameters in Multinomial logistic model**

Independent Variable	Parameter	Paddy	
		Coefficient	Marginal Effect
Constant	$\gamma_0$	-22.90	
Family Labour(Days)	$\gamma_1$	-0.00(0.00)	0.00 (2.41)
Market Access	$\gamma_2$	2.62(0.49) ***	0.10 (0.04)
Forecasting Ability	$\gamma_3$	0.11(0.59)	0.00 (0.02)
Total expenditure (LKR)	$\gamma_4$	0.00(0.00)	1.42e-06 (0.00)
Age (Years)	$\gamma_5$	0.04(0.02) **	0.00 (0.00)
Sex	$\gamma_6$	-1.21(0.69) *	-0.05 (0.05)
Above secondary education	$\gamma_7$	17.99(1.44) ***	0.71 (0.34)
Secondary education	$\gamma_8$	18.46(1.36) ***	0.48 (0.24)
Primary education	$\gamma_9$	17.28(1.51) ***	0.44 (0.28)
Land(Acres)	$\gamma_{10}$	0.01(0.07)	0.00 (0.00)
Ancestry	$\gamma_{11}$	-0.15(0.46)	0.01 (0.01)
No of memberships	$\gamma_{12}$	0.02(0.15)	0.00 (0.00)
Independent Variable	Parameter	OFC	
		Coefficient	Marginal Effect
Constant	$\gamma_0$	-20.29	
Family Labour(Days)	$\gamma_1$	-0.00(0.927)	-2.00e-06 (0.00)
Market Access	$\gamma_2$	3.52(0.000) ***	0.30 (0.06)
Forecasting Ability	$\gamma_3$	-1.31(0.112)	-0.03 (0.02)
Total expenditure (LKR)	$\gamma_4$	-0.00(0.452)	-1.22e-06 (0.00)
Age (Years)	$\gamma_5$	0.00(0.955)	-0.00 (0.00)
Sex	$\gamma_6$	-1.22(0.088) *	-0.77 (0.06)
Above secondary education	$\gamma_7$	16.8(0.000) ***	0.26 (0.34)
Secondary education	$\gamma_8$	18.33(0.000) ***	0.52 (0.23)
Primary education	$\gamma_9$	17.44(0.000) ***	0.56 (0.28)
Land(Acres)	$\gamma_{10}$	-0.08(0.391)	-0.00 (0.00)
Ancestry	$\gamma_{11}$	0.55(0.242)	0.01 (0.01)
No of memberships	$\gamma_{12}$	0.29(0.028) **	0.01 (0.00)

\*\*\* for significance at 1%, \*\* for significance at 5%, \*for significance at 10%

Standard errors are in parenthesis

Log likelihood= -169.2464, Likelihood ratio chi2 (24) = 166.13, Prob>chi2 = 0.0000, Pseudo R2 = 0.3292

Results are compared with the baseline choice of not-to-cultivate option

## **Conclusions, implications and significance**

The study emphasizes that it is of utmost importance to mainstream policy agenda on enhancing climate change adaptation and adaptive capacity of rural agricultural communities in Sri Lanka as they are at a higher vulnerability. The study provides further evidences to emphasize changing patterns of rain fall, drought, warming and deepening of ground water levels are the major climate related problems faced by farmers in the dry zone. According to the results, food self-sufficiency, monthly income and level of education are the factors that lead to enhance climate change adaptation. Therefore initiatives should be stem up to improve access to education and elevate living standards of rural communities by increasing income level. At the same time strengthening of local and private institutions aiming at social and human capital build up is important. Further improving market access should be one of the substantial areas that should be given priority in implementing strategies to enhance climate change adaptation in the rural context.

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## [S1/03] **Development of Pineapple (*Ananascomosus*) and Watermelon (*Citrulluslanatus*) Blended Ready-To-Serve Beverage**

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### **Introduction**

In a horticultural sense Watermelon (*Citrulluslanatus*) is classified as a vegetable crop. The crop itself is actually a fruit. The season for this crop is rather short lasting only about two months. Its harvesting time in Sri Lanka is from May to June. Thus, it is a real summer crop. The consumption of watermelon is also confined to summer only. Higher quality in watermelon is associated with high total sugar content, deep red color and pleasant crisp texture. The maturity thus plays a very important role in the marketing. When it is under matured, the fruit is low in total soluble solids and light in color. But when it is over matured, the color fades, and the texture becomes soft, although the total soluble solids still remain high. Processing of fruits into value added products is the best option to control the huge losses. Fresh fruits are utilized for the preparation of jam and squash, juice, sauce and confectionery. Present dietary scenario necessitates exploring the possibilities of incorporating novel ingredients in commonly consumed foods rather than developing new food product (Aleem-Zakir *et al.*, 2012). Juice blending is one of the best methods to improve the nutritional quality of the juice (Awsi and Dorcus, 2012). It can improve the vitamin and mineral content depending on the kind and quality of fruits and vegetables used. Pineapple (*Ananascomosus*)

belongs to the family of bromeliaceae. Its pulp is juicy and fleshy with the stem serving as a supporting fibrous core. It is an excellent source of antioxidant vitamin C which is required for the collagen synthesis in the body. And it is also available in May to June at low prices in the markets. In Sri Lanka watermelon has been grown in 159 ha while pineapple is cultivated in 4782 ha. The annual production of watermelon and pineapple are 8349mt and 51,611mt respectively (Department of Agriculture pocket book of agricultural statistics 2011). The aim of this research was to prepare and determine shelf life of Ready-To-Serve beverage from pineapple and watermelon fruit juices at different combinations and to determine the most suitable combinations of juices for the commercial preparation.

## **Methodology**

Undamaged, disease free, healthy, mature and ripe watermelon (Variety - *Thillina*) and pineapple (Variety - *Mauritius*) fruits were purchased from the commercial horticultural farms of the Department of Agriculture, Sri Lanka. The drink was prepared by adding sugar, citric acid and sodium metabisulphite, according to the Sri Lanka Standards (1985) for RTS fruit beverages. RTS beverages were developed using watermelon and pineapple juices at different combinations. The prepared beverages were filtered through the strainer (200  $\mu$ m) to get a clarified juice and filled in previously sterilized glass bottles (200 ml) leaving 2.5 cm head space and sealed airtight by crown corking. Then in bottle sterilization was done at 105°C for 10 min and cooled to room temperature of 30 $\pm$ 1°C. The following treatment combinations were formulated.

- T<sub>1</sub> - RTS beverage with 100% watermelon juice
- T<sub>2</sub> - RTS beverage with 90% watermelon juice and 10% pineapple juice
- T<sub>3</sub> -RTS beverage with 85% watermelon juice and 15% pineapple juice
- T<sub>4</sub> -RTS beverage with 80% watermelon juice and 20% pineapple juice
- T<sub>5</sub> - RTS beverage with 75% watermelon juice and 25% pineapple juice
- T<sub>6</sub> - RTS beverage with 70% watermelon juice and 30% pineapple juice

These freshly made beverages were assessed for the nutritional, organoleptic and microbiological qualities. The chemical evaluations were done by using standard AOAC (2002) methods. The microbial assessment was carried out by estimating total plate count according to the method described by Arachchi (2003) in raw mango RTS. The total plate count was determined by observing the colonies formed especially bacteria.

The organoleptic qualities including colour, flavor, taste, thickness and overall acceptability were evaluated by randomly selected 30 semi-trained members using nine-point hedonic scale testing. A 50ml of juice at 7°C was presented to the panelists during each serving. Among the six treatments, the most preferred three treatments were selected for storage studies based on their quality characteristics. The samples were stored at ambient temperature of 30±1°C and relative humidity 75 – 80% to determine the shelf life of the prepared RTS beverages.

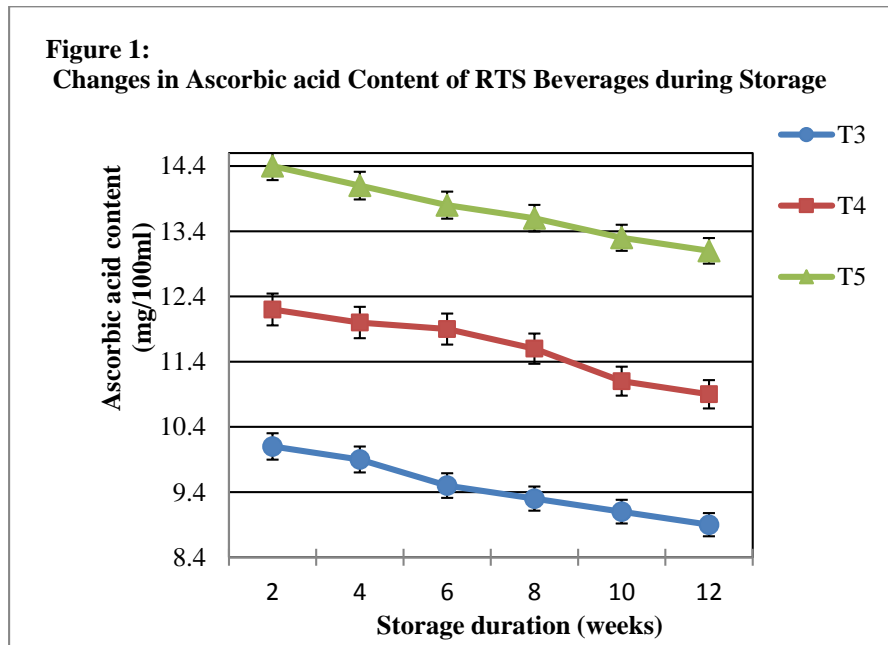
The difference between means was compared using Duncan's Multiple Rang Test using SAS statistical package. Tukey's studentized range test was used for organoleptic evaluation to compare the difference between means.

## **Results and Discussion**

The freshly made RTS beverages were assessed for nutritional qualities, organoleptic characteristics and microbial quality. Samples subjected to sensory evaluation showed that there were significant differences ( $p < 0.05$ ) between treatments of freshly made pineapple blend watermelon RTS beverages. The titrable acidity, ascorbic acid, total soluble solids and total sugars of freshly made pineapple blend watermelon RTS beverages increased, while pH decreased with the increased concentration of pineapple juice from 10 to 30%. Among all six treatments the best three treatments were selected based on their quality characteristics for storage studies. Nutritional, sensory and microbial tests were carried out at two week intervals during the entire storage period. The changes in ascorbic acid content of the RTS beverages made from watermelon- pineapple during storage are shown in Figure: 1.

The ascorbic acid content showed a significant ( $p < 0.05$ ) decreasing trend to the storage period in all treatments. This reduction was due to the oxidative degradation of ascorbic acid to dehydro ascorbic acid during storage as the ascorbic acid is highly sensitive to the presence of oxygen in its environment. Jawaheeret *al.* (2003) reported that another principal cause of ascorbic acid decrease might be residual

oxygen present within the container head space assisted by degrading activities of light.



Note: The vertical bars indicate the standard errors

In this study, the pH of pineapple blend watermelon RTS beverages decreased during storage (Table: 1). Similarly, Majumdaret *al.* (2008) also reported that pH values decreased in ash gourd-mint leaves juice during six month storage.

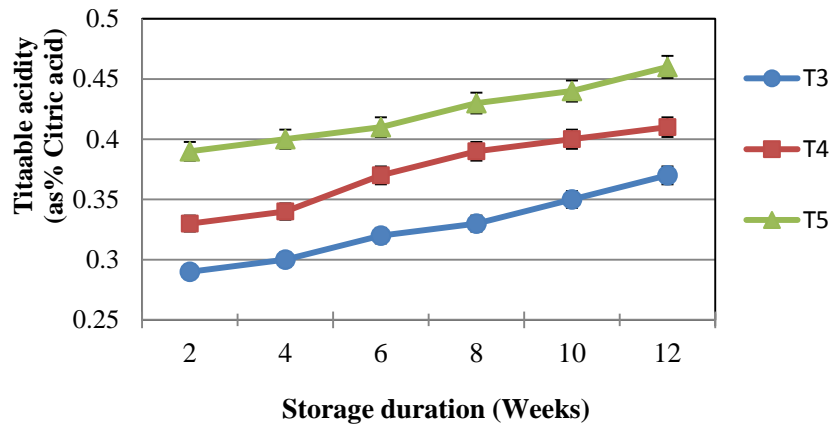
**Table 1: Changes in Nutritional Characteristics of RTS beverage during storage**

Nutritional Parameters	Treatments and storage period					
	T <sub>3</sub>		T <sub>4</sub>		T <sub>5</sub>	
	2 <sup>nd</sup> week	12 <sup>th</sup> week	2 <sup>nd</sup> week	12 <sup>th</sup> week	2 <sup>nd</sup> week	12 <sup>th</sup> week
pH	4.88	4.33	4.76	4.62	4.63	4.52
TSS (Brix)	13.8	13.0	13.9	13.1	14.4	13.6
Total sugar (%)	13.0	12.1	13.4	12.6	14.1	13.3

High acid and low pH may be due to the production of acetic acid and lactic acid during storage. Total sugar in all treatments had the decreasing trend with the storage period because hydrolysis of polysaccharides and oxidation of sugars took place during the storage period as supported by Fennema (1996).

The TSS reduced gradually (Table: 1) which might be due to the chemical interactions taking place among the organic constituents of the beverage. In all treatments, titrable acidity significantly ( $p < 0.05$ ) increased throughout the storage period reaching a maximum value of 0.46 was observed in RTS beverage with 85% watermelon and 15% pineapple juice with the minimum value of 0.29 which was observed in RTS beverage with 75% watermelon and 25% pineapple juice (Figure: 2).

The increase in tritable acidity is due to the hydrolysis of polysaccharides and oxidation of sugars leads to formation of organic acids (Fennema, 1996). Among the tested treatments, the RTS beverage formulated with 80% watermelon and 20% pineapple juice contained 13° Brix, 0.41% titrable acidity, 12.6% total sugars, 10.9 mg/100g ascorbic acid and pH of 4.62 at the end of 12 weeks of storage. However, titrable acidity of these beverages increased from 0.33 to 0.41% which is within acceptable range for long term storage. Sensory evaluation was made for pineapple blend watermelon RTS beverage after two weeks interval through panel of 30 semi-trained panelists. The panel evaluated color, flavor, taste, thickness and overall acceptability using a 9-point hedonic scale.

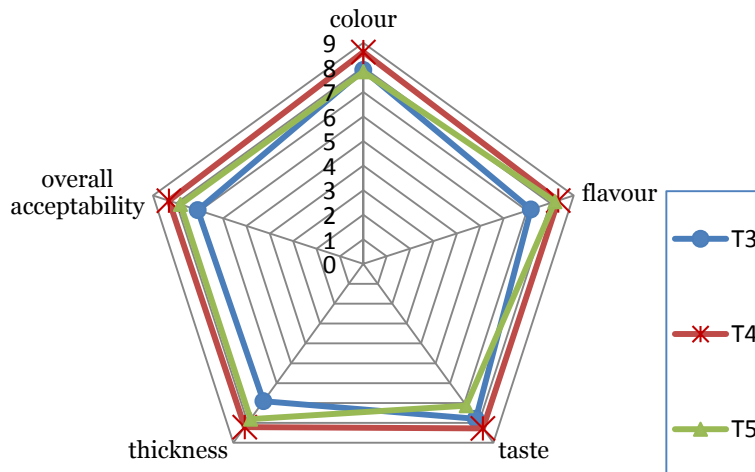
**Figure 2: Changes in Titrable acidity of RTS beverage during storage**

Note: The vertical bars indicate the standard errors

Organoleptic characters of Pineapple Blend Watermelon RTS Beverages stored at ambient temperature were changed slightly apart from freshly made RTS beverages during the storage period (Figure: 3).

Means with the same letters are not significantly different from each other at 5% level based on Tukey's Test Sensory parameters which were measured using nine point hedonic scales. The results of sensory assessment revealed that there were no significant differences ( $p < 0.05$ ) between the treatments in terms of color, taste and overall acceptability while flavor and thickness had significant differences ( $p > 0.05$ ) among the tested treatments.

**Figure 3: Sensory characteristics of Pineapple Blend Watermelon RTS Beverages at the end of the storage period of 12 weeks**



Means with the same letters are not significantly different from each other at 5% level based on Tukey's Test Sensory parameters which were measured using nine point hedonic scales. The results of sensory assessment revealed that there were no significant differences ( $p < 0.05$ ) between the treatments in terms of color, taste and overall acceptability while flavor and thickness had significant differences ( $p > 0.05$ ) among the tested treatments. The findings of microbial studies showed no total plate counts at the end of 12 weeks of storage in the formulated beverages.

## Conclusions

RTS beverage formulated with 80% watermelon and 20% pineapple juice showed the best overall acceptability compared to other combinations and could be stored at ambient conditions of  $30\pm 1^{\circ}\text{C}$  and relative humidity 75–80% for a minimum period of 12 weeks without any significant changes in the quality attributes.

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[S1/04] **Agricultural Innovation: The Role of Micro-Inventions by Rural Farmers in Minor Crop Industry with a Special Reference to the Meerigama D.S Division**

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**Keywords:** *Agriculture innovation, Macro-invention, Micro-invention, Minor crops, Rural Development, Sustainability*

## **Introduction**

Agricultural development is not only a defence against hunger for every household but also can raise income nearly four times more effectively than the growth in any other sector. Agricultural innovation typically arises through dynamic interaction among the multitude of actors involved in growing, processing, packaging, distributing, and consuming or otherwise using agricultural products. Agricultural innovations are primarily concerned with a need for increasing production (of food, fodder, secondary products) as well as enhancing quality (of produce, production process, growing conditions) (Veen, 2010). Innovations affect many areas: crops, animals, growing conditions, implements and management practices. As main forms of innovations, two types of inventions by various stakeholders in agriculture can be identified. They include, ‘macro-inventions’ (radical new ideas for adoption) and ‘micro-inventions’, that are changes or modifications (for adaptation) in tools and practices made by skilled practitioners (farmers, craftspeople), rather than by

inventors or entrepreneurs. The farmers are important stakeholder in minor crop industry and they often apply their own-modified practices and methods which usually are referred to as 'routine innovations, sub-inventions or micro inventions' to enhance crop productivity. But these modifications are not accepted and recommended by the formal mechanism as crucial in modifying and complementing macro-inventions. This hidden conflict between skilled and experienced farmers and the formal mechanism may badly affect the sustainability of the rural minor crop industry. This may create isolation and vulnerability in reaching appropriate guidance, training and support for potential farmers with less skills and experiences. Furthermore, the limited application of backward and forward linkage in technology inventions may result in a 'technological complex'(Dyer 1997; Myrdal 1997; Sherratt 1983; Watson 1983) and 'agricultural stagnation'. With this view, the study attempts to analyse the role of Micro-Inventions used by rural farmers in minor crop industry in Sri Lanka.

## **Methodology**

A qualitative research was conducted in Meerigama D.S Division, with a sample of purposely (and snowballing sampling method which was especially useful when someone was trying to reach people who are inaccessible or hard to find) selected 30 (both experienced and newly entered) farmers (target population was 125) who cultivate pineapple, betel, and/or banana for their livelihoods. Additionally, six extension officers (Agricultural Instructors) attached to three agrarian centres (*Meerigama, Pallewela, and Pasyala*) in Meerigama D.S Division to represent the formal mechanism were selected. As data collection

methods, focus group discussions, observations, and face to face in-depth interviews were used. As data analysis methods, thematic analysis and case studies were mainly adopted. Here, descriptive analysis was undertaken with substantial description and efforts were taken to find main themes of the discussion. Furthermore, special characteristics and exceptional behavioral patterns of some farmers and extension officers, and their experiences related to the objectives of the study were identified. In this study, multiple reliability strategies were incorporated to make sure the accuracy of the findings. They included triangulation of different data sources of information, member checking, and peer debriefing, spending prolonged time in the field and presenting negative or discrepant information that runs counter to the themes.

## **Results and findings**

Agricultural innovations adapted by the farmers include growing conditions (fertilizer management and land preparation), implements (cultivation patterns and use of easy devices), and management practices of changes relates to production and ownership. The findings of the research show that skilled and experienced farmers use their own methods and practices, especially in plant selection, planting, fertilizer and weed management. Though the production is in considerable quality and quantity, the agricultural income is not sufficient since they lack implementing market oriented-management practices. Further, the extension officers maintain good relationship with farmers, knowing that farmers pay no or less attention for their guidance. But this dependency on each other gives mutual benefits to both. The

farmers with less experience follow both informal (from experienced farmers) and formal methods (from AIs) in their cultivation processes but they end up with mixed results. It shows that the adaptation of these methods is not systematically developed for adoption and that there is poor decision making. Many improvements involve adaptations to suit the (new) local circumstances rather than the wholesale adoptions of technologies brought from outside. Farmers are willing and able to challenge existing ways of doing things, but the prevailing ideology among extension officers (government mechanism) seems discouraging the new farmers.

### **Conclusions, implications and significance**

Innovation plays an important role in creating jobs, generating income, alleviating poverty and driving social development. The agricultural inventions do not frequently focus on the adoption of newly introduced technologies, but the adaptation of existing ones. Further, as there is a failure of the formal mechanism to establish the linkage between micro and macro inventions, it is proven that the potential farmers with less experience and skills are vulnerable to failures. Extension officers need to be qualified to build the trust among farmers. For innovation to occur interaction among diverse stakeholders in minor crop industry need to be opened and they should draw upon the most appropriate available knowledge. Aside from a strong capacity in R&D, the ability to innovate is often related to collective action, coordination, the exchange of knowledge among diverse stakeholders, the incentives and resource available to form partnerships and develop businesses,

and conditions that make it possible for farmers or entrepreneurs to use the innovations. Agricultural innovations, small and large, have been catalysts for bigger changes, such as tying people to land, land ownership, population growth, specialization and social hierarchy, wealth and prestige acquisition, colonization of agriculturally marginal land, increases in production, trade and exchange, urbanization and, ultimately, the rise of the state and our own modern world. Therefore, it is important for stakeholder-based supportive policies for the sustainability of rural minor crop industry along with rural development.

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**Session-2**  
**Education in**  
**Knowledge**  
**Economy**



[S2/01] **The Difference in Employability of Graduates in public and Private Sector Management Education Institutes in Sri Lanka**

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**Abstract**

*The rationale for carrying out this research project lies in the findings of a survey that outlines the difference in Employability of university graduates. This is due to the exploratory demanding nature of the job market available for graduates of public and private higher education sectors. The aim of this study is to identify the difference in employability of the graduates in public and private higher education institutes who offer management degree programmes. As education is one of the major standards of measuring development and as human capital is the main asset of the country, it is important to study how the higher education of Sri Lanka is prepared to support undergraduates to develop employable skills. Due to the heavy competition in entering public universities in Sri Lanka, the higher education is open to private providers and they are affiliated with foreign universities. These two institutes in higher education follow their own ways of producing graduates. Therefore it creates a significant requirement to identify differences in employability of graduates of public and private higher education institutes. This study reviewed available theoretical literature such as Human Capital Theory, Institutional theory, Theory of employment and unemployment and job market signalling. The study has comprehensively reviewed different views generated by other authors pertaining to graduate employability in general. Primary data was collected through a questionnaire and interviews by randomly selected 121 graduates who have passed out from two selected education institutes. An empirical survey was designed with two sets as to study the views and experiences of graduates who are using Facebook and google+ sites by using 'Snowball sampling' method since questionnaires were distributed among the above social media network communities. The researcher concludes that both institutes pay their attention to develop theoretical knowledge in their students. Public institutes were one step ahead in developing practical skills of students. Leadership programmes, internships, industrial visits and*

*extracurricular activities should receive further attention of both institutes. It is found that provided support to develop enterprise skills and interpersonal skills are not sufficient in order to fulfil the requirements of the job market.*

**Keywords:** *Employability, Knowledge, Interpersonal skills, Enterprise Skills, Technical Skills*

## **Introduction and Research Problem**

Sri Lanka has now become a victim of the forces of globalized education industry. Up to 12,000 Sri Lankan students go abroad each year to study (ICEF Monitor 2013), meaning Sri Lanka could be a significant source of supplying students to universities overseas. In recent years, Sri Lanka has spent over Rs.80 billion annually for educational purposes and this is about 12% of Sri Lanka's trade deficit, 18% of external reserves of the country or 25% of total capital expenditure of the government in 2009 (Nanayakkara, 2010). This is not a trend that favours economic development in Sri Lanka because this expenditure does not justify the benefits of educating students who went abroad (Nanayakkara, 2010). Therefore the government has invited the private sector to invest in education, because some 100,000 seek further studies annually through the private sector education system (Dissanayake, 2014). Private institutes can open colleges as they are capable of and are more profit oriented. The private education institutes are behind targets and they offer academic programs differently. According to the recent advertisement displayed by Esoft institute (2012) the students can enrol & continue higher education without having A/L results. Therefore it is questionable whether these

private institutes are in line with the expected quality standards of the country. On the other hand, the higher education sector is in a position to supply more skilled labour and thereby promote economic growth (Chandrasiri, 2008), but poorly managed public universities are registered in the minds of local people for student strikes, agitations, clashes and blood-shed and frequent closing of faculties and campuses (Nanayakkara, 2010). Furthermore the educational institutes are criticized for not accommodating the volume and variety of students' demand, high unit cost arising from unproductive overheads, inflexible curricula and teaching methods, and, lack of research output (Vidanapathirana, 2000). The country's Higher education institutions are charged to develop human capital through teaching and knowledge development, building a knowledge base through research, dissemination and use of knowledge by interacting with the users of knowledge. Therefore, this study focuses to identify any difference in employability of graduates in public and private higher education institutes who offer Management degree programmes.

## **Methods**

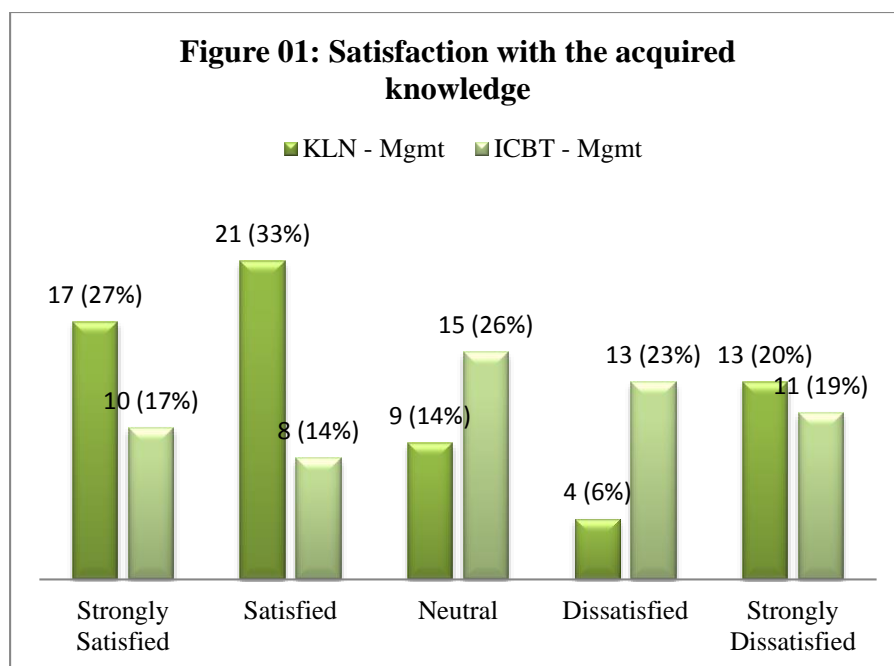
This study compares the employability of graduates of Public and Private Higher Education institutes who offer Management Degree programmes. Therefore, the graduates of the Faculty of Management from University of Kelaniya and The Department of Management at ICBT were selected to conduct this study. An empirical survey was designed with two sets as to study the views and experiences of graduates first who are using Facebook and google+ sites by using 'Snowball sampling' method and thee questionnaires were distributed

among the above social media network communities. Secondly, online interviews were conducted with graduates from both institutes via Skype calls in order to study the employment transition, promotions and challenges after the graduation. 64 graduates of the University of Kelaniya and 57 Graduates of ICBT participated in this study. The convenience sampling method was used in the second set to obtain more scientific result that could be used to represent the entire population. Therefore the sample was selected from the sampling frame which was given by the Alumni Association of the University of Kelaniya and ICBT Campus. Employability has the influence of controllable variables such as qualifications, soft skills, job specific skills, technical skills and non-controllable variables such as Government actions, Social factors, Economic Growth, Employers' expectation and psychological factors. Later, the above mentioned employability transition, promotions and challenges after the graduation collected from Skype interviews were evaluated and the correlation was measured between the satisfaction of the gathered knowledge and the satisfaction of the present employment. Research data analysis was conducted in the methods of univariate analysis such as frequency tables, diagrams, measures of central tendency and measures of dispersion.

## **Results and Findings**

The analysis was based on empirical evidence which focused on degree programmes offered by both institutes. The majority of the graduates stated that they are satisfied with the knowledge they

acquired from the University of Kelaniya. Dissatisfaction was shown by graduates from ICBT (Figure 01).



Also 1/5 of graduates of public universities are strongly dissatisfied and shows that the provided knowledge is insufficient. Most of the graduates are not satisfied with the practical and job specific skills provided by the institutes (Table 01). Based on the mean value, over 50% of graduates from both institutes agree that the acquired knowledge has supported in employment (Table 01).

**Table 01: Statistically analysed data**

	Satisfaction with the acquired knowledge		Support from the acquired knowledge in employment		Satisfaction with the gained knowledge and job specific skills		Employment and its relevance to the degree	
	KLN - Mgmt	ICBT - Mgmt	KLN - Mgmt	ICBT - Mgmt	KLN - Mgmt	ICBT - Mgmt	KLN - Mgmt	ICBT - Mgmt
Mean	12.8	11.4	32	28.5	12.8	11.4	32	28.5
Standard Error	2.9	1.2	14	2.5	2.4	3	19	13.5
Median	13	11	32	28.5	13	10	32	28.5
Mode	Satisfied	Neutral	Yes	Yes	Neutral	Dissatisfied	Yes	Yes
Standard Deviation	6.6	2.7	19.7	3.5	5.5	6.7	26.8	19
Sample Variance	44.2	7.3	392	12.5	30.7	45.3	722	364.5
Range	17	7	28	5	14	17	38	27

*Source ; Survey Data*

35% of public university graduates are employed in public sector and public sector jobs are usually more secure than other jobs. They also provide higher benefits, such as old-age pension, and require lower levels of efforts. Sometimes, they also carry more prestige (Rama, 2003). English Language fluency was the main challenge which the graduates of the public universities faced (Table 02). Graduates of private institutes have mentioned that they faced challenges in applying practical skills in employment. Correlation analysis (satisfaction in provided knowledge and practical skills) in both institutes brought up a different opinion. It is a negative weak relationship as -0.3 in the public universities as, lack of attention paid to deliver these two areas together as one interrelated component in the curriculum. The opposition of this can be seen in the Correlation

analysis (0.4) of private institute curriculum as paying attention to consider knowledge and practical skills as one component in their curriculum, however slow it occurs.

**Table 02: Data distribution of challenges faced in the first job**

Challenges faced in the first job	Response			
	KLN - Mgmt		ICBT - Mgmt	
English Language	50	47%	9	10%
Computer literacy	12	11%	10	12%
Knowledge	11	10%	23	27%
Practical skills	28	26%	25	29%
Common sense	5	5%	16	19%
Any other	1	1	3	3%
Total	107	100%	86	100%

*Source ; Survey Data*

## Conclusions, implications and significance

This study highlights the importance of improving the employability of graduates of public and private higher education sectors especially in the Management stream. Graduates from both institutes have to go through a difficult period in the early stages of their career due to some shortcomings in their degree programmes. Based on the results of this research on selected two institutes, it was observed that there should be proper procedures and standards established in public and private higher education to reach the international quality standards of higher education. There should be a system set up for undergraduates to engage with industrial activities during their study time which helps creating relationships and networking with industries. The access from university to corporation and vice versa must be built as a strategy. At

the same time public- private higher education institution collaboration must be established in order to ensure the development of graduates who have equal employable skills and abilities. It is required to monitor and evaluate students' progress continually and therefore a suitable mechanism should be implemented with the involvement of external parties such as industries and foreign university representatives. The results have a significant influence on the higher education sector of Sri Lanka as it helps both sectors to understand how they need to develop and upgrade themselves in order to produce employable graduates.

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## [S2/02] Cost Competitiveness of Sri Lanka's State University System in Higher Education Service Delivery

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### Abstract

*Though the free education in Sri Lanka has had many achievements, the bureaucratic governance and the budgetary constraints have limited the further development of the State-run national university system to cater to the growing demand. This has forced candidate students to look for alternatives offered by local and foreign private universities. There is also a perception that the present State university structure is cost-ineffective and thus is a burden on national coffers. This question of cost-competitiveness of the Sri Lankan higher education sector was subject to examination in the present study. The results indicated that the State university system is significantly cost effective in producing graduates of internationally acceptable quality. An in-depth analysis on the discipline of Medical Sciences confirmed that the Sri Lankan State university system is significantly capable of competing cost-wise with the international universities in producing medical graduates. Letting the State university system suffocate within the bureaucratic governance and budgetary constraints is thereby proven unwarranted as the system appears capable not only of cost-effectively meeting the local demand for higher education, but also of being internationally marketable, potentially becoming a true knowledge-hub paving the way to earn foreign exchange to the national economy.*

**Key words:** *State Universities, Cost Effectiveness, Foreign Exchange Effect, International Competitiveness, Higher Education Voucher Scheme*

## **Introduction**

Compared to other countries in the region, Sri Lanka has a history of over 70 years of free education, which has resulted in many achievements on human development. However, the bureaucratic governance and budgetary constraints have set obstacles to the further development of the State-run national university system to cater to the expanding demand. This has, since of late, compelled candidate students to look for alternatives offered by local private universities and also by foreign universities leading to an outward drainage of hard-earned foreign exchange [1]. Also, there is a perception that the present State university structure is cost-ineffective, and thus, is a burden on national coffers. If so, the relative stagnation of the State sector in higher education, the expansion of the private sector's presence, and also the increase in out-bound migration for education purposes could be an unavoidable consequence [2]. However, if the reality is different, the relatively shrinking trend of the State university system would neither be justifiable, nor healthy. This question of cost-competitiveness of the Sri Lankan higher education sector was subject to examination in the present study in order to understand its comparative strengths, such as the potential for internationalization of the State university system [6], and the weaknesses, and to evolve possible policy interventions in view of developing the sector further.

## **Materials and Methods**

The total costs per student per year pertaining to each academic stream in 2011 were estimated using the data published by the University

Grant Commission [5] on stream-based recurrent costs for the year 2011 and university-based investments over several past years.<sup>1</sup> Cost outliers were statistically identified and those lying outside the acceptable limits (at 95% confidence level) were removed<sup>2</sup> before such estimation of stream-wise national averages. With regard to local and foreign private universities, tuition fees for similar degree programs were obtained by consulting their prospectus and also through direct inquiry, as their cost data were not published. Graphical representations, outlier investigation and statistical comparison of means were adopted in the analysis.

## Analysis and Results

The Table 1 summarizes the university-wise capital and recurrent cost estimates for the six main academic streams, namely Medicine, Engineering, Science, Agriculture, Management, and Arts/Law, and the stream-wise average total cost estimates are depicted in the Box-Plots in the Figure 1.

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<sup>1</sup>University-wise capital costs were estimated by working out capital stocks as at 2011, and applying a capital depreciation rate of 5% per annum, making capital injections prior to 1991, fully depreciated by 2011, not reflect in the capital stock. Series of assumed and estimated investments were brought into 2011 prices using investment deflator computed using macroeconomic data published by the Central Bank of Sri Lanka.

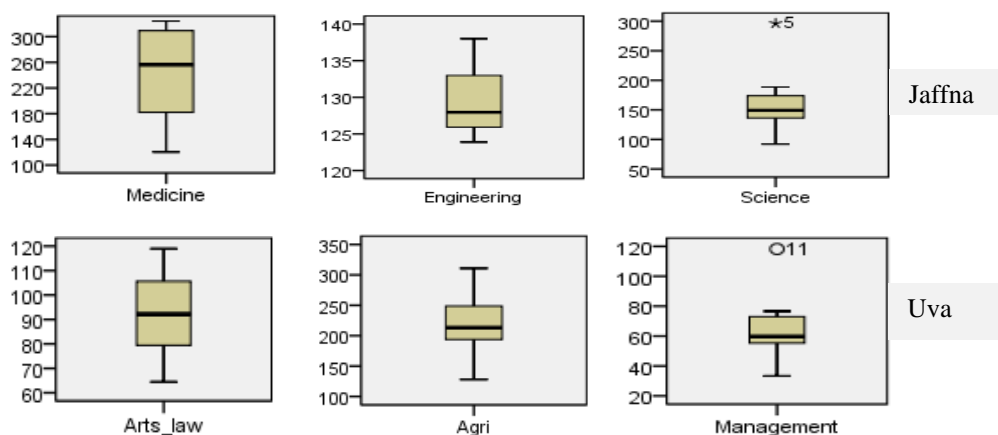
<sup>2</sup>Outliers removed concerned the Uva-Wellassa University (in Management), and the Jaffna University (in Science); the former seems a direct result of high capital intensity and low student enrolment reveals, possibly owing to that being a relatively new university, while the latter seems caused by the extremely high recurrent cost intensity in 2011, the root cause needs investigation.

**Table 1: Composition of Expenditures per Head per Year by Academic Streams and Universities**

(All Costs are in Rs 000s)

University	Capital Expenditure	Recurrent Expenditure					
		Medicine	Engineering	Science	Agriculture	Management	Arts/Law
Colombo	12.46	250.01	-	131.59	-	46.66	85.63
Peradeniya	7.96	193.97	115.91	136.51	266.33	-	99.61
Sri J'pura	8.11	316.08	-	125.69	-	49.88	77.25
Kelaniya	9.92	297.48	-	178.74	-	42.66	79.02
Moratuwa	17.57	-	110.38	-	-	-	-
Jaffna	13.22	236.87	-	283.04	209.91	-	82.12
Ruhuna	15.14	295.64	122.86	154.40	202.99	37.34	103.83
Eastern	13.74	148.49	-	146.01	297.09	46.01	50.74
South Eastern	17.51	-	-	136.48	-	58.47	52.08
Rajarata	30.16	90.36	-	108.46	175.19	46.48	49.26
Sabaragamuwa	23.22	-	-	68.83	184.93	46.69	82.41
Wayamba	21.11	-	-	86.71	160.98	45.50	-
Uva	41.37	-	-	137.07	86.69	76.86	-

Source: Authors' estimations based on data published by the University Grants Commission [5]



Note: The estimated per head total cost for the year 2011 is represented by the Y axis

**Figure 1: Mean Cost per Student per Year for Main Academic Streams**

A few particular features, however, could be observed. The discipline of Medicine costs nearly double that of Engineering or triple that of

Social Sciences or Law. Rajarata and Eastern Universities managing with recurrent costs of less than 50% pertaining to the more established Universities prompt the need to examine the causes to exclude compromising quality. Agriculture appears a close contender to Medicine in terms of recurrent costs. It is even costlier than Medicine at Eastern, Rajarata and Peradeniya Universities. Agriculture imposes relatively lesser recurrent costs at Uva, Wayamba, Sabaragamuwa and Rajarata universities. Wayamba and Sabaragamuwa universities in Science, and Eastern, South-Eastern and Rajarata Universities in Arts, appear operating at much lesser recurrent costs than their respective counterparts in other Universities. Jaffna University records an exceptionally high recurrent cost per student in Science; to the extent that it is almost double that of the Science streams in other universities, more than what is incurred on their own Medical students, and nearly two and a half times that of an average Engineering undergraduate. The most note-worthy possibility is the clear recurrent cost effectiveness of Management and Engineering Faculties in comparison to Arts/Law and Science, respectively, when the inverse is what would generally be anticipated. The capital cost structure indicates higher capital intensities in all four relatively new institutions : Uva-Wellassa University, for example, has nearly five times the capital cost per student per year compared to Sri Jayawardenapura University, while the Rajarata University is having nearly four-fold than of Peradeniya University, which could be a combined effect of the heavy capital injections needed in the early years of these young universities, and the relatively lesser number of students registered. The reasons for such characteristic differences, however, merit examination in a detailed research.

## ***International Competitiveness***

The estimated average costs pertaining to the Sri Lankan State universities were compared against the charges levied by a selected group of competing local and international universities offering similar academic streams, as summarized in the Table 2.

**Table2: Average Cost per Student per Year by Academic Stream–2011**

University	Medicine	Engineering	IT	Science	Management	Arts/Law	Agriculture
Colombo	262,471	N/A	75,735	144,054	59,119	98,089	N/A
Peradeniya	201,936	123,876	N/A	144,473	N/A	107,576	274,290
J'pura	324,197	N/A	N/A	133,800	57,991	85,360	N/A
Kalaniya	307,401	N/A	N/A	188,656	52,81	88,938	N/A
Moratuwa	N/A	127,954	N/A	N/A	33,409	N/A	N/A
Jaffna	250,089	N/A	N/A	296,263	N/A	95,339	223,130
Ruhuna	310,775	137,999	N/A	169,535	52,476	118,966	218,123
Eastern	162,230	N/A	N/A	159,749	59,744	64,479	310,822
South Eastern	N/A	N/A	N/A	153,992	75,976	69,592	N/A
Rajarata	120,526	N/A	N/A	138,627	76,641	79,419	205,357
Sabaragamuwa	N/A	N/A	N/A	92,049	69,914	105,629	208,153
Wayabma	N/A	N/A	N/A	107,827	66,618	N/A	182,092
Uva Wellassa	N/A	N/A	N/A	178,439	118,226	N/A	128,063
Average (Sri Lankan State Universities)	256,000	128,000	75,735	149,000	59,500	92,100	212,000
Local Private Inst	#	#	240,667	207,500	207,944	#	#
Foreign Affiliated (L)	#	#	348,750	246,806	282,000	83,333	#
Foreign Affiliated (H)	1,333,000	#	424,167	422,917	475,833	456,807	#
Foreign (L)	545,350	682,500	325,000	#	#	154,000	#
Foreign (H)	15,376,725	1,980,000	1,500,000	#	#	#	#

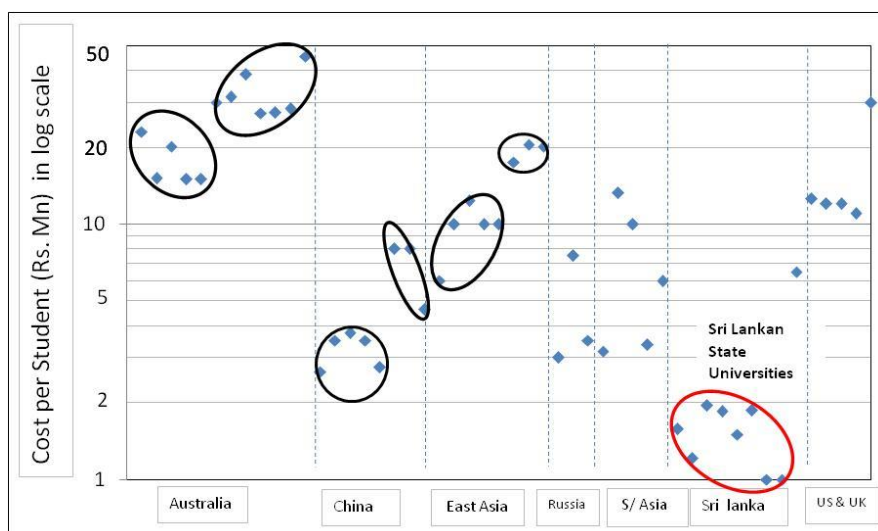
*Note: N/A – Non availability of the particular stream;*

*# - No information*

The results indicate that the costs (including capital costs) incurred by the Sri Lanka's State university system in producing a graduate of quality are significantly less than the fees charged by the competitors, except in the Arts stream.

### *The Case of the Medicine Stream*

The case of Medical education was further examined to fathom the magnitude of apparent cost advantage among alternatives. The Figure 2 scatter plots the regional cost clusters against that of the Sri Lankan State university system.<sup>3</sup>



Source: Authors' estimations

**Figure 2: Per Head Cost Clusters pertaining to Degree Programmes in Medicine**

It is mirrored in this analysis that the Sri Lankan State university system outperforms, in terms of its cost advantage against all competing local, regional and international institutions offering MBBS degree programmes. The closest competitors to Sri Lankan State university system appear to be those institutions in China and Russia,

<sup>3</sup> These individual observations represents the foreign institutes frequently selected by local students as their higher education destination for medicine, and are prescribed by the local education consultants.

which also are positioned significantly above the cost levels of the Sri Lankan State university system.

The magnitude of this cost advantage is reflected in the statistical analysis of programme costs and the significance of their differences, as summarized in the Table 3. Accordingly, Sri Lanka could strategically exploit this comparative advantage, not only to arrest the current exodus of foreign exchange spent abroad to study medicine, but also to earn foreign exchange by attracting foreign students to study Medicine in the Sri Lankan State university system.

**Table 3:**  
**Comparison of Average Regional Costs per Degree Programmes in Medicine**

Region/ Country	Average cost for the degree programme	Sdt Deviation	$\Delta$ Average Cost	Calculated <i>t</i> - value	Minimum Cost (Rs.Mn)	Excess compared to SL average as a Percentage
Sri Lanka	1.53	0.3	-	-	-	-
Australia - Low	17.7	3.7	16.1	9.618***	15	80%
Australia-High	30.5	4.2	28.8	16.63***	27.3	1684%
China - Low	3.2	0.5	1.6	6.46***	2.64	73%
China - High	6.9	2	5.3	4.76**	4.62	202%
Russia	4.6	2.4	3	2.24**	3	96%
South Asia	8.7	5.1	7.1	2.14**	3.17	107%
East Asia - Low	10.6	1.2	9	15.29***	6	292%
East Asia -High	19.4	1.6	17.8	18.65***	17.5	1044%
UK-USA	19.4	9.4	17.8	5.01***	11.03	621%

*Notes:  $\Delta$  Ave Cost = Average Cost Difference as against the Cost of Sri Lankan State University System*

*The t-values indicate the significance of the differences of costs (\*\*\* at 1%, and \*\* at 5%).*

The cost differences appear holding significant even after a substantial profit margin is charged on the total costs, possibly owing to the excessive profit margins earned by the competitors. In that light, the high costs in foreign exchange incurred by the national economy to educate its citizens abroad amounts to an unnecessary erosion of saveable resources. For instance, Rs 1.6Bn per year of foreign exchange would be saved during the next 6 years if the country could provide facilities to produce 1500 more doctors per year enabling the achievement, by 2020, of the current doctor:population ratio of Singapore of 18:10000, as against the lowest possible cost incurred for studying in China.

The results also indicate that the Sri Lanka's State education system offers a significant foreign exchange earning potential. Internationally marketing the MBBS degree programme at Rs 2 Mn with a mark-up of nearly 33%, for instance, could earn approximately Rs 2000 Mn per year of foreign exchange for a batch of 1000 students, while still being nearly 37% more cost attractive than the minimum cost competitor in South Asia or 24% less costly than that of the lowest cost Chinese competitor.

## **Conclusions**

The study brought evidence to conclude that the commonly held belief of Sri Lankan State university system being cost-wise inefficient is far from reality. In fact, in many a discipline, the Sri Lankan system appears cost-wise highly competitive. This illegitimizes the currently observed trend of inadequate expansion of the system and the resultant constraints to increase the intake to Sri Lankan State universities in

such competitive disciplines as Medicine, Engineering or Management which push the local students to migrate for education at much higher foreign exchange costs and also at the risk of brain drain.

There is no need to “protect” the State higher education system as it appears internationally cost competitive, and the system could be allowed to grow in the emerging global education market [3]. However, this calls for granting it the necessary autonomy and independence. If the “free-education” right of the Sri Lankan students, who get selected to the national universities based on their z-scores at GCE Advanced Level examination, could be ensured by administering a “higher education voucher scheme”, the system is likely to grow in the market competition with no additional burden on the public coffers. The national universities so liberated will then be able to compete effectively based on the quality of education service delivery and earn incomes through paid seats offered to those who do not qualify to benefit from the free education voucher scheme.

This could possibly be the key towards sustainably developing Sri Lanka as a knowledge hub [4] through gaining international popularity while preserving the spirit of “free-education” by providing equal opportunity and affordability in higher education in the long run.

In the meantime, the relatively high cost intensities identified through the study, particularly in the disciplines of Arts and Science (compared to Management and Engineering), need to be further examined, and treated with appropriate policies and strategic interventions.

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[S2/03] **Women Entrepreneurial “failures”: underlying characteristics and possible causes- An exploratory case-based survey**

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**Abstract**

*This paper discusses the challenges of being a woman entrepreneur, and more specifically the issue of why women have a relatively low success rate or high failure rate as business entrepreneurs, and possible common factors that underlie such a situation. Due to the fact that there is almost no research on this area in Sri Lanka, any attempts to tread into this sphere of study lacks a basic anchor and research parameters. This research study, which is deemed an exploratory survey, was inspired and directed by a widely assumed view that, despite a growing and emerging trend of women entrepreneurs notably in the SME sector, business success rate by women entrepreneurs lags behind their male counterparts by a considerable margin. While a growing number of professionally qualified women have reached the top most positions of large businesses, the greatest concentration of women entrepreneurs are found in the SME/cottage category. A considerable proportion of women entrepreneurs have their business origins uniquely associated with their gender positions in the society and they are also faced to a considerable degree with gender-bias challenges. Evidently, women have started businesses of their own under circumstances and factors that are commonly identifiable with the gender: such as passion associated with their innate skills, change of circumstances or prevailing economic conditions around the household that force upon them to undertake business responsibility and undertaking self-employment in a business that gradually has grown into enterprise scale. It is also evident that the struggle and the challenges women entrepreneurs face in business growth, or in the least, their struggle to remain afloat in business appear to be complex than any average business challenges faced by their male*

*counterparts. It is hoped that this piece of research will generate further interest, and in the medium term, a critical set of policy interventions that will create a paradigm shift that enables, inspires and sustains women entrepreneurship as a vital input of development.*

**Key words:** *Women Entrepreneurs, Failed business enterprises, Work-life balance, Gender-specific business challenges*

## **Introduction: Women and business**

Women owned businesses in South Asia are showing major strides following an exponential growth of professional careers and the opportunities created for women (Tambunan, 2009). Growth of new sectors and product innovations and hence the economic opportunities have created a huge attraction to women towards the business world overshadowing the chores that are traditionally associated with them. The expanding globalization and which resulted in bringing about opportunities pertaining to product value chain management have enabled non-traditional forms of business models which thereby create an enabling environment to attract women into businesses significantly. For instance, the growth in the apparel industry where women display a greater synergy of skills is a case in point. In Sri Lanka, women are playing an emerging role in education and in a range of professional fields which shows a growing trend of women entrepreneurship especially in the SME sector. Many women, encouraged by easy financial opportunities which are being offered by an array of banks and rural-based informal financial institutions, are taking the initiative to start up business of their own. It is quite conceivable that this trend will only grow and diversify in the times ahead. In the West, women are increasingly turning to

entrepreneurship as a way of coping with the ‘glass ceiling’ that seems to prevent them from reaching top managerial positions in organizations. Those fighting for equity in wages, rewards and perks, and for those who seek life-business balance, find entrepreneurship as a vent for stress with greater self-satisfaction, professional flexibility and space to success (Moonasinghe, 2000).

It is believed that women run businesses face far more challenges than their male counterparts and face greater risks of failures. The statistics on business failures general, especially those of SMEs, are difficult to obtain while any data and information on women entrepreneurs and their business failures are extremely few and far between. Yet, it’s a widely held view that women entrepreneurs in the SMEs record higher rate of failures, or in the least, women headed business predominantly remain stagnant or do not grow into bigger businesses. While this notion may be subjective when taken as a general principle, our preliminary survey indicated that high rate of failure in women run businesses is in fact a conceivable notion. Contemporary women entrepreneurship is directly and indirectly induced by an ongoing paradigm shift on the emerging role of women and their importance in development. For instance, the emphasis placed upon the women in achieving Millennium Development Goals when the challenges faced by them in business success clearly are a matter of growing significance.

## **Research Problem**

Why do women entrepreneurial failures are so widespread, especially in comparison to their male counterparts, despite the fact that women have made great strides in, for instance, global recognition as development catalysts, education, opportunities for professional skills and higher aptitudes, and are regarded and renowned as better managers of economic resources in the household? Moreover, what specific internal attributes and characteristics could be distilled from the findings to develop a common all inclusive model of women entrepreneurship? Could there be nature of business/firm -specific characteristics, and how widespread are they across the segment of women entrepreneurial failures?

**Research Objectives:** This research aims to identify the qualitative innate parameters that may be fundamentally associated with women entrepreneurial success. Also, the research aims to ascertain any sector/industry /firm-specific characteristics that may influence the outcomes of women entrepreneurial success.

**Research rationale:** Data on research or information on business failures are rarely documented and are not easily accessible in the public domain, and no repository of data on such failed enterprises exists and this in an Asian context is even more evident. Information or structured information or research on women entrepreneurial failures is almost unheard of. Whereas there is a growing trend in women entrepreneurship it's unmistakably true that their role in

development is indispensable and this aspect is well articulated and recognized in the MDGs. Thus, a sound understanding of commonly observed failures women entrepreneurship is a dire need.

## **Methodology**

Gathering information was carried out using the case study method where triangulation method of data collection and information extraction, namely face-to-face interviews, structured questionnaire, and physical observation of body language were used as the primary tiers of information. Moreover, each situation was handled with an open mind in a very informal setting. The depth, quality and the scope of data gathered varied significantly from case to case. 15 individuals who consented to be interviewed and provide the required information were the sample. However, based on the quality of the information, data from only 9 cases were used in the final analysis.

**Limitations:** Given the highly sensitive and unstructured and very informal nature of the data and information on business failures, and in this case that of women entrepreneurial failures, it is expected that the data will invariably have a situational and circumstantial bias. Moreover, lack of any data repository of business failures and almost no previous research as a guide, the conclusions inevitably tend to be absolute without any base line material to compare them with.

**Literature survey:** From the basis of the study, both data collection and analysis assumes a straight forward yet adapted definition of successful entrepreneurship as one that remains a growing concern and creates value in both tangible and intangible variables in terms of profits and goodwill for the benefit of primarily its owners and secondly other stakeholders. Stated differently, it can be stated that the former is a necessary condition while the latter is a sufficient condition. Business failure takes place when the business fails to realize the above basic outcomes, and also sustain a growth of the business. In a broader definition of successful enterprises which captures specific characteristics of women entrepreneurs, attributes such as being in control of one's life and economic activities that potentially add value to resources for self-fulfilment and growth seem appropriate. This piece of study adopts the latter definition in the discussion and investigation in order to capture characteristics seen in failed women entrepreneurs, and possible attributes critical for their success. It needs to be borne in mind that each case had individuality and unique characteristics that are subjective at micro level.

Literature from Asian countries covers a multitude of critical aspects of women entrepreneurship. For instance, Seymour (2001), Sinha (2003) and also Das(2000) identify three types of women entrepreneurial sources, and they are: *chance*- the types of business originates from hobbies, personal passions, part-time engagements that develops into enterprises; *forced*- where they are forced into business due to change of circumstances primarily in the household and most common being incapacitation or demise of the husband, or commonly due to domestic economic pressures; and *created*- where exposure,

training skills development inspires to start a business and later it was developed into an enterprise. In our case study, we found that the business origins of women entrepreneurs primarily emanate from the factors as follows: *forced* – 2 cases; *chance*- 10 cases and *created* – 3 cases, and in the last 2 categories, more than one factor have been predominantly relevant. Not surprisingly, those *forced* lacked any basic entrepreneurial inputs for long-term business sustenance.

### Research findings and conclusions

The sample survey had the following characteristics:

Garments: *Fashion dresses, uniforms for school and industry ware*

Handicrafts: *Fancy stationary, graphic printing gift items; hand crafted jewellery*

Services: *Launderette, graphic designing, accounting*

Sector No of	Garments- non export type	Handicrafts	Services	Ongoing status	Driver factors
5 -10	1	2	1	Stagnant for last 5 years	Predominantly <i>chance</i>
10-20	2	2	4	3 closed down; 2 are faced with imminent closure; rest performance below industry averages	Mix of <i>chance</i> and <i>created</i>
20-50	3			2 closed down after existence of 3-5 years in business; 1 in business but stagnant	Mainly <i>forced</i>

It was evident across the entire sample space that, within the domain of business entrepreneurship which exists in a highly competitive and complex world of male-dominated enterprises, women are placed at a

disadvantageous position due to societal norms and mainstream business practices. The samples investigated led to the conclusion that, a widespread gender bias in the business success perpetuated by the prevalent mainstream business culture, where going beyond the rules and norms in order to secure competitive advantage and the existence of “killing competition” by any means attitude, is just more than a common daily business practice. This is something women entrepreneurs face as extraordinary challenges in a male dominated business environment. A possible strong corollary of this finding is that lack of clear cut property rights and social protection. The nature of business practices seen in this part of the world compounded by the social esteem women perceive compel women to take extraordinary measures to minimize business and all other forms of risks and this in turn yields them to face extra costs thus becoming less competitive viz-a viz their male counterparts.

Also woman entrepreneurs who have been pushed into responsibility following sudden change of circumstances in the household, or the economic pressures. This abrupt extraneous factors deprive women of not only the much vital learning curve exposure but also the opportunities to conquer it soon enough. Connected to this outcome is yet another fact of life where the self-esteem commonly held by women and that they are subject to stronger public opinion leaves them with lesser leeway to learn from mistakes in an increasingly murky business climate. Women entrepreneurs are inherently caught up with a family-business dichotomy which places them with limitations of becoming a self-interest driven, business like individuals who dare to take business-focused decisions. Also evident from the findings is that there are cases where passion-driven over enthusiasm taking precedent over many basic parameters of successful business management practices.

Overall, a shift from being a house-hold manger to a business manager appears to take time which a competitive business environment does not offer easily. Finally, this piece of research hopefully will create an awareness of women entrepreneurial fatalities, and encourage research and policy intervention to turn this situation around to create women, business and development synergies as a national objective.

On the positive side, those who have success in business are the ones who display capacity to adapt fast, knack for leadership, out-of-the-box thinkers, and those who could successfully segregate multitude of responsibilities that emanates from a right combination of life-business balance. Also, evident are the extreme cases where the women entrepreneurs who display no-nonsense and matter of fact attitude often command over their male counter-parts.

While the data and information gathering inherently has been extremely complex, the above findings provide vital leads to comprehensive research in the future, and perhaps more importantly generate research interest. In a very dynamic business environment, which over the recent past has characterized rapid strides of technology adaptation, while at the same time a parallel social remake up where women undertake complex responsibilities beyond household chores, women entrepreneurship and their success is a virtual fact of the business environment.

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## **[S2/04] Credibility of the Z Score in Predicting the Choices of Students in Selecting Degree Offering Institutes in Sri Lanka**

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*Keywords: Higher Education in Sri Lanka, Z score, Multinomial Logistic Regression*

### **Introduction and research problem**

University education is a critical component of human development in developing countries. It provides high-level skills necessary for the labour market and the training that is essential for professionals. Although there are well established national universities in Sri Lanka, students need high Z-scores to get into these national universities. The University Grants Commission of Sri Lanka changed the method of determining the cut-off scores for university admissions from raw scores to standardized z-scores in 2001. The Z - Score depends on the mean and the standard deviation of raw marks. The number of subjects

was also reduced to three from four in the year 2000. It is not surprising that the education system in Sri Lanka is very competitive with only a few national universities in the country. A significant number of A/L students who qualify for university education fail to secure a place in the national universities of the country. Therefore, a majority of the qualified students seek university level education from other degree offering institutions. It is obvious that the Z-score is a good indicator to predict the choice of students in selecting national universities in Sri Lanka. However, in a scenario where other degree offering institutions in the country do not pay much attention to the Z score of the students in their enrolments, the student have a choice to select any institute for his/her study irrespective of his/her Z score value. Therefore, the objective of this study is to explore the credibility of the Z score in predicting the choices of students in selecting degree offering institutions in Sri Lanka.

## **Methodology**

The sample consists of 112 students who are currently reading for Logistics Management degrees from CINEC, KDU and NSBM. Random sampling method and a questionnaire survey were used to gather data. Quantitative as well as qualitative data were utilized in this research. Out of 112 students selected for the study, 37.5 percent are from KDU, 20.5 percent from NSBM and 42 percent from CINEC. The sample includes 43 (38.4%) females and 69 (61.6%) males. Boxplots were used to detect outliers. The following Multinomial Logistic Regression method has been applied to analyse the credibility

of the Z score in predicting the choices of students in selecting degree offering institutes.

$$\text{Logit}(Y = j) = \log \left( \frac{\text{pr}(Y = j)}{\text{pr}(Y = j')} \right) = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \dots + \beta_k x_k$$

Where  $j'$  is the reference.

$$\text{Logit}(Y = 2) = \log \left( \frac{\text{pr}(Y=2)}{\text{pr}(Y=1)} \right) = \beta_0 + \beta_1 \text{ZCO} \text{ and } \text{Log it}(Y = 3) = \log \left( \frac{\text{pr}(Y=3)}{\text{pr}(Y=1)} \right) = \beta_0 + \beta_1 \text{ZCO}$$

where ZCO = S-score

McFadden  $R^2$  and  $P$  values were utilized for testing the goodness of fit and the statistical significance of the parameters of the model. Data was analysed using the SPSS application.

## Results and findings

The average Z score of the KDU students reading for the Logistics Management degree was 0.877. The score for NSBM was 0.9685 and that for CINEC was 0.784. The average Z score of the sample was 0.857.

**Table 1: Descriptive Statistics of the independent variable**

Source: Survey Data

	Minimum	Maximum	Mean	S.D	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
Z-score	.0013	1.7100	.856913	.3712222	.007	.228	-.574	.453

**Table 2: Parameter Estimates of the Multinomial Logistic Regression model**

Institute <sup>a</sup>	B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B)	
							Lower Bound	Upper Bound
2	Intercept	-1.241	0.724	2.938	1	0.087		
	ZCO	0.692	0.721	0.922	1	0.337	1.998	0.486 8.213
3	Intercept	0.695	0.536	1.685	1	0.194		

	ZCO	-0.702	0.59	1.417	1	0.234	0.496	0.156	1.574
a. The reference category is: 1.									

Source: Survey Data

The  $R^2_{McF}$  value of the model is 0.017. Parameters are not significant at 0.05 significance level.

## **Conclusions, implications and significance**

The study tries to examine the significance of the Z score in predicting the choices of students in selecting degree offering institutes (fee levying basis) in Sri Lanka. The Multinomial Logistic Regression model suggests that the Z score is not a significant factor in predicting the choices of students in selecting degree offering institutes among the selected three institutes. The low McFadden  $R^2$  and high  $P$  values suggest that the goodness of fit is very low and the parameters are not statistically significant. Furthermore, the findings show that the main forces of influence for the decision to select degree offering institutes are family members (34.8%) and friends (22.3%). It would appear from this study that the Z score is not a significant indicator in predicting the choices of students in selecting degree offering institutes (fee levying basis) in Sri Lanka. Therefore, it is necessary to examine the relationship between the choice of students and factors such as the A/L stream, distance from home, employment sector of the parents, employment field of the parents, influences, reputation, discipline, facilities, fees and charges, teaching staff, duration of the degree, content of the degree, flexibility, location of the institute and demographic factors.

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## [S2/05] **Conservation of Agricultural Biodiversity: Does Education Matter?**

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### **Abstract**

*The overall aim of this study was to evaluate the farmer preference of agricultural biodiversity in small-scale farms in Sri Lanka. The study attempted to investigate farmers' valuation of different aspects of agricultural biodiversity and how farmers' valuation of agricultural biodiversity changes with the change in their education on agricultural biodiversity. The Choice Experiment (CE) method (combined with Randomized Control Method) was used to collect the data while models such as Conditional Logit (CL) and Random Parameter (RP) Logit were used to analyse the data. The results clearly show that the farmers' education level as well as environmental concern on agricultural biodiversity can play a major role in the conservation of agricultural biodiversity in small-scale farms in Sri Lanka. The overall findings of this research study will help policy makers to implement relevant policies to reduce degradation of agricultural biodiversity that is increasingly posing a major impediment to agricultural growth, environmental protection and sustainable development.*

**Keywords:** *Agricultural biodiversity, Education, Valuation*

## **Introduction**

Agricultural biodiversity is a sub-set of general biodiversity which is essential for global food production, livelihood security, environmental protection and sustainable agricultural development. It can be defined as the variety and variability of animals, plants and micro-organisms that are used directly or indirectly for food and agriculture, including crops, livestock, forestry and fisheries (FAO, 2007). It comprises the diversity of genetic resources (varieties, breeds) used for food, fodder, fibre, fuel and pharmaceuticals. It also includes the diversity of non-harvested varieties that support production (soil micro-organisms, predators, pollinators), and those in the wider environment that support agro-ecosystems (agricultural, pastoral, forest and aquatic). The direct and indirect benefits of conserving farm level biodiversity can be explained on the basis of total economic value (TEV) framework (Brown, 1990). TEV consists of use and non-use values. Benefits obtained by individuals using agricultural biodiversity are defined as use values. Use values include, direct, indirect, portfolio values and option values (Primack, 1993; Swanson, 1996; Evenson et al., 1998). However, bequest values, altruistic values, existence values and cultural values of agricultural biodiversity are considered as under non-use values (Brown, 1990; Primack, 1993; Evenson et al., 1998).

The objective of the present study was to investigate farmer valuation of different aspects of agricultural biodiversity (including their environmental concerns). Accordingly, the main research questions of this study were (1) do farmers have positive preferences on more

diverse farming systems? (2) does the farmers environmental concern affect their valuation of agricultural biodiversity? and (3) how does farmers' valuation of agricultural biodiversity change with the change in their education on agricultural biodiversity. The Choice Experiment (CE) method (combined with Randomized Control Method) is used to estimate farmers' preferences for agricultural biodiversity. It also assists to measure the values that farm families attach to multiple benefits of agricultural biodiversity. The overall findings of this research will help to implement policies to reduce degradation of agricultural biodiversity in rural agricultural areas in Sri Lanka.

## **Materials and methods**

The Choice Experiment (CE) method was used to estimate farmer preference for agricultural biodiversity. Models such as Multinomial Logit (ML) Model, Conditional Logit (CL) and Random Parameter (RP) Logit models (Greene, 2000) were used to analyse the data. This study employs an experimental approach (Randomized Control Method) to collect the data in order to answer the second and third research questions. Firstly, 21 villages from Ampara district were selected purposively. Then the villages were divided into three groups (one control group and two treatment groups). Accordingly, randomisation to select households into different groups (treatment or control) was done at the village level. Accordingly, a 'village' is the unit of randomisation in this study. A number of 20 households were selected from each village randomly.

### *Basic Steps of the survey*

- (i). Households for the survey from the district were selected using the method explained above.
- (ii). One treatment group was provided with education on agricultural biodiversity while other treatment group was provided with information in order to improve their environmental concerns. Control group is not provided with any information (iii). CE survey covers all groups in the district at the end of the cultivation season

Education program included two steps. Firstly, we met respondents and explained the important of agricultural biodiversity and environmental protection individually. Secondly, we provided leaflets (but not keep with them-they can read it in front of us or we can read it for them) showing the importance of maintaining diverse farming system in their farms. The survey was carried out by administering a questionnaire through a face-to-face interview with the Head or any other working member of the households. Accordingly, the final survey covered 420 households.

In this study the most important attributes of farms and their levels were identified in consultation with experts from the Ministry of Environment in Sri Lanka, drawing on the results of informal interviews and workshops with small-scale farmers in the study sites, focus group discussions and a thorough review of previous research in this area in the country. After identifying the attributes for the experiment, we assigned values or levels to each attribute. These levels were chosen to represent the relevant range of variation in the present or future interest of respondents. In general, focus group discussions

will indicate the level of the attributes as well as the best way to present them. Though commonly presented in words and numbers, attribute levels may be presented using pictures. To the extent that visual representations of attribute levels are utilised, it is likely that respondents will perceive levels more homogeneously, likely leading to more precise parameter estimates in the modelling stage. We presented the choice set using pictures of the different attributes and their levels in this study. Selected attributes, their definitions and the levels are given in Table 1.

**Table 1: Identified attributes of agricultural biodiversity in the country**

Attributes	Definition	Levels
Number of species	This is measured by the total number of crop and animal species that are cultivated in the small-scale farm in a given season	1, 4, 7,10
Mixed farming system	This attribute investigates whether a farmer prefers an integrated crop and livestock production system over a system that is specialised in crops or livestock.	Yes, No
Organic production	This attribute investigates whether a farmer prefers organic methods of production over a system using chemical fertiliser and pesticides	Yes, No
Estimated costs in terms of additional labour days	This is defined as a percentage of additional labour requirements under different policy options. It indicates the additional costs that farmers have to bear when they are accepting a new policy.	5 %, 10% 15%

Table 1 shows the attributes that we used in the CE study. The first three attributes reflect the various attributes of agricultural biodiversity found in the small-scale farms in Sri Lanka. The last factor is the monetary attribute in terms of additional labour costs that farmers have

under different policy options. As compared to willingness to pay (WTP), willingness to accept is measured as a benefit rather than a cost (Freeman, 2003). In order to estimate this benefit, a monetary attribute in terms of additional labour costs that farmers are willing to offer is included. The size of the hypothetical small-scale farm is fixed as one acre<sup>4</sup> in area in each case (this is the average small-scale farm size in Sri Lanka).

The choice experiment was designed with the assumption that the observable utility function would follow a strictly additive form. In this study, we explored a variety of different specifications of the utility functions to identify the best specification of the data. Finally, CL models were run for the three groups separately by including attributes of the CE survey. Then CL models with interaction were run. This specification of the model was not significantly different from the previous specification. In particular, the model did not reveal a higher level of parametric fit compared with the first model. Therefore, it can be concluded that the improvement in model fit was not significant. The Hausman-McFadden test also revealed that CL model without interactions is a better fit for the data than the CL model with interaction (Greene, 2000). We estimated the results using RPL model to investigate whether there is an observable improvement of the results. RPL model is one of the fully flexible versions of the discrete choice models because its unobserved utility is not limited to the

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<sup>4</sup> This small-scale farm size was chosen from the agricultural census survey conducted in 2002 (Census of Agriculture, 2002)

normal distribution. General specification of the CL model can be given as follows;

$$U_{ij} = \beta_0 + \beta_1(CD) + \beta_2(MF) + \beta_3(OF) + \beta_4(LR)$$

Where,  $\beta_0$  refers to the alternative specific constant and  $\beta_{1-4}$  refers to the vector of coefficients associated with the vector of attributes describing farms characteristics.

## Results and discussion

The mean values of age were 38, 40 and 37 of the two treatment groups and control group, respectively. The average number of persons in the household was 5, 4 and 5 while average education levels were 10, 9 and 9, respectively. Although agriculture was the dominant source of household income, monthly income from non-farm activities was approximately Rs. 1,350, Rs. 1,300 and Rs. 1,425 per household, which accounted for almost 5 per cent of the total household income. The mean labour usage per season was 74 man-days for three samples. This is expected, given the tedious labour intensity for all agricultural work in semi-subsistence economy. Rice was cultivated by almost all households followed by various types of vegetables and cash crops. The maximum number of crop varieties cultivated by any household was seven. The comparison of descriptive statistics clearly indicates that there is no difference between different groups.

The results of the estimated basic CL model for the separate groups are presented follows.

**Table 2: Regression results of the CL model**

Variables	Education (biodiversity)	Education (Environment)	Control group
ASC	2.32(0.019)*	3.028(0.005)*	2.984(0.019)**
Crop diversity	0.131(0.000)*	0.319(0.008)*	0.018(0.069)***
Mix system	0.129(0.001)*	0.246(0.001)*	0.092(0.092)***
Organic farms	0.096(0.040)**	0.177(0.020)**	0.064(0.341)
Labour requirement	-3.1E-04(4.9E- 05)*	-2.5E-03(4.2E- 04)*	-2.1E-04(2.2E- 05)*
Prob > $\chi^2$	0.000	0.000	0.000
Pseudo $R^2$	0.228	0.321	0.120
$N$	560	560	560

Note: i. Standard errors are shown within parentheses

ii. \*denotes significant at 1% level while \*\* and \*\*\* indicates significant variables at 5% and 10% level respectively

All attributes in the first and second models were statistically significant at conventional levels (5 percent), and their signs were as expected. The overall fit of the model as measured by McFadden's  $R^2$  was also good by conventional standards used to describe probabilistic discrete choice models (Ben-Akiva and Lerman, 1985). When analysing the results of these two models, it is clear that all of the farm attributes are statistically significant at 5 per cent level implying that any single attribute increases the probability that a farm is selected whereas different socio-economics variables and preferences remain equal. Since the underlying sample is statistically significant ( $P < 0.05$ ), these parameters represent preference estimates of farm families for farms attributes in among two treatment groups. Third model shows

the situation of the control group. For this group organic farm variable is not significant ( $P > 0.05$ ) even under ten per cent level while all other attributes are significant at five or ten per cent level. Relatively significance of the attributes of this model is less when comparing with other two models. The results clearly show that the education has some impact on farmer's valuation of agricultural biodiversity in study area.

## **Conclusions**

This research is one of the first attempts to use choice modelling to investigate farmers' preference for different attributes of agricultural biodiversity that can be seen in small-scale farm in Sri Lanka. We applied the choice modelling approach with RCM to identify whether farmers preferences on different attributes of agricultural biodiversity are affected by the education.

In general, the findings of the choice experiment support the assumption that small-scale farms and their multiple attributes contribute positively and significantly to the utility of farm families in Sri Lanka. Also their valuation is highly affected by their education on biodiversity and environmental attitudes. The overall findings of this research will help to implement policies to reduce degradation of agricultural biodiversity that is increasingly posing a major impediment to agricultural growth, environmental protection and sustainable development. Further, the research findings will contribute to the sustainable use of agricultural biodiversity to improve farmers' well-being and achieve an environmental friendly farming system. It also helps to increase awareness and generates support for investment

in conservation and development of agricultural biodiversity. Moreover, it will provide an opportunity to make necessary policies that provide incentives to protect biodiversity at farm level that generate regional as well as global benefits in the future.

As the results of the present study show, education is important in determining the farmers' valuation of agricultural biodiversity. Designing formal and informal education programs will improve farmers' abilities to conserve agricultural biodiversity in the country. Moreover, a further initiative can be taken to strengthen the capacity of farmers through farmer-centred training workshops geared towards conserving agricultural biodiversity. This could be done in a collaborative manner involving the government, district assemblies and NGOs. Government also needs to intensify its agricultural extension service programs by training and deploying qualified extension officers. The officers, in turn, should intensify farmer education on agricultural biodiversity.

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**Session-3**  
**Energy and  
the Economy**



## [S3/01] **Financial Feasibility Analysis of a Small Hydro Power Plant With Respect to Uncertainty Variables**

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### **Abstract**

*As a rapidly developing country, energy plays a vital role in the Sri Lankan economy. With the depletion of fossil fuel and rising energy costs more emphasis is given to renewable energy and alternative power generation, especially towards Hydro Power Plants (HPP). As Small Hydro Power Plants (SHPP) are relatively cheap and environmental friendly compared to large scale HPP, there is an increased investor interest towards SHPP energy generation in Sri Lanka. However the financial feasibility of a SHPP is heavily dependent on several uncertain external variables such as the flow of the river, time taken for government approvals, electricity tariffs, rate of inflation etc. The proposed hybrid method focuses to develop a realistic technique to determine the financial feasibility of a SHPP by incorporating uncertainty variables in to traditional Discounted Cash Flow (DCF) methods such as the Net Present Value (NPV) and Internal Rate of Return (IRR) using the Markov chain process. The cash inflows of the SHPP were forecasted using the Markov chain process, while cash outflows were linearly forecasted using several key assumptions. The financial feasibility of the SHPP was assed using both NPV and IRR based on these forecasted cash flows. According to the findings, it*

*was found that the calculated NPV was positive and the IRR was greater than the required rate of return. However, both NPV and IRR calculated were considerably lower than the NPV and IRR calculated in the initial feasibility study.*

**Keywords:** *Financial Feasibility, Markov Chains, Small Hydro Power Plants, Uncertainty Variables*

## **Introduction**

Sri Lanka is a country with many hydropower resources. Hence, increased use of hydro power energy generation can reduce the country's dependency on fuel imports and save foreign exchange. Hydro Power Plants (HPP) below the capacity of 10MW are Small Hydro Power Plants (SHPP). They are built in an isolated area and are primarily based on the run-of-the –river principle, which means water is not stored in a reservoir and is used only when it is available, thus SHPP have been given prominence in recent years as they are a cheaper and eco-friendly alternative to large scale HPP.

A prospective investor has to carry out a technical and financial feasibility study prior to obtaining necessary government approvals to construct a SHPP. It is crucial to estimate the financial feasibility as accurately as possible due to the long term nature of the investment and the decision made to invest is irreversible and includes high capital costs (Carmichael, 2011). The approval process of a SHPP takes approximately 3 years, while construction takes another 2 years. However, during this time several key variables of the SHPP such as the river flow, electricity tariffs, capital costs, etc will change. Hence, an initial financial feasibility study conducted without considering

these uncertainty factors would be unrealistic and inapplicable even before the actual commencement of the plant. However, currently in Sri Lanka, the financial feasibility of a potential SHPP is calculated ignoring the effect of these uncertainty variables.

The objective of this study, therefore, is to present a realistic method for assessing the financial feasibility of a Small Hydro Power Plant (SHPP) taking several of these uncertain variables into account.

### **Data and Methodology**

This case study is conducted on a 2.2MW SHPP located in the lower reaches of Madulla Oya in Karapalagama, Walapane in the NuwaraEliya District. The SHPP carried out its initial feasibility study in 2010 and applied for government approvals during the same year. However the government approvals were granted in 2013 and construction of the plant began immediately after. This research is carried out using the financial data in the initial financial feasibility report which was prepared in 2010.

The daily rainfall data of catchment area was taken from the Meteorological Department of Sri Lanka from 1993-2010. This rainfall data was used to calculate the flow of the river. Inflation rates forecasted by the International Monetary Fund (IMF) for Sri Lanka in The World Economic Outlook (WEO) database for 2010 were used for cash outflow calculations.

The analytical method builds upon the traditional Discounted Cash Flow (DCF) methods and compliments it by providing additional insights towards the uncertainties associated with future cash flows of a SHPP. The mathematical model is carried out in two parts. The cash inflows of the SHPP for 20 years are forecasted using the Markov chain process (Pfeifer and Carraway, 2000), while the cash outflows are linearly forecasted using several key assumptions. The financial feasibility of the SHPP is assed using both the Net Present value (NPV) and the Internal Rate of Return (IRR) based on these forecasted cash flows (Trowbridge, 2013).

Cash inflows of a SHPP are earned solely from the electricity generated and sold to the Ceylon Electricity Board (CEB). Therefore the revenue function can be shown as follows,

$$R_1 = E * T * 10^6 \dots\dots\dots (1)$$

Where  $R_1$  is the revenue earned (LKR),  $E$  is the energy generated (GWh) and  $T$  is the electricity tariff (LKR/kWh) applicable through the Standardized Power Purchase Agreement (SPPA).

The SPPA will be signed between the CEB and the investor once the SHPP has the necessary government approvals. However, the time taken for government approval process is an uncertain factor and during this period the electricity tariff rates would be revised by the Public Utilities Commission of Sri Lanka (PUCSL). The developers have the option of selecting either a three-tier tariff or a flat tariff. If a

flat tariff is selected, this rate will be valid for a period of 20 years after signing the SPPA.

The energy generated in a particular month,  $E$  in GWh, can be calculated as shown below,

$$E = \frac{P_1 * D * 24}{10^9} \dots\dots\dots (2)$$

Where  $D$ , is the number of days in that particular month while  $P_1$ , is the potential power (Watts) that can be produced by the SHPP and can be calculated as shown below,

$$P_1 = \eta \rho Q g h \dots\dots\dots (3)$$

Where,  $\eta$  is the efficiency of the turbine (85%),  $\rho$  is the density of water (1000 kg/m<sup>3</sup>),  $Q$  is the flow of the river or the water discharge passing through turbines (m<sup>3</sup>/s),  $g$  is the acceleration due to gravity (9.81 m/s<sup>2</sup>) and  $h$  is the gross head (60 m) which is the maximum vertical distance between the water intake and turbines.

Therefore from (1), (2) and (3) we can see that the main uncertain variables contributing to the cash inflows of a SHPP are  $Q$  and  $T$ . Out of these two,  $T$  would be uncertain only from the date an investor applies for government approvals until the SPPA is signed. Because after signing the SPPA a flat tariff would be applicable for the next 20 years. Therefore during the approval process  $T$  is assumed to increase linearly throughout the years and for this study  $T$  is forecasted for 3 years using historical data.

The flow of the river Q which has a direct impact on the future cash inflows of the SHPP is forecasted for 20 years using the Markov chain process<sup>5</sup> (Pfeifer and Carraway, 2000), while cash outflows were linearly forecasted using several key assumptions. The financial feasibility of the SHPP was assessed using both NPV and IRR based on these forecasted cash flows (Trowbridge, 2013).

The Markov chain process was applied to each month of the year, as the variations in the river flow during the dry and wet seasons were considered in order to get a realistic forecast of the annual river flow Q. Since it takes approximately 5 years between applying for government approvals to the actual commencement of the SHPP, the flow data was forecasted for 25 years using the  $n$ -step transition matrix.

Then the cash inflows of the SHPP for that particular month for any time period  $n$  depending on the current state was calculated using the Markov property and a reward matrix. Subsequently, to forecast the annual cash flows, the above process was carried out for each of the 12 months and the addition was calculated. This was done for 25 years. The costs relating to a SHPP were separated into two broad categories.  $I$ , the initial investment costs were forecasted for 5 years using the inflation rates forecasted by the International Monetary Fund (IMF) for Sri Lanka while recurring costs such as operating and maintenance

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<sup>5</sup>The Markov Chain method is a stochastic process and works in discrete states and transitions from one state to another. Markov Chains has a specific property called the Markov Property which means the next state depends only on the current state and not on the preceding states.

costs were forecasted for 5 years using the same method as described above and then from year 6-25, which is the life span of the SHPP, the inflation was assumed to increase linearly by the inflation rate used for the 5th year. Taking the government approval process into consideration, cash flows earned during the 20 year life span of the SHPP were discounted back 25 years to the present time, while  $I$  was discounted back 3 years when calculating the NPV.

### Analysis and Results

Let us consider the month of February to illustrate the Markov chain process. Table 1, given below lists the monthly flow data ( $\text{m}^3/\text{s}$ ) for February from 1993 to 2010.

**Table 1.** Monthly flow data ( $z$ ) for February.

Year	$z$	Year	$z$	Year	$z$	Year	$z$
1993	2.72	1998	2.21	2003	3.30	2008	2.18
1994	6.02	1999	5.74	2004	1.52	2009	1.75
1995	5.96	2000	7.15	2005	1.94	2010	6.16
1996	10.91	2001	5.26	2006	2.81		
1997	1.67	2002	2.20	2007	3.09		

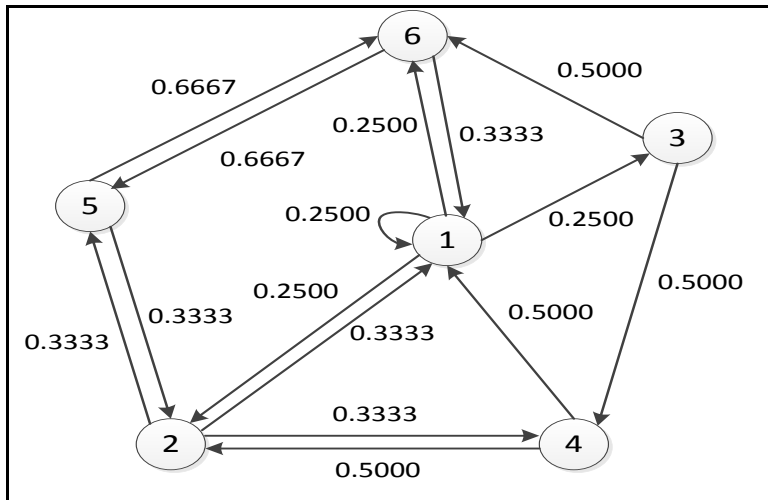
*Source: Feasibility Study of Karapalagama Small Hydro Power Project (2010).*

The random variable  $z$  is defined to represent the monthly flow of the river during February in a particular year. For the 18 years of data, the monthly flow varies between  $1.52 \text{ m}^3/\text{s}$  and  $10.91 \text{ m}^3/\text{s}$ , therefore we define six states, namely  $S_1, S_2, S_3, S_4, S_5, S_6$  as shown in Table 2.

**Table 2.** Transition states and **z** classes for February

State	Classes
S1	$1.00 \leq z < 1.95$
S2	$1.95 \leq z < 2.22$
S3	$2.22 \leq z < 2.82$
S4	$2.82 \leq z < 3.31$
S5	$3.31 \leq z < 5.97$
S6	$5.97 \leq z < 11.00$

We can use a transition diagram to illustrate the six states and the transitions between each of these states as shown in Figure 1, below.



**Figure 1.** Transition diagram between states

Then we define the one-step transition matrix  $P$  for the month of February to be as follows,

$$P = \begin{bmatrix} 0.2500 & 0.2500 & 0.2500 & 0.0000 & 0.0000 & 0.2500 \\ 0.3333 & 0.0000 & 0.0000 & 0.3333 & 0.3333 & 0.0000 \\ 0.0000 & 0.0000 & 0.0000 & 0.5000 & 0.0000 & 0.5000 \\ 0.5000 & 0.5000 & 0.0000 & 0.0000 & 0.0000 & 0.0000 \\ 0.0000 & 0.3333 & 0.0000 & 0.0000 & 0.0000 & 0.6667 \\ 0.3333 & 0.0000 & 0.0000 & 0.0000 & 0.6667 & 0.0000 \end{bmatrix}$$

The reward matrix  $R$ , for February using (1), (2) and (3) is calculated to be as follows,

$$R = \begin{bmatrix} 5,227,479 \\ 10,193,584 \\ 11,605,003 \\ 14,741,491 \\ 17,302,956 \\ 44,506,383 \end{bmatrix}$$

This shows that, in any future period during the month of February if  $z$  is in state S1 the revenue from the SHP plant would be LKR 5,227,479. If  $z$  is in state S2 the revenue would be LKR 10,193,584 and so on. Since the monthly flow rate for February is currently in state S6, using the Markov property we can define  $\gamma$ , the initial probability distribution to be as follows,

$$\gamma = [0 \quad 0 \quad 0 \quad 0 \quad 0 \quad 1]$$

Using the relationship  $V^n = \gamma P^n R$  we can forecast the expected cash inflows of the SHPP during February for the next 25 years as shown in Table 3.

**Table 3.** Forecasted expected cash inflows ( $V$ ) for February.

Year	$V$	Year	$V$	Year	$V$
1	13,277,797	10	20,032,218	19	18,709,800
2	28,006,893	11	17,963,247	20	19,037,432
3	14,762,861	12	19,647,300	21	18,770,442
4	23,155,990	13	18,274,116	22	18,988,013
5	15,911,551	14	19,392,761	23	18,810,713
6	21,540,148	15	18,481,008	24	18,955,195
7	16,818,923	16	19,223,930	25	18,837,456
8	20,620,104	17	18,618,487		
9	17,498,570	18	19,111,852		

To forecast the annual expected cash inflows we need to carry out the above process for each of the twelve months and get the addition. This has to be done for 25 years.

Then using the standard formulae<sup>6</sup>, the expected NPV and expected IRR can be calculated. Though the SHPP is financially feasible from an investor's point of view as the NPV is positive and the IRR calculated is greater than the required rate of return (Table 4), both the

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$${}^6NPV = \sum_{t=1}^{20} \frac{CF_t}{(1+r)^{t+5}} - \frac{I}{(1+r)^3}$$

The IRR can be defined as  $\beta$ , the rate at which the NPV of the project is equal to zero, as expressed below :

$$NPV = \sum_{t=1}^{20} \frac{CF_t}{(1+\beta)^{t+5}} - \frac{I}{(1+\beta)^3} = 0$$

expected IRR and the expected NPV calculated are considerably lower than the IRR and NPV calculated in the initial feasibility.

**Table 4. Comparison of the NPV and IRR of the SHPP.**

Indicator	Initial Feasibility Study	Proposed Hybrid Methodology
NPV	LKR 489,384,696	LKR 380,204,113
IRR	31%	21.48%

*Note : The values in the Hybrid Methodology column are expected values*

*Source: Authors' calculations based on the Feasibility Study of Karapalagama Small Hydro Power Project (2010).*

## Conclusions

The study shows that when forecasting the cash inflows of the project, using the flow data forecasted by Markov chains is more realistic than considering a constant flow figure. The approach used in this research can be further developed in order to consider the impact several other uncertainty variables such as interest rates, exchange rates and using a three-tier electricity tariff would have on the financial feasibility of SHPP.

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[S3/02] **Multiplier Effect of Foreign Exchange Economies  
on the Comparative Viability of Renewable Energy-  
based Power Projects in Sri Lanka**

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## **Introduction**

In the conventional “economic analysis”, capital investments are evaluated based on their viability to the national economy [1]. An economically unviable venture would be discouraged by regulatory and policy machinery even though it is financially attractive to the investor; while a financially unviable project with sufficient economic viability would be promoted through financial incentives granted to the investors. In performing economic appraisal, shadow price are used instead of market prices in order to reflect the true opportunity costs and values to the economy of inputs and outputs.

The foundations of this methodology rest on the premise that domestic market prices are distorted due to a number of reasons compared to the “world price” platform, which is considered the bench-mark for estimating distortions. This implies that the “border prices” of traded or tradable inputs and outputs are used in estimating the net economic benefits of a project, which amounts to working out the “net foreign exchange effect” of such investment.

According to Keynesian logic [2], a net foreign exchange gain (an additional foreign exchange earnings through exports or an additional

foreign exchange saving through substituting for imports) securable in a project would not stay static within the economy as long as such savings are domestically invested or consumed. That raises aggregate expenditure, generating additional spirals of effective demand creation, and thereby supplementary economic value added.

This “multiplier effect” is generally ignored in the conventional economic analysis, which gap was chosen as the focus of this research. The study therefore was conceived to estimate, and demonstrate, the use of multiplier as an integral aspect in economic analysis of projects through a comparative appraisal of renewable energy-based power generation options available for Sri Lanka.

## **Materials and Methods**

Four renewable energy based electricity generation technologies, namely Bio-mass, Wind, and Solar, were subject to analysis as against the Coal power option, for comparison sake. Conventional economic analyses were first performed to rank the projects based on their levelized net present economic costs.<sup>7</sup> These levelized net present economic costs were then adjusted by “domestic value multiplying effect” of foreign exchange saved. The supplementary GDP effect was accounted for as a “value bonus” given to each respective alternative, compared to coal technology, corresponding to the amount of

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<sup>7</sup>Levelized cost is the Net Cost of an energy system divided by the energy output over the system’s life, with time value of money taken into account (Information article, December 2011; [www.dyesol.com](http://www.dyesol.com))

exchange saved. Thus the levelized present value cost to the economy (arrived at through, conventional economic analysis) would reduce by that much when the “import substitution benefit premium” was deducted from the respective costs <sup>8</sup>, resulting in an “import substitution adjusted levelized cost”.

The multiplier for Sri Lanka was worked out through regression analyses using macroeconomic data, and adapting the methodology suggested by Dwidehi [2], where Investment (Gross Domestic Capital Formation) was considered to be exogenous. The Consumption by the private sector (C), and the Taxation (T) were assumed determined linearly as functions of Disposable Income ( $Y_d$ ), while the Government current expenses (G) and Imports (M) were assumed linear functions of Taxation (T), and Gross Domestic Product (Y), respectively. The model adapted for this exercise is described below:

$$\begin{aligned} \text{Macro-economic relationship:} \quad & Y = C + G + I + X - M \\ \text{in which,} \quad & C = C^* + c(Y_d) ; \\ & G = G^* + k(T) ; \\ & T = T^* + t(Y_d) \end{aligned}$$

$$Y_d = Y - T + S \text{ and}$$

$$M = M^* + m(Y)$$

where,  $C^*$ ,  $G^*$ ,  $T^*$  and  $M^*$  were constants representing “intrinsic” Consumption, Government recurrent expenses, Taxation and Imports, respectively; while  $c$ ,  $k$ ,  $t$  and  $m$  were corresponding gradients.

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<sup>8</sup> Same analysis could also be performed by assigning a “cost premium” to each unit of foreign exchange spent, thus amplifying the “economic costs” of those alternatives having greater “per kwh” foreign cost components.

The multiplier thus would take the form,

$(\pi) = (1+t) / [1 + t - c(1-t) -kt + m(1+t)]$ , which represents the total multiplied value addition to the domestic economy that could be secured through a rupee of additional aggregate expenditure “within the economy”, enabled in this case by foreign exchange saving on electricity generation using renewable energy technologies.

The technical and financial information pertaining to the renewable energy projects were sourced from a number of secondary sources, including the expert agencies involved in appraising the renewable energy-based power generation programmes in Sri Lanka [3]. The macro economic data were obtained from the publications of the Ministry of Finance and Planning [4] and the Central Bank of Sri Lanka [5].

## **Results and Discussion**

The Table 1 summarizes the levelized costs of three renewable energy alternatives for power generation, appraised at “financial” and “economic” angles. Among the assumptions made are, the discount rates (economic: 6%, and financial: 12%), and the shadow price conversion rates (all foreign costs: 1, local labour : 0.8, local material 0.75, local fuel : same rate as local labour, and other O&M costs : same rate as local material, investment: 1.5).

**Table 1: Conventional Analysis of Power Generation Alternatives – Financial and Economic perspectives**

	Biomass Energy	Solar Energy	Wind Energy	Coal Energy
Plant capacity	10 MW	10 MW	25 MW	285 MW
Life	25 Years	25 Years	25 Years	35 Years
Levelized Cost (Rs/kwh)				
Financial (@ DR 12%)	21.83	23.36	10.26	11.12
Economic (@ DR 6%)	20.15	15.10	6.87	9.84

*Source :Author's estimates based on data sourced from Resource Management Associates, Sri Lanka*

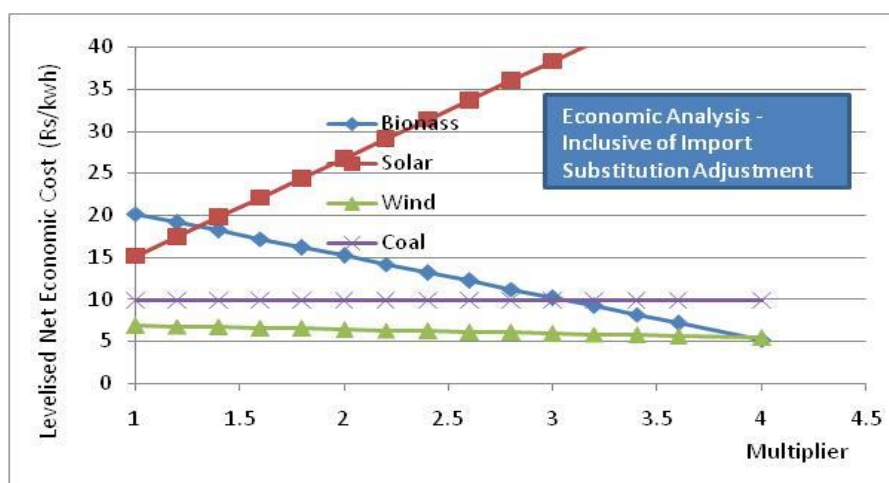
The sensitivity of these results on the discount rate was examined in order to perceive any change of relative positioning of technologies when the opportunity cost of investment changes. It was revealed that Wind power is likely to be the most attractive among all alternatives, and would never become “economically” less attractive to any competing alternative at any “economic discount rate” that could be reasonably used.<sup>9</sup> However, wind power could become “financially” less attractive than coal power at discount rates greater than 14%. Though biomass appeared financially more attractive for electricity generation than solar energy, the relative position would reverse when economic viability parameters are compared, and under “financial” view point also when discount rates figure below 11%.

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<sup>9</sup>Resources are available at much lower opportunity costs to the economy; thus no reason to use higher discount rates for economic analyses. However, wind technology would remain superior even at high discount rates as 12%

### ***Import Substitution Effect of Renewable Energies – Role Played by the “Multiplier”***

The effect of the multiplier in adjusting “economic attractiveness” of those “import substituting” renewable energy technologies, in comparison to coal power, at different hypothetical multiplier levels, could be demonstrated graphically as depicted in the Figure 1.



**Figure 1: Impact of Multiplier on Levelized Cost of Electricity from Alternative Sources**

*Source: Author's estimates*

A number of interesting observations could be made out of this analysis. First, it could be noted that the multiplier effect could play a significant role in determining the relative economic preferences among candidate renewable energy-based power project, and that the cost estimates when multiplier equals one would correspond to conventional levelized economic costs (Table 1). Second, Solar energy would lose its “economic” attractiveness compared to biomass, and

thus would become the least attractive among all, at multiplier levels above 1.3. This would be because of relatively higher “foreign capital intensity” of solar power. Third, the supremacy of wind energy would not be challenged by other contenders under any level of multiplier below 4. Last, the biomass based power generation, though is much costlier in the overall sense, would secure the greatest boost from the “multiplier” effect of exchange savings owing to its much lesser “foreign components” compared to all other technologies; and thus, would become superior to coal power over and above multiplier level of 3, and also would supersede wind energy if multiplier value increases beyond 4. The importance of estimating the multiplier applicable for the Sri Lankan economy was thus evidenced.

### **Multiplier Estimation**

The linear relationships assumed for macroeconomic parameter determination were estimated using OLS methodology using statistics for nineteen years from 1996 to 2013, sourced from the Annual Reports of the Central Bank of Sri Lanka [5]. The coefficients of determinants so estimated were used in computing the multiplier; the results are summarized in the Table 2.

**Table 2 : Estimation of Coefficients and the Multiplier**

Parameter	Relationship tested	Constant	Coefficient Of the Determinant	Adjusted R <sup>2</sup>	F - Statistic
C	$C = C^* + c[Y_d]$	126.5	0.70(11.61)	0.94	0.97
m	$M = M^* + m[Y]$	293.9	0.28(7.41)	0.86	0.93
t	$T = T^* + t[Y_d]$	163.4	0.06(5.11)	0.74	0.88
k	$G = G^* + k[T]$	- 421.9	2.46(7.46)	0.86	0.93
$\pi$	Multiplier ( $\pi$ ) = $(1+t) / [1 + t - c(1-t) - kt + m(1+t)]$				2.11

*Note : All estimated coefficients were significant at 1% level*

## Conclusions

Several interesting inferences emerge out of these results. First, the multiplier estimate of 2.11 implies representing an overall value addition exceeding two rupees for each rupee of additional aggregate expenditure in the Sri Lankan economy in average during 1996-2013. This would apply to any foreign exchange savings securable through renewable energy-based power generation, while it might also be compared against the multiplying effect of 2.4 and 4.3 estimated in the World Bank Tourism Sector Analyses for Seychelles and Madagascar, respectively [6]. Next, biomass technology would not be more attractive than wind power (as the multiplier would be less than 4), nor would it out-perform coal power (as the multiplier would not be near 3) as per the prevailing cost structures. It is also interesting to observe that the multiplier being greater than 1.3 has made solar power the least attractive of all options. This result is not surprising because of high

capital intensity of solar power plants, a large share of which is imported; and also because of their low plant factors.

These results underline the strategic necessity to develop Wind energy-based electricity generation in Sri Lanka, which would help the economy grow faster while securing a greater degree of energy self-reliance. Ways and means of reducing capital investment requirements (particularly foreign components) of biomass and solar technologies also would be worthwhile to explore in the long-run. Biomass in particular could be quite promising as with a marginal augmentation of coal costs in the world market, it could become economically more attractive, particularly in an environment where technology and plant efficacy are fast developing.

It must also be noted that the above economic estimations did not consider any negative externalities associated with competing power generation technologies. Biomass would be carbon neutral, as firewood plantations would become an automatic necessity, while both Solar and Wind would have no emissions altogether. Such was not attempted in this study, as it is beyond the scope of this research.

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[S3/03] **The Ambivalence of Electricity Tariff Setting in Sri Lanka: A Reflection of a Deeper Crisis needing Strategic Systemic Intervention**

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**Key words:** *Electricity, Affordability, Supply Economics, Tariff Policy, Sri Lanka*

## **Introduction**

Sri Lanka, though still being a developing country, is vigorously pursuing a strategy of “electricity for all”, and has already attained an electrification level of 96% by 2013 (Central Bank of Sri Lanka, 2013), quite a credible achievement compared to 29% level of electrification by the turn of the century (Ceylon Electricity Board, 2000). Continuous augmentation of the supply capacity is an imperative component of such a strategy as the electricity demand grows at an average rate of 1.5% approximately for each 1% real growth of the country’s gross domestic product (Ceylon Electricity Board, 2010).

However, the State owned electricity supplier, the Ceylon Electricity Board (CEB), is in financial difficulty with substantially high continuing and accumulated losses (Morimoto and Hope, 2001), and thus, any further expansion of the generation capacity at heavy capital expenses is a difficult task. This is because increasing capacity under such circumstances would imply borrowings, which would further

deepen the financial crisis; and also because any current losses could tend to amplify with expanded electricity supply unless the profitability of electricity supply business, at least on the new generation capacity added, cannot be ensured.

Electricity pricing occupies the centre stage of this problem. The CEB has been supplying electricity at an average tariff level below the cost of supply since a long time leading to accumulated losses. The gap is still in the negative that every additional unit supplied also is at a loss. CEB being a State enterprise is governed by the public policy which comprises of societal welfare as well, and also comes under the jurisdiction of the Public Utilities Commission of Sri Lanka (PUCSL) in relation to pricing, and thus, is unable to practice “cost plus” electricity tariffs, leading to this ambivalence.

It is this dilemma of electricity pricing and its systemic causes are focused in this research which discusses strategic options available to set prices with a view to ensuring supply side economics, “fairness” to the public, and growth. Though it is difficult to achieve all these together, potential short and medium term policy alternatives to overcome the crisis would be evolved.

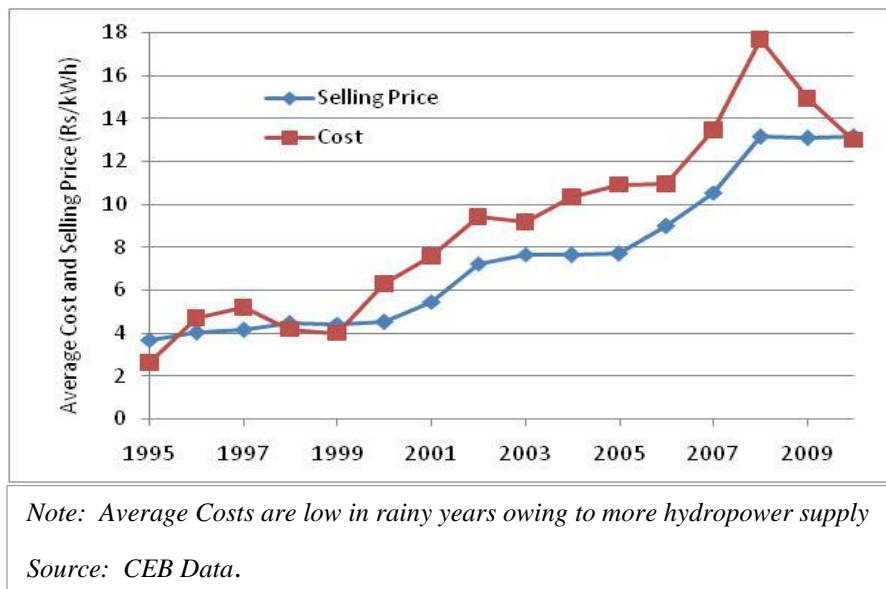
## **Materials and Methods**

The research looks at the supply side economics of electricity tariffs. It takes the approach of a comparative analysis of supply expansion and tariff policies adopted over the years. Data and information on costs of supply, tariff structure and overall supply economics are obtained from secondary sources, including published documents from the CEB, PUCSL, and also from various policy statements made from

time to time by the Government. Techno-economic imperatives of electricity system management and the historical evolution of policies which have lead the system to be in the present crisis are examined at length. The recent tariff structure proposed by the PUCSL the subsequent political intervention to reduce the tariff conditions, and also their justification and socio-economic implications are particularly analysed.

### Analysis and Results

Figure 1 shows the evolution of average sales price (reflecting the average electricity tariff) in comparison to the average cost per kWh supplied, which depicts how the CEB has run into deficit over the years, and has accumulated losses.



**Figure 1: Evolution of Selling Price (Average Tariff) and Average Cost of Supply**

There are at least two main political economic reasons for which the CEB was not allowed to increase tariff levels to cover the increasing costs: First, the cost of production rose rapidly so that any tariff set to cover such costs would have created socio-political problems. The affordability of the low-end consumers in particular would not have been adequate to pay any such cost recovery tariffs. As access to energy is an indicator in the measurement of poverty in a country (Morimoto and Hope, 2001), the tariffs applicable to the low-end users belonging to low income segments should not be increased, and it is imperative to provide at least a limited number of electricity units at a concessional price to such low income households in developing countries. Second, Sri Lanka is identified among the countries having highest electricity tariff levels in the Asian region (Ferdinando and Gunawardana, 2012) and further increase of electricity prices would have caused local costs of production, thus leading to loss of international competitiveness of our exports.

The political economic examination conducted in this study also found out several other constraints against implementing cost-recovery tariffs in the current context. The possibility of “self-generation” by the high-end consumers, who face substantially high tariff levels owing to the step-wise augmenting tariff structure practiced as per the policy of ensuring electricity affordability to low-end consumers, is a matter for concern.<sup>10</sup> Such would be sub-optimal vis-a-vis national

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<sup>10</sup> Consumptions below 90 units per month are billed below the average cost of supply, while those above 90 Units are charged at Rs 26.50 or higher, significantly above the average cost of supply.

interests as self-generation at small scale, though would be cheaper for the high-end consumers facing high electricity tariffs from the grid, would not have economies of scale and thus would be more costly per kWh in average to the national economy, and also would be environmentally harmful if resorted to diesel generators. On the other hand, the socio-economic justice of granting below-the-cost tariffs for the new low-end consumers, brought into the electricity grid supply under the coverage expansion drive, becomes questionable, if such is to be compensated through supplementary revenues earned by practicing high tariffs for the existing consumers over and above 90 Units of consumption per month. While it is economically rational to charge high from high-end consumers owing to which over-and-above basic consumption the high cost generators have to be operated, particularly in the peak times, a counter argument could be construed that it would be unfair to penalise them again with high tariffs. It is they who have been paying the CEB a tariff above the cost throughout (at least up to mid-1990s) to expand the system to accommodate the new entrants, and that it would be those new entrants who are responsible for the necessity to run expensive generators in the peak periods rather than the high-end but long-standing customers of the CEB. It is therefore evident that the tariff setting, particularly in view of recovering costs of supply, becomes a complex politico-economic dilemma, which gives rise to an up-ward rigidity of electricity tariffs.

It is in this context that the domestic sector tariff increase announced by the CEB with the concurrence of the PUCSL in 2013 was substantially reversed under social pressure through a politically guided concession granted on May 1<sup>st</sup> 2013. The tariff levels for consumption between 1 to 30 Units and between 31- 60 Units

stipulated by the authorities were thus reduced to Rs 3 per kWh and Rs 4.70 per kWh respectively, while the tariff levels for consumption beyond 60 units were raised. Table 2 summarises the domestic sector tariff structure before and after the May Day concessions.

**Table 1: Tariff Structure on Domestic Sector, Before and After May 01<sup>st</sup>, 2013**

Tariff Structure Authorised by PUCSL on April 20, 2013		Final Tariff Structure Implemented after Concessions granted on May 1, 2013	
Consumption Block	Tariff Rate (Rs/kWh)	Consumption Block	Tariff Rate (Rs/kWh)
All Consumption Levels		Consumption upto 60 Units per Month	
00 - 30 Units	5.00	00 -30 Units	3.00
31-60 Units	6.00	31-60 Units	4.70
61-90 Units	8.50	Consumption above 60 Units per Month	
91-120 Units	15.00	00-60 Units	10.00
121-180 Units	20.00	61-90 Units	12.00
181-210 Units	24.00	91-120 Units	26.50
211 -300 Units	26.00	121-180 Units	30.50
301-900 Units	32.00	Over 180 Units	42.00
Over 900 Units	34.00		

*Source: PUCSL*

In this tariff structure, the entire range of consumptions up to 90 units a month could be considered “subsidised” as the highest rate of Rs 12 per kWh applicable for any consumption up to that level is below the average cost of supply.

A controversial aspect examined in this study is the proposal to charge the total consumption at the tariff stage applicable for the highest Unit instead of applying the (state by stage tariff for consumptions belonging to each such block. The main argument against such a policy would be the abrupt jump of the bill if a marginal unit is consumed over a tariff boundary. This, according to critiques, is unfair. On the other hand, one prominent counter-argument would be the necessity to

address the “anti-equity bias” of high end consumers paying the same concessionary tariff on the first few blocks of consumption. Further, the substantial jump of the bill on consumptions slightly above the cut off levels would, at least theoretically, incentivise electricity conservation owing to substantial savings to secure by managing consumption below the cut off. This policy suggestion,<sup>11</sup> though was not fully implemented, could be observed reflected in the charging of flat rate of Rs 10 per unit for the totality of consumption from zero, when the consumption level surpasses 60 units per month.

The crisis is therefore evident. Welfare requirements call for low rates applied at least on low-end consumers. Any shortfall of revenue destroys supply economics, or, if financed through the Treasury, would finally fall on the general public, including those who even do not have electricity connections to their residences. If charged on the high side consumption, including the commercial sector, the competitiveness would be lost. The 25% reduction of tariffs across-the-board announced in September 2014 would further aggravate this situation.

There appears no solution for this crisis in the short run; but in the medium to long term, managing the supply cost structure and possible economics could be explored.

The Sri Lankan electricity generating system gradually became increasingly comprised of costly thermal power.<sup>12</sup> The energy costs would be Rs 40 and Rs 27 per kWh if generated by Diesel Gas Turbines and Diesel Combined Cycle plants respectively while it

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<sup>11</sup>A previous attempt to implement such a policy was once rejected by the Courts.

<sup>12</sup> Particularly, Furnace Oil and Diesel fired power plants

would be around Rs 20 per kWh for furnace oil technology. In contrast, hydro power plants, the dominant mode of electricity generation until early 1990s, generate electricity at almost zero energy cost.

It could be perceived that this was an outcome of the failure at policy level to invest in low-cost power generation technologies, such as coal power (having an energy cost of around 8 Rs per kWh), even though such was recommended since early 1980s as per the Long Term Generation Expansion Plan (LTGEP) of the CEB. The ideological position that the electricity industry could be driven by the market forces appeared to have prevented State sector investment coming into such new power generation capacity (other than in hydro power plants). The resultant increased dependence on private sector Independent Power Producers (IPPs) since mid1990s led to the gradual injection of small scale oil-fired power plants, which were less capital intensive, even though their costs of generation were much higher.<sup>13</sup> Such high costs were passed on to the CEB through “power purchase agreements” signed between the CEB and the IPPs while guaranteeing a “cost-plus” power purchase price tagged to oil prices. That amounted to ensuring profits for IPPs, while sandwiching the CEB between the power-purchase agreement driven cost on the one hand and the inability to pass that cost over to the consumers by way of increased tariffs on the other. This was a clear formula for financial disaster, as warned by the Department of National Planning in a confidential

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<sup>13</sup>Private investors naturally preferred faster pay-back periods than investing in such technologies as coal power with high capital intensities and longer pay-back periods in spite of their lower operating costs.

policy analysis submitted to the Government in 1996 (Gunaruwan, 1996). In fact, the analysis predicted that Sri Lanka would lose its hitherto enjoyed comparative advantage of having low electricity tariffs owing to this increased dependence on IPPs. The subsequent deterioration of the economic strength of the CEB (which had financial reserves amounting to Rs 2.3 billion by 1996), its current heavy debt stock, and down-ward rigidity of costs of generation, were results of this choice of inappropriate strategy opted for by the policy makers against that professional advice.

Sri Lanka lately has taken steps to invest in coal power plants, and the first three stages of the Norochcholai system (3 x 300 MW capacity) is now connected to the grid. While this new technology should help bring down the average cost of generation, several intricacies associated with the plant design and the technology has prevented the country from securing the maximum cost reduction benefits from it.<sup>14</sup> While the technical reasons for this sub-optimality are beyond the scope of this study, the fact that the coal power plant is inappropriate for peaking purposes,<sup>15</sup> does not become a substitute for the expensive diesel-based operation during peaks, but rather it becomes a substitute for the less costly base-load plants. The plant designed with 300 MW turbines, instead of many numbers of smaller turbines, also has

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<sup>14</sup> As per Minister Ranawake, the true cost per kWh generated by Norochcholai plant in 2102 has been 27.88 Rs/kWh owing to its under-loaded operation and technical failures. (<http://www.youtube.com/watch?v=wAwlmuQdhNQ>)

<sup>15</sup> Owing to the inability to frequently shut down and re-start depending on the daily demand patterns.

significantly affected its operational loading, thus preventing the system obtain energy at the lowest possible cost from the plant.

The coal technology itself is not free from disadvantages either. It is import dependent as much as oil, and would be vulnerable to international fluctuations of coal prices. Increased global demand for coal could raise international coal prices, thus potentially negating the economic advantages coal power has in the medium to long run. Coal technology does not support the energy self-reliance objective either, which should be a strategic priority for country having lost her high degree of energy self-reliance enjoyed when the system was run almost exclusively on hydro-power.

It is in this context that the policy focus on renewable energies becomes important. Studies have already shown that Sri Lanka has nearly 4000 MW of unexploited mini and micro-hydro capacity, a substantial wind power development potential, and a competitive advantage in going for biomass energy on a commercial scale. It has been revealed also that biomass and wind power technologies are fast improving in their capabilities that the specific cost of generation through such technologies are fast coming down. Economics with multiplier effect of foreign exchange saving for domestic consumption or investment purposes alone would make biomass and wind technologies supersede coal power generation in the medium run (Gunaruwan, 2014). Solar energy also is promising in the Sri Lankan

climatic conditions.<sup>16</sup> Such innovations would enable the system to become self-reliant, environmentally sustainable, while bringing down the average cost of electricity generated within the economy.

## **Conclusions**

The outcome of the policy analysis enables recommending three strategic directions for policy consideration. First, the short-term electricity pricing policies adopted should not be leading to further aggravation of the crisis. The tariff structure and Treasury endowments should be so determined that the financial health of the Utility is not compromised, and that the basic energy empowerment of the poor segments of the society is ensured. Second, the inefficiencies in the system should be addressed so that the power plants operating in the system are dispatched effectively with maximum loads to keep the specific generation costs low. Third, reliance on the IPP model has proven disastrous in the Sri Lankan context, and thus should not be considered for financing future capacity additions, particularly with regard to wind projects currently under scrutiny. It is economically disadvantageous to bind the Utility on a power purchase contract when it has no political or economic flexibility to determine the tariffs on a “cost plus” basis. Last, the system should be developed along the economically optimum path so that the average cost of power in the system is gradually reduced, enabling it to overcome the current financial and economic crisis. The renewable technologies, particularly wind and biomass power generation, could be candidates for consideration as they seem offering techno-economic feasibility

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<sup>16</sup> Solar photovoltaic for small scale remote consumption, in particular.

and environmental sustenance, while, at the same time ensuring energy security, self-reliance and lowering specific costs of power supply in the long run.

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**Session-4**  
**Environment and**  
**Sustainable**  
**Development**



[S4/01] **The Importance of Solid Waste Management for Sustainable Development: A Study of Solid Waste Management for Sound Environmental Development in Hambantota Municipal Council, Sri Lanka.**

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**Abstract**

*Sustainable development (SD) has become a catch phrase in global development agendas. SD is a matter of environmental conservation followed by socio- economic development. Development and environmental practitioners see Solid Waste Management (SWM) as a compulsory towards Sustainable development. This study explores the importance of SWM for SD in Hambantota Municipal Council (HMC) in Sri Lanka. A mixed methodology was used to gather information. Findings reveal that a SWM process may have a clear positive impact on sound environmental development as waste management is insufficient. The community seems little aware of its impact on the environment or/and sustainable Development in HMC. The study further revealed that there is little synergy between local authorities and the communities. There are challenges of limited resources, facilities and funds and illegal dumping in HMC. The study suggest an Integrated SWM process, with waste separation, recycling and composting and include SWM in to Development policies for Sustainable Development in HMC.*

**Keywords:** *Sustainable Development, Solid Waste Management, Hambantota Municipal Council, Sri Lanka*

## **Introduction and research problem**

Countries over time experience development with growth of industrialization, trade and internationalization. To some extent a discussion has emerged whether this development is sustainable. Recently, most development practitioners have focused on sustainable development (SD) as an environmental concept placing the emphasis on intergenerational equality focus on future development of the world (Carter, 2001). According to World Conservation Strategy (WCS) development depends on environmental conservation (Adams, 2009, p.275). However, the human way of life has placed a lot of pressure on the environment because of their high consuming behaviour which is accelerating simultaneously with economic development. Especially, the solid wastes (SW) have become a major consequence of development. The SW affects the natural environment to a great extent and pose a serious threat (Anand, 2010, p.5), to achieve Sound Environmental Development (SED) or so called Sustainable Development (SD). Therefore, sound SW management is one of the necessities in each and every development process. In this respect, the study identified SW management as one of the most important issues which should be addressed to sustain a countries development that meets the needs of the present without compromising the ability of future generations to meet their own needs.

Sri Lanka has provided a better example of this issue with new development processes, since the environment is been challenged with rapidly generated SW. Especially, development has accelerated consumer behaviour and has generated a significant amount of SW in

recent years. According to the National Environmental Action Plan (NEAP), management of solid waste has been identified as one of the major challenges for sound environmental development in Sri Lanka. Therefore, it is important to identify the importance of SWM for SED/SD in Sri Lanka.

Presently, Hambantota district is being developed under a master development plan. Thus, it is important to lead this development towards SED/SD. As the SW is a significant issue with this concern, the research considers SWM practices and its impact on Hambantota Municipal council (HMC) to identify the importance of SWM to formulate the ongoing development process sustainable for future generations. Therefore, the study focuses on SWMs impact on environment and sustainable development in the study area. The main Research Question was to investigate how solid waste management practices have impact on sustainable development in Hambantota Municipal council. There, the researcher tried to identify the current solid waste management practices and how those SWM practices affect the local environments in HMC. With the findings, the researcher tried to find out the correlation between SWM and SED/SD and how the SWM can be affected to SED/SD, according to the literature review. Furthermore, the study focused on the perceptions of local communities about the important of SED/SD and the importance of solid waste management for SED/SD.

## **Methodology**

The research adopted a case study design to assess solid waste management for sustainable development in Hambantota Municipal council, Sri Lanka. Both qualitative and quantitative methods were

used. The semi structured interview, self-completion questionnaire, focus group discussions and non-participation observation instruments were used to collect data. Government reports, municipal council reports and many other documents from different organizations and academic papers regarding waste management and its impact on the environment supported to collect secondary data. Self-completion Questionnaires (SCQ) have been used to collect quantitative data followed by qualitative data. Random sampling was used to select 69 households and 59 business population for SCQ, within 5,852 households and 412 business places with expected errors 0.12%. The sample size was determined by using a mathematic function (  $n = \frac{N}{1 + N(\alpha)^2}$  ). Purposive sampling is used to select participants for the interviews and focus groups and self observation areas. Qualitative data were analysed with the thematic analysis approach, where the researcher looked for patterns to build up themes. When the final classification of the themes had been constructed, a discussion of the findings was done with regard to the literature review and the data from documents reviewed. The research findings were supported by the qualitative data which were used to find relationships such as deviations, correlations, regressions and tendencies of given statistics.

## **Results and findings**

The research findings revealed that the new development process in the study area has significantly affected the environment with rapidly generated solid waste. Due to the lack of proper solid waste

management practices in Hambantota Municipal Council, the natural environment and eco-systems have been considerably affected. The research statistics indicates that 77% of Households (HH) and 91 % of Business Places (BP) in the study area empty SW daily. However, there are issues with unauthorized waste disposal practices due to the lack of proper waste management process in HMC. 81% of HH and 43% of BP dispose their waste in to unauthorized places. There are issues with the unavailability of public waste bins (Only 4% for HH and 17% for BP are available). HMC waste collection process was identified as ineffective and inefficient as only 19% of the HH and 49% of BP have access to waste collection tractor. Therefore, 75% of HH and 46% of BP are not satisfied with the waste management process by HMC. Moreover, the lack of waste separation and recycling practices, the absence of sanitary land filling and inadequate processes by Hambantota Integrated Solid Waste Management Centre are significant. The absence of practical usage of regulation and laws is identified as a barrier to residents engaging in proper waste management processes, because the council could not enforce these practices.

Therefore, the lack of proper SWM practices has significantly affected the natural environment and finally the Sound Environmental Development (SED) in HMC. The relationship between these waste management practices and environmental impacts were significant with research findings. Moreover, the research revealed that the lack of public awareness, lack of environmental education and lack of sufficient information about SWM and its impacts has significant correlations. Awareness about SWM impact on sound environmental development or/and sustainable development is seemingly low. The

study reveals that most of the community members do not have clear ideas about sustainable development or sound environmental development. It is because most of the development processes have no concern on promoting sustainable development in action. However, 75% of HH and 78% of BP think environmental impacts could be minimized with proper waste management. Higher proportion of the respondents agreed that solid waste management practices should be developed in Hambantota area for sustainable development. As a percentage 71% of householders and 68% of business personnel agreed to the point. Therefore, the study identified that lack of proper SWM practices have considerably affected the Natural environment and ecosystem, and because of that, the SD is been challenged. Hence, a proper SWM practices is important for the sustainability of new development process.

### **Conclusions, implications and significance**

The Research Study identified SWM as one of the important issues which should be addressed for sound environmental development contributing to knowledge by determining the importance of SWM for SED/SD. The research implicate that SWM process in HMC should be developed in order to sustain the ongoing development process. Therefore, SWM practices must be improved with waste separation from the household level, more efficient waste collection systems, and sustainable recovery and disposal practices. Considering the nature and components of waste generated by households and business places, the waste reduction, reuse, recycling and composting processes would be more suitable in managing the challenge in the

study area. Public education, awareness and properly planned waste management programs also need to be introduced into the current waste management system. Especially, awareness programmes must be conducted in order to improve the knowledge about the importance of sound environmental development/Sustainable development and the impact of SWM on it. Since the development process has accelerated the generation of SW in the study area, it is necessary to implicate SWM policies in to development projects.

The strength of this research study is the case study's setting which is the newly developed area, HMC, Hambantota, Sri Lanka. Further, this research study incorporates the views of the HMC community to explore their level of understanding of Solid Waste Management, environmental and sustainable development. This is strength because community views have been largely examined with the research.

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[S4/02] **Excessive Usage of Chemical Fertilizer in the Paddy Sector of Sri Lanka: An Economic Argument for Environmentally Sustainable Policy Intervention**

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**Key Words:** *Chemical fertilizer, Subsidy, Paddy, Excessive use, Environmental damage, Policies*

## **Introduction**

In the present day context, chemical fertilizer is considered to be an essential input to agricultural activities, without which the productivity of the sector and the value creation are widely believed to be sub-optimal. This input, however, has its negative consequences as it could pollute water, both surface and ground, and also could lead to food contamination. Besides, it is costly and corresponds to a significant share of cost of agriculture produce, and also is associated with a significant annual foreign exchange outflow from the economy. Thus, chemical fertilizer is considered to be a “necessary evil” in agriculture.

However, the beneficial effect of chemical fertilizer is not directly proportional to the quantities of usage. More quantities of application in agriculture do not necessarily mean more output, more so in the long run [8]. Thus, any excessive use, in the hope of having greater

benefits, could amount to waste, and also an unwanted environmental headache with no associated benefit.

It is this aspect of chemical fertilizer use in agriculture that was studied in the present research. The objective was to estimate any “excess use” of chemical fertilizer, based on the levels recommended by the Department of Agriculture, and thereby to estimate the potential economic benefits that could be envisaged if such excessive use could be reduced through environmental intervention in the deployment of fertilizer in the paddy sector.

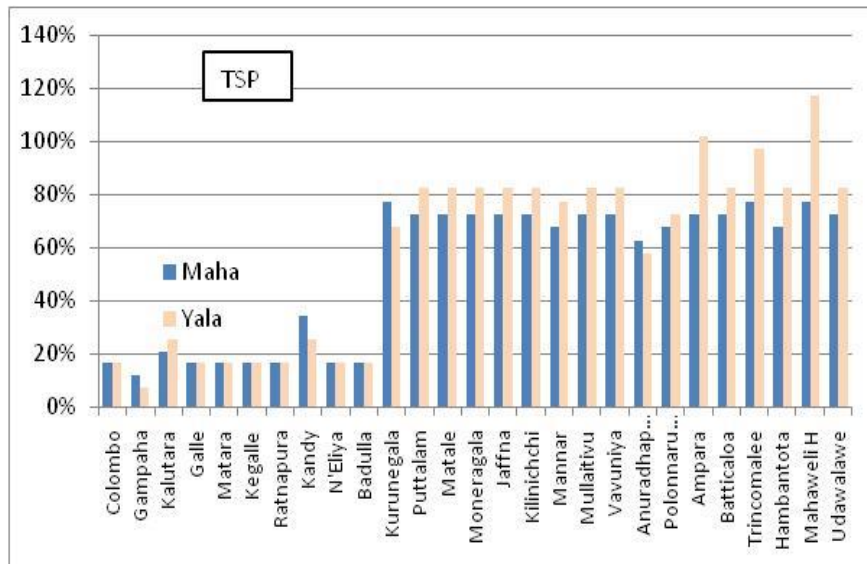
## **Materials and Methods**

The research gathered secondary data from the National Fertilizer Secretariat, the Department of Agriculture, and the Central Bank of Sri Lanka pertaining to quantities of application of fertilizer as against the prescribed amounts by the Agriculture Department, enabling estimation of the excessive use. It also surveyed literature to fathom the environmental impact of chemical fertilizer use. The direct economics corresponding to avoidance of any such excessive usage was thus assessed. Policy directions which would lead to this end were also discussed.

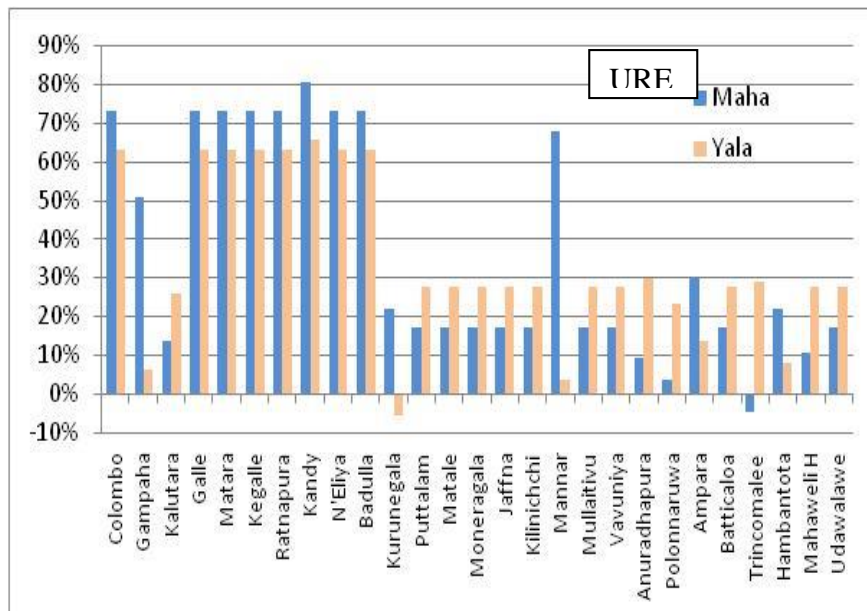
## **Results and Discussion**

The results revealed that the usage of chemical fertilizer in the Sri Lankan Paddy sector, is much more than the recommended quantities. Figure 1(a), (b), (c) demonstrate the district-wise patterns of excess

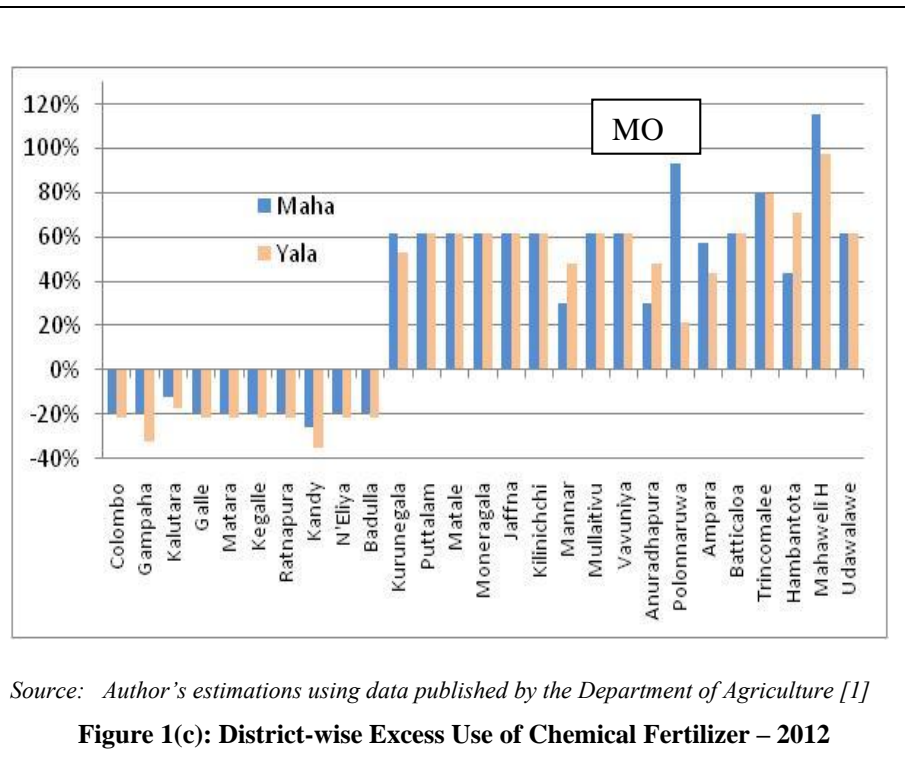
usage of TSP, Urea and MOP, the three main fertilizer types administered in paddy cultivation.



**Figure 1(a): District-wise Excess Use of Chemical Fertilizer – 2012**



**Figure 1(b): District-wise Excess Use of Chemical Fertilizer – 2012**



The above mirrors the over-usage of chemical fertilizer in the paddy sector, which is disproportionately high at times, more than double the amounts recommended by the Agriculture Department.<sup>17</sup> Particularly high excesses are found in the irrigated dry zone areas (with regard to TSP and MOP) and in the Wet Zone (with regard to Urea), while the only significant under-usage is recorded pertaining to MOP and in the rain-fed Wet Zone. The downward revision of recommended levels over the years tends to question the “short-term yield optimality” of

<sup>17</sup> The amounts recommended over the years by the Agriculture Department have been decreasing, and the present study adopted, as the basis of analysis, the recommended levels for 2013.

even the currently stipulated quantities, while the diminishing marginal returns on incremental application at constant marginal costs would establish the “economically optimum” levels much below the “short-term yield optimal” levels, the combined effect of which, even though beyond the scope of this study, could possibly put the actual over-use even higher than these estimates. Nevertheless, any amounts used over and above the stipulations (assuming their “yield optimality”) would not lead to a corresponding augmentation of yields, and such wasteful “excess use” would undoubtedly be wasteful, and would amount to nothing but paying through scarce resources to produce environmental ill-effects such as water pollution, food contamination and soil degradation in the long-run.

According to Dissanayake and Chandrajith (2009), for instance, Phosphate rocks by their very geological and mineralogical nature contain a host of environmentally hazardous chemical elements such as Cadmium, Lead, Mercury, Uranium and Arsenic, which, through fertilizer use, contaminate agricultural soils [5]. This was supported by Rajapakse (2013) who found high Phosphate and Nitrate contents in ground water in the agricultural areas [7]. Uranium, apart from its radiotoxicity, is chemotoxic. Cadmium is listed among the most dangerous elements in fertilizer,<sup>18</sup> particularly upon the discovery of its association with the disease called ‘*Itai-Itai*’. Several other diseases also are known to be caused by the excessive presence of these toxic elements; gastrointestinal, pulmonary and kidney ailments

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<sup>18</sup> Cadmium is known to be present in pesticides as well. Jayatilake et al (2013) concluded that chronic exposure of people to Cadmium (reflected by the significantly high urinary excretion of Cadmium in patients) would be a potential cause behind CKDu in largely agricultural areas of Sri Lanka [6].

being noteworthy [5]. Evidence also has been found to suspect the presence of Arsenic in ground water as a potential causal factor for Chronic Kidney Disease of unknown etiology, or CKDu [4]. Chandrajith et al (2011) believe that the unique hydro geochemistry of the drinking water could be closely associated with the incidence of this disease, thereby leading to suspect water pollution as one of the main causal factors [3].

In spite of this evidence, paddy farmers appear continuing to use chemical fertilizer in excessive quantities. Few inducements could possibly be behind this trend, including (a) the false belief that more use of fertilizer, even beyond the specified levels, would produce greater crop yields<sup>19</sup>, (b) the fertilizer subsidy<sup>20</sup> keeping the prices very low and driving the demand up, and (c) the long-term nature of environmental ill-effects, thus making them ineffective as “deterrents”. An explicit strategic action plan therefore would become necessary to curb this wasteful excess use of chemical fertilizer. Such will be a “win-win” strategy, as there would be no physical production loss, while the society stands to gain all associated direct economic (reduced wasteful expenses including import bills) and environmental (mainly, reduced soil and water pollution) benefits.

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<sup>19</sup> Long term effectiveness of chemical fertilizer in producing high crop yields is questionable, according to research conducted at Batalagoda-Sri Lanka. Rice yields have shown a declining trend where Nitrogen was applied (from 7 to around 4 tons per ha), while they remained unchanged at around 3.5 Tons per ha in plots with no Nitrogen treatment [8]. This makes “high yields” obtained through fertilizer applications an “unsustainable phenomenon”. Thus, cost incurred in foreign exchange would be for “damaging” the soil quality of paddy lands in the long-run. .

<sup>20</sup> A bag of 50 Kg of fertilizer is made available to farmers at Rs 350, the true cost of which to the economy would be approximately Rs 3,000, implying a subsidy of nearly 90% of the cost to the economy of such fertilizer supplies [2].

The research studied the direct economics associated with such a strategy in two stages, namely the estimation of (a) avoided subsidy bills on public coffers, and (b) potential foreign exchange savings.

### ***Potential of Savings of Subsidy to Public Cooffers***

The subsidy shouldered by the public coffers on the above estimated wasteful excessive use of fertilizer is a preventable cost, and such prevention thereby would be potential financial saving to the Treasury securable through a well-conceived and implemented strategy. This potential benefit could be worked out by applying the subsidy element of approximately Rs 2,650 per bag of chemical fertilizer, and the results are summarized in the Table 1.

**Table 1 : Savings of Subsidy by Eliminating Wasteful Excess Use of Fertilizer in Paddy Sector**

	TSP	UREA	MOP	TOTAL
Actual purchase of chemical fertilizer in 2012 (MT)	94,046	276,934	9,488	
Share of Total imports	86%	70%	66%	
Excess purchase in the paddy sector (MT) <sup>#</sup>	35,164	43,880	23,971	103,015 MT
Subsidy per MT of Chemical Fertilizer				Rs 55,000
Potential savings of fiscal burden by reduction of wasteful excess usage in 2012				Rs 5.64 Bn
Potential savings as a share of total Transfer payments in 2012				3%

*Sources : (a) Central Bank Annual Report – 2013 [2], (b) Agricultural Statistical handbook [1]*

*Note: # All island averages were assumed applicable to districts where the actual fertilizer usage intensity is not made available to the study.*

This implies that prevention of wasteful excessive use of fertilizer in the paddy sector could save nearly Rs 6 Billion (or nearly two-and-a-half percent of the total transfer payments in 2012) if the excess procurement of fertilizer in the paddy sector could be prevented.

### ***Potential Savings of Foreign Exchange***

The excess of fertilizer bought in the paddy sector also is associated with wasteful drainage of foreign exchange as almost all chemical fertilizers are imported. Given that the CIF price of fertilizer in 2012 was USD 486 per Metric Tons, the elimination of the wasteful use of over 100,000 MT of chemical fertilizer would have saved nearly USD 50 Mn of foreign exchange to the economy, amounting to nearly 2% of the total foreign debt service payments in 2012.

Moreover, the expenditure in foreign exchange is resources drainage out of the economy, which otherwise could be spend within the domestic economy generating a spiral of effective demand creation, thus leading to what is called the multiplier effect. Therefore, the actual economic effect of such foreign exchange savings on the gross domestic product of the economy is bound to be many times greater than the direct foreign exchange savings.

### ***Political Economy of Fertilizer Use***

Agriculture sector still has a very significant presence in the Sri Lankan socio-economy and polity, even though the sector's share in the country's GDP (11% in 2013) and exports (25% in 2013) has gradually reduced over the years [2]. The provision of livelihoods to millions of rural people, the retarding effect over the urbanization pressure, and the role played in the domain of food security, have made the sector (particularly the paddy sub-sector) increasingly recognized as socio-economically and politically strategic. Furthermore, strengthening the agriculture sector is explicitly envisaged by the Government to enhance the living conditions of farming communities and also to promote industries and exports based on post-harvest economic activities.

It is therefore socio-politically important that the encouragements provided to agriculture, particularly to paddy sector, are maintained. Any curtailment of subsidies is bound to be politically sensitive. Thus, a strategic reduction, and eventual elimination, of wasteful excessive use of fertilizer appears to be the only politically feasible niche open to the policy makers. Even the farmers would find it difficult to resist such a strategy as wasteful use, at however much subsidized price, would still be a cost to them as well.<sup>21</sup>

A few strategic interventions could be proposed in this regard. First, the awareness of the potential environmental and long-term soil

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<sup>21</sup> However, it is believed that paddy farmers sell a portion of their excess procurement of fertilizer to other agricultural activities. Resistance could thus be anticipated as any rationalization would deprive farmers earning this undue profit.

productivity damage may be created among the paddy farmers. This could be attempted through agricultural extension services, and also through media campaigns. Second, the paddy farmers should be issued with chemical fertilizer at subsidized prices only up to the techno-economically optimum levels and based on actual area cultivated. Succeeding in this, though would be subject to the effectiveness of managing fertilizer supply chain, would help reduce actual deployment of fertilizer inputs in the paddy fields, and thus would reduce environmental ill-effects. Third, an active promotion of organic fertilizer (could be produced locally by way of municipal waste composting) could be envisaged, to the extent that any subsidy granted on chemical fertilizer made conditional to a certain proportionate mixing with organic fertilizer. The Government also may, in the medium run, attempt to reduce the gap between the subsidized prices of fertilizer applicable to paddy and other crops, thus discouraging any excessive procurement in view of re-selling to other domains of agriculture.

## **Conclusion**

According to the above analysis, avoiding wasteful use of agro-chemicals in the paddy cultivation emerges as a policy priority. Since over two thirds of the total amount of chemical fertilizer imported to Sri Lanka is purchased in the paddy sector, any reduction of wasteful use there would have a significant beneficial impact on cost economics in addition to environmental benefits.

The study revealed the possibility of (a) retaining, within the national economy, an amount of foreign exchange worth over USD 50 Mn (or, nearly half a percent of total export earnings of the economy in 2012), even if the multiplier effect of such foreign exchange saving is completely ignored, and (b) easing of public coffers to the tune of Rs 6 Bn a year (or over two- and-a-half percent of the total transfer payments shouldered by the Government) which could be diverted to more productive use, while (c) securing significant environmental benefits by way of reduced contamination of soil, water and agricultural produce. It is noteworthy that no or insignificant investment is required to realize these benefits. Environmentally sustainable policy intervention is therefore justified even on direct economic grounds.

It may be worthwhile, however, to note that any such policy address on fertilizer use is likely to be politically sensitive, and a strategic approach would be necessary to manage potential resistance and resentment that might emerge from the farming community.

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[S4/03] **Effectiveness and Economics of Carbon Foot-  
Print Reduction in Aviation: An Analysis of Measures  
Adopted by the Sri Lankan Airlines**

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**Abstract**

*Aviation is a catalyst for economic growth, a vital contributor to world trade and also a major global employer. With these benefits comes the impact of negative environmental externalities, mainly through fuel combustion emissions which the service providers around the globe recognise the need to address. This paper presents an analysis conducted to evaluate the effectiveness of the measures adopted by the national flag carrier of Sri Lanka (Sri Lankan Airlines) in its mission to reduce Carbon foot print. The results revealed that the use of navigational methods such as RNAV/PBN and the operation of A320 aircraft under ETOPS as having had the most significant impact among many adopted by Sri Lankan Airlines. The study also enabled quantification of fuel saving benefits and carbon emission reduction benefits the airline has managed to secure over the past four-and-a-half years through the implementation such strategies.*

**Key Words:** *Airline Operational Methods, Fuel Efficiency, Carbon Emission Reduction, SriLankan Airlines*

**Introduction and Research Problem**

Global air transportation, including domestic and international operations, currently represents 2% of global Carbon Dioxide (CO<sub>2</sub>) emissions, which is increasingly becoming an environmental concern in the backdrop of air traffic expected to grow at an annual average

rate of 4.5% over the next 20 years (ICAO, 2011). The Asia and Pacific region would contribute significantly to this trend with a projected growth rate of 6.2% between 2011-2030. Therefore, the aviation industry is considered a notable culprit behind climate change, and tremendous pressure has been put on the sector to find ways to limit and reduce its CO<sub>2</sub> and non-CO<sub>2</sub> emissions (Sgouridis, et al., 2011). It is in this conjuncture that Sri Lankan Airlines, the national flag carrier of Sri Lanka, embarked on a mission to reduce its carbon foot print by implementing a gamut of operational and technological measures since 2010.

The current research intends to examine at length the measures implemented in this direction by the Sri Lankan Airlines, their relative effectiveness in reducing its carbon foot-print and their impact to the economics of the airline.

## **Materials and Methods**

Reducing aviation emissions whilst growing the supply capacity to cater to the demand growth is likely to require a range of economic, operational and technological measures implemented in combination (Dray et al, 2010). Some of the measures, , implemented by the Sri Lankan Airlines to reduce emission levels (SriLankan, 2013) were appraised in this research, choosing fuel consumption intensity as the proxy to reflect the relative efficacy of each such measure implemented. The four measures of enhancing fuel efficiency selected, namely (i) the replacement of the aging A320 fleets with brand new

aircrafts, (ii) the implementation of RNAV / PBN approaches to airports wherever possible, (iii) the adoption of the new flight planning system called LIDO for route optimisation, and (iv) the introduction of ETOPS operations for Airbus A320 enabling the aircraft type to be deployed on routes hitherto unauthorised,<sup>22</sup> were captured against each flight for the period between 2010-2014 and the corresponding fuel consumption and the flight distance computed using the Rockwell Collins Distance Calculator.

The Ordinary Least Square methodology was adopted to assess the significance of measures in reducing the fuel intensity per seat-kilometre supplied. The flights operated by the A320 aircrafts were used for this purpose as a case analysis.

The models tested are as follows:

$$FCSK_{TOT} = A + B(NEW) + C(RNAV) + D(LIDO) + E(DIST) \dots\dots\dots (1)$$

$$FCSK_i = P_i + Q_i(RNAV) + R_i(LIDO) + S_i(DIST) \text{ for each A320 aircraft "i"... } (2)$$

where, the first model is estimated on the totality of A320 aircrafts and the second set of models (i=1,9) correspond to each individual A320 aircraft identified by their codes. FCSK abbreviates fuel consumption in litres per seat km, while NEW, RNAV and LIDO are dummy variables representing the strategic measures (whether such were active or not, pertaining to each flight concerned). DIST denotes the flight distance in thousand kilometres.

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<sup>22</sup> RNAV/Performance Based Navigation (PBN) (a navigational method that permits the aircraft to operate on any desired flight path within the coverage of the station referenced navigational aids), LIDO (a flight planning system used by the SriLankan Airlines) and Extended Range Twin Engine Operations (ETOPS) which is a rule that allows twin engine aircraft to fly shorter distance routes with a reach for the nearest airport within the certification level), are fuel saving measures introduced by the International Civil Aviation Organisation (ICAO) and International Air Transport Association (IATA).

The fuel consumption economics attributable to ETOPS operations were examined by analysing the flight operations data on Singapore (SIN), Kuala Lumpur (KUL) and Bangkok (BKK) sectors<sup>23</sup> for the period from 2010 to June 2014. The data pertaining to flight operations, aircraft type, route-wise fuel consumption, and passenger load factors required for the analysis were sourced from the databases of the Sri Lankan Airlines.

## **Analysis and Results**

Cross-section regression analyses were performed using the above forms of regression models, and the validity of the models was verified. It was found that the variable NEW had strong correlation with LIDO and DIST, and therefore the Model 1 was re-estimated without the variable NEW among the independent variables. The results of the regression analyses are summarised in the Table 1.

It is evident from the above results that the use of navigational method RNAV/PBN has been significantly influential on the fuel savings in A320 flights in general and in each A320 aircraft individually. Similarly, the correct sign and the high t-value associated with the coefficient of the variable representing the distance indicate the strong significance of fuel saving effect per seat km of longer distance flights. This result conforms to the general expectation that longer flights consume lesser fuel per seat kilometre than shorter haul flights.

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<sup>23</sup> It is on these routes that ETOPS have been effective in permitting shortest trajectory A320 operation instead of larger aircrafts (such as A330 or A340).

**Table 1: Summary of OLS Analysis Results**

Model	Constant	NEW	RNAV	LIDO	DIST	R <sup>2</sup>	F-Value
Total A320 (with NEW)	0.0346	8.176 (0.47)	-0.003*** (-15.36)	0.0001 (0.49)	-0.0045*** (-52.38)	0.366	1032.43
Total A320 (without NEW)	0.0346		-0.003*** (-15.50)	0.0002 (0.51)	-0.005*** (-63.29)	0.366	1376.61
Aircraft G	0.0346		-0.0019*** (-5.06)	-0.0001 (-0.35)	-0.005*** (-23.60)	0.397	186.82
Aircraft J	0.0342		-0.0025*** (-7.20)	-0.0003 (-0.99)	-0.005*** (-24.42)	0.384	202.81
Aircraft K	0.0355		-0.0019*** (-7.08)	-0.0003 (-1.37)	-0.004*** (-30.22)	0.437	305.27
Aircraft L	0.0353		-0.0039*** (-11.24)	0.0009 (3.06)	-0.005*** (-29.94)	0.476	306.69
Aircraft M	0.0396		-0.0074*** (-4.62)	0.00051 (0.49)	-0.006*** (-9.66)	0.118	35.25
Aircraft N	0.0329		-0.0016*** (-3.49)	-0.00038 (-1.49)	-0.003*** (-21.57)	0.480	263.30
Aircraft O	0.0321		-0.0016*** (-4.93)	0.00002 (0.142)	-0.003*** (-26.63)	0.589	377.96
Aircraft P	0.0328		-0.0025*** (-7.05)	-0.0001 (-0.05)	-0.003*** (-27.83)	0.574	340.85

Note : \*\*\*, \*\* and \* stand for 1%, 5% and 10% levels of significance, respectively

The insignificance of the coefficient of the variable NEW in the Model 1 enables inference that the replacement of new A320 aircrafts for old A320s has had no significant fuel saving effect. It is however possible that any effect is camouflaged by the Distance variable, which is further evidenced by the strong correlation between the two determinant variables, necessitating the removal of one of the variables from the analysis. The model without the variable NEW was retained in place of the Model 1.

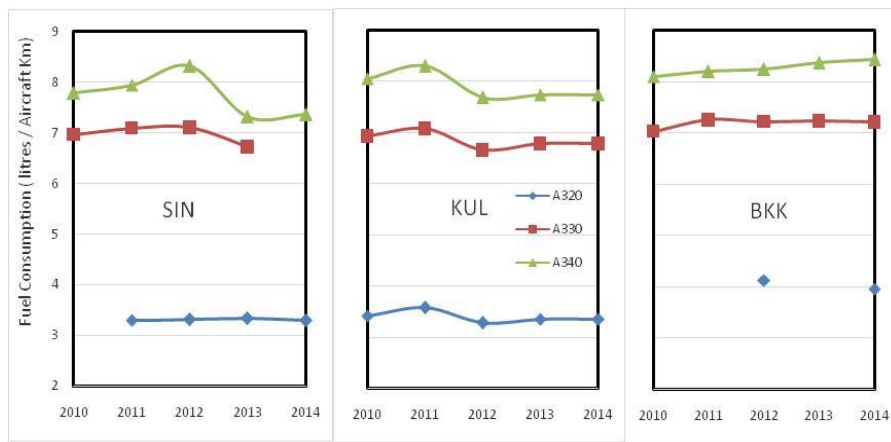
It is noteworthy that the strategic variable LIDO did not show any significant fuel saving influence with regard to A320 flights, and therefore, the measure could not be considered as effective in reducing the carbon foot-print in the Sri Lankan Airline flight operations on A320 aircrafts. This might be owing to the fact that an actual flight path would be largely circumstantial than the optimum plan suggested by LIDO. Nevertheless, the reasons for such ineffectiveness, and whether the measure has been effective on other types of aircrafts, need further investigation.

The strategic variable ETOPS could not be tested in the above analysis as the measure concerns permitting A320 aircrafts to operate on the Bangkok, Kuala Lumpur and Singapore routes hitherto served by larger aircrafts such as A340s and A330s. Besides, fuel intensity per seat km could not be used as a comparative measure in this regard as different types of aircraft have different seating capacities and seat-km supply economics could not be compared in isolation without examining the corresponding demand conditions represented by the load factors. Therefore, the fuel consumption per aircraft kilometre in the three routes for which ETOPS was granted was examined over the period between 2010 and 2014, where the operation of A320 aircrafts represent the ETOPS enabled flights. The Figure 1 summarises the fuel consumption per aircraft kilometre in the three sectors by aircraft type and their evolution since 2010.

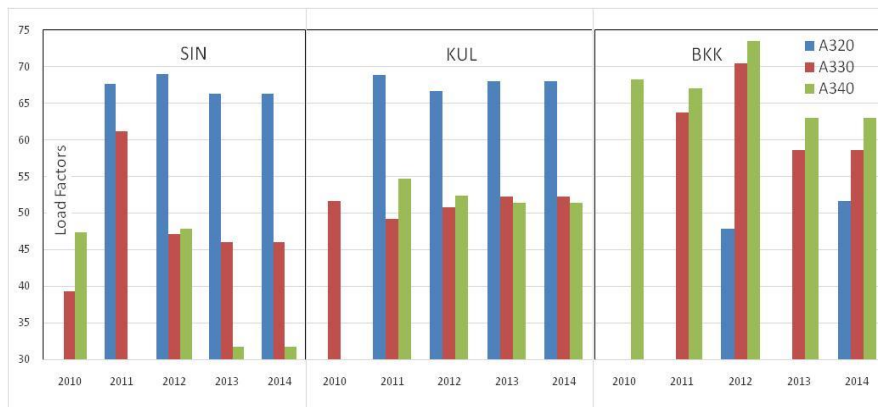
It becomes clear from this analysis that the operation of A230s is much more fuel efficient than A330s or A340s per flight in the three sectors. Larger aircrafts (A340s or A330s) should be operated only if

economies of scale could be aimed at in high demand conjunctures. The demand patterns as reflected by the load factors recorded in the three sectors (Figure 2) indicate that the chances of such “high demand conditions” necessitating deployment of larger capacity aircrafts would have been minimal; the maximum load factor observed being slightly over 70%.

**Figure 1: Fuel Consumption per Aircraft Kilometre for A320, A330 and A340 Aircraft**



**Figure 2: Load Factor Distribution for SIN, KUL and BKK Sectors for Year 2010-2014**



*Note: Higher load factors in the BKK sector for A340s and A330s as Hong-Kong passengers are included*

Thus, it could be inferred that the A330 and A340 aircrafts were operated in the three sectors not because of heavy passenger demands calling for larger craft, but because of the lack of permission for A320s to operate across Indian Ocean over the shortest distance to these three destinations. Hence, the Sri Lankan Airlines appear to have benefitted, in terms of fuel economics, from the ETOPS approval to operate A320 aircrafts to fly, firstly 90 minutes and thereafter 120 minutes, away from an airport for emergency landing, which has enabled the airline achieve the three sectors with increasing share of operation by A320 aircrafts ever since 2012.

**Table 2: Fuel Saving by Operating ETOPS on SIN, KUL and BKK Routes**

Year	Km operated on ETOS	Fuel Saved			
		Min (if A330 substituted)		Max (if A340 Substituted)	
		Mn litres	Percentage	Mn litres	Percentage
2010	2468	0.0013	< 1%	0.0041	< 1%
2011	148672	0.5497	1%	0.6941	1%
2012	4664204	16.899	30%	22.182	36%
2013	6511334	22.146	40%	26.944	44%
2014 (Jan-Jun)	4516531	8.885	27%	19.188	45%

Table 2 summarises the fuel economies that the Sri Lankan Airlines would have secured over the past four-and-a-half years owing to ETOPS authorisation. The fuel consumption on the three sectors (SIN, KUL and BKK) would have been 1%, 30%, 40% and 27% more if the mileage operated by the A320 aircrafts under ETOPS in 2011, 2012, 2013 and in first six months of 2014, respectively, had to be operated by A330 aircrafts. These would have been 1%, 36%, 44% and 45% more if the operation had to be done using A340 aircrafts. Therefore,

it could be inferred that the ETOPS operation enabled Sri Lankan Airlines save between 48 to 69 million litres of fuel, amounting to financial savings ranging from 60Mn to 85Mn US dollars, over the past four-and-a-half years.

## **Conclusion**

Implementation of RNAV/PBN navigational methods and the use of ETOPS facility have provided the airline with a significant fuel saving over other measures. This study also has found that LIDO flight planning method, though identified among green strategies by the airline, has been unsuccessful in significantly economising fuel.

On ETOPS alone, the airline has been able to save 48 to 69 million litres of fuel over the past four and a half years, corresponding to a CO<sub>2</sub> emission reduction of approximately 122,481 to 174,345 tonnes of CO<sub>2</sub>. This significant reduction of carbon foot-print has enabled the national carrier to fulfil its objective of moving towards a green airline.

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[S4/04] **Potential of Wild-Life Tourism Development in Sri Lanka: An Economic Analysis**

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**Key Words:** *Wild-life parks, Tourism, Carrying Capacity, Potential Economic benefits*

### **Introduction**

Wild-life parks in Sri Lanka are one of the main foreign tourist attractions, with over 340000 visits (or approximately 25% of the total foreign tourist visits) in 2013. Therefore, in view of achieving the target of hosting 2.5 million foreign tourists by 2016[5], Sri Lanka's wild-life parks would constitute an important motive power. Appropriately conserving and managing her wildlife reserves, Sri Lanka, a country endowed with rich bio-diversity [7], could look forward to exploit wildlife tourism as one of her strategic pathways towards economic development [1][3].

Though this hypothesis is logically advanced, no quantitative estimates are available as yet regarding the capacity of wild-life parks in hosting foreign tourists, and thereby the exchange earning and value addition potential. The present study was conducted with the aim of addressing this knowledge gap.

## **Data and Methodology**

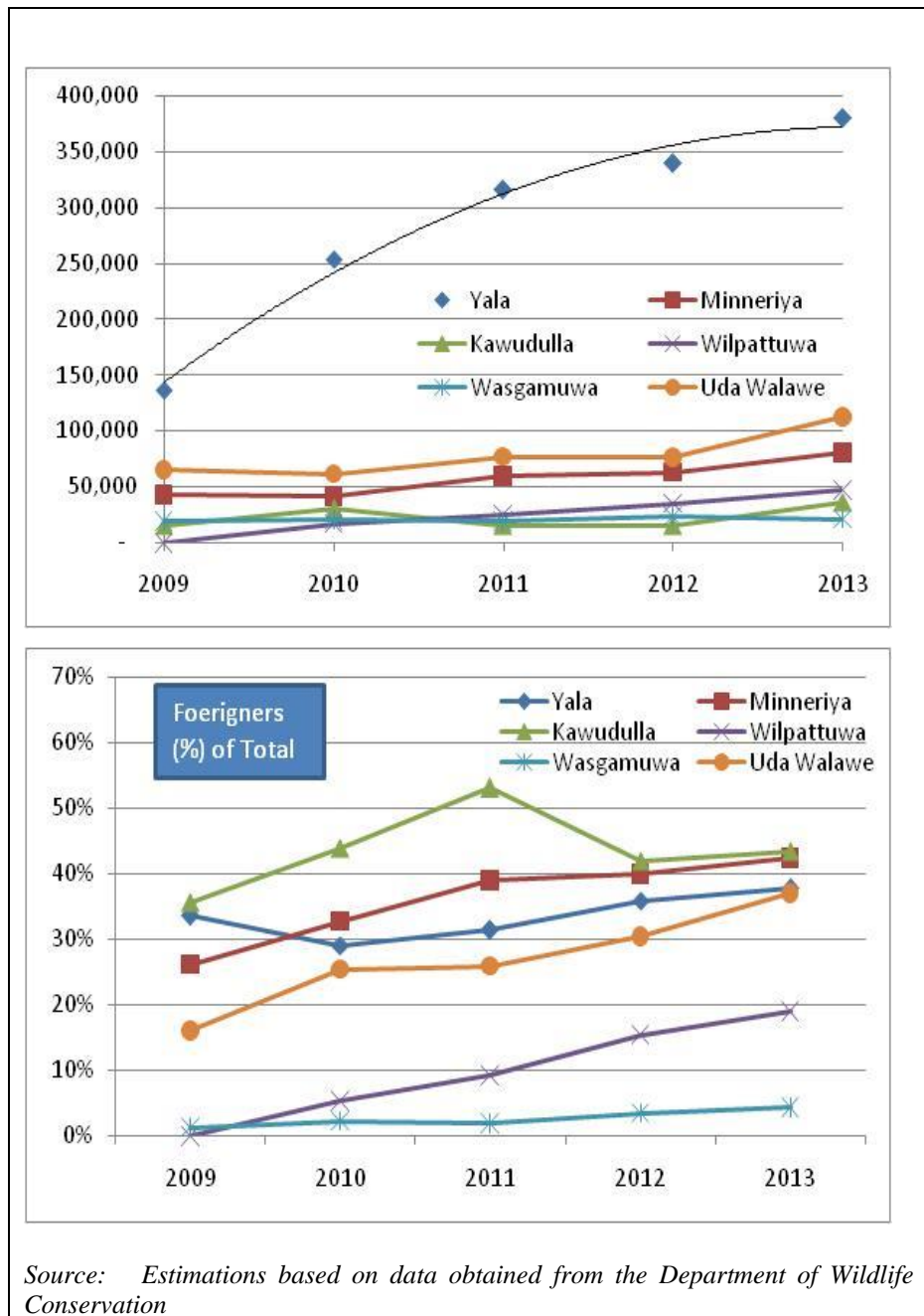
The research examined the wild-life park visitation by foreign and local tourists and their trends over the period from 2009 till 2013. Expert opinion and stake-holder comments also were sought to understand the possible causes behind such trends. Park visitation densities were used as a yard-stick to assess their further scope of visitation growth. Attempts were also made to estimate the potential economic gains associated with such an achievement.

Data were obtained from the Department of Wildlife Conservation, Sri Lanka Tourism Development Authority and other relevant publications. Comparative tabulation, Graphical examination of data and scenario-based projections were used as analytical methods

## **Analysis and Results**

Statistics pertaining to visitation recorded at twelve wild-life parks over the five years between 2009 and 2013 were subject to analysis. It was observed that six of those (Yala, Uda-Walawe, Minneriya, Kawudulla and Wiplattuwa) account for over 70% of the total foreign tourist visitations by 2013. Therefore, those six parks were selected for detailed analysis.

First, the past trends of park visitation were examined to understand the patterns of their evolution. The Figure 1 depicts the trends of (a) the total visitation numbers and (b) the share of foreign tourists in the total visitation over the past five years from 2009 until 2013.



**Figure 1: Total Visitors attracted at the selected Parks and the share of Foreign Visitors**

It is noteworthy that Wilpattuwa (the largest of all parks) and Wasgamuwa, are dismal performers among the selected parks, even though their rich diversity of animals and forestry, and less disturbance from tourist visitations and vehicular movements should have made the watching experience at these parks the greatest [2]. According to tour operators, this would have been caused by their lack of easy access to main tourist transit routes and to quality tourist residential facilities. However, Wilpattuwa, together with Minneriya and Uda-Walawe, have experienced significant up-ward trends in visitation levels over the recent past. This might be signaling the potential they offer in expanding wild-life based tourism. Uda-Walawe, Minneriya and Kawudulla parks, advantaged by the high certainty they offer in elephant watching and also by their location closer to main tourist transit routes and quality hotel infrastructure, stand attractive to tour operators.

In a clear contrast, Yala, the park which stood out as the most preferred wildlife tourism destination in Sri Lanka owing to the favorable conditions it offers, appears to be gradually approaching saturation. Its foreign visitation share also shows a relative stagnation over the years, possibly owing to the deterrent effects caused by the increased overall tourist visitation and vehicular movements as opined by the experts.

The latter observation is important because it possibly reflects that Yala is gradually approaching its sustainable tourism carrying

capacity,<sup>24</sup> if not exceeding it. In the absence of scientifically estimated “sustainable carrying capacities” specific to the selected parks, present study used the visitation density at “saturation level” seemingly approached by Yala to estimate the scope for further eco-tourism development potential at other wild-life parks chosen for the analysis. This is based on the implicit assumptions that (a) the sustainable carrying capacity of Yala is not significantly different to what is indicated by the visitor saturation level observed,<sup>25</sup> and (b) the acceptable maximum tourist visitation levels applicable to all parks would be proportional to their square area, implying that the threshold visitation density would be the same for all parks in Sri Lanka.

### *Scope for Improvement*

First, the total (both foreign and local) tourist visitation densities of the selected six national parks in 2013 were calculated. Next, Yala’s saturating visitation density was used to estimate the visitation levels the other parks could target at under different scenarios by 2020. The results are summarized in the Table 2.

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<sup>24</sup>Carrying Capacity of an eco-tourist destinations means the maximum number of tourist visitations it could bear without its ecological functions as well as the quality of visitor experience being negatively affected [6].

<sup>25</sup>What is observed in Yala might be an indication of the park’s carrying capacity being fast approached or else a symptom of “excessive visitation”. If the latter is the case, it corresponds to carrying capacity being exceeded, causing harm to both wild-life conservation and eco-tourism interests.

**Table 2: Foreign Tourist attraction Growth Potential of National Parks in Sri Lanka by 2020**

Park and Area (Mile <sup>2</sup> )	Total Visits in 2013	Density 2013 (Visits/Mile <sup>2</sup> )	Foreign Visits in 2013	Scenario A (Visits/Yr)	Scenario B (Visits/Yr)	Scenario C (Visits/Yr)
Yala (57 <sup>*</sup> )	379,414	6,656	142,714 [38%]	150,081	150,081	150,081
Minneriya (34)	80,576	2,370	34,065 [42%]	100,619	100,619	57,299
Kawudulla (27)	36,314	1,344	15,775 [43%]	82,102	82,102	19,258
Wilpattuwa (508)	46,551	92	8,846 [19%]	675,740	26,538	19,895
Wagamuwa (143)	21,336	149	934 [ 4%]	43,820	1,868	1,185
UdaWalawe (119)	112,414	945	41,487 [37%]	307,423	307,423	61,194

*Note :*

(i) \* : Corresponds to the area open for tourism, which is one-fifth of the total park size

(ii) Within square brackets are foreign tourist visitation ratios, assumed applicable even for 2020.

(iii) Foreign and local eco-tourism in Sri Lanka are assumed grown at the same average annual rate.<sup>26</sup>

The Scenario A represents the case where all six parks reach their maximum capacities corresponding to the saturating visitation density estimated for Yala. A more moderate second scenario (Scenario B) was construed where Minneriya, Udawalawe and Kawudulla would reach the maximum visitation density of Yala, while Wasgomuwa and Wilpattuwa respectively would double and triple their current densities.<sup>27</sup> All Parks continuing to experience a linear growth of visitation, estimated based on their visitation data during the past five

<sup>26</sup> It is likely that this would have led to under-estimate foreign tourist visits to wild-life parks, and there by the corresponding tourism based revenues and value added benefits, across all scenarios examined in this study.

<sup>27</sup> Wasgomuwa has had a 12% growth in density in the past four years, while Wilpattuwa has tripled in three years.

years, is represented by Scenario C, which is also considered the Scenario under no policy intervention (base-line scenario). There would be no difference among scenarios pertaining to Yala, because its visitation density would plateau at 7000 visitors per square mile<sup>28</sup>.

These estimates were then cross-checked against the official target of hosting 2.5 million foreign tourists by 2016, which corresponds to an average annual growth rate of foreign tourist arrivals of around 20% over the next three years. Assuming the prevalence of the same annual rate of increase the country would stand to host at least 5 million foreign tourists by 2020, provided that the environment persists to be conducive. This would imply Sri Lankan wild-life parks hosting nearly 1.2 million foreign tourists by then, even if the prevailing park visitation rate of 25% by foreign tourists is assumed stagnant over the next half a decade. Given that the six parks chosen account for over 70% of the park visits by foreign, it is not unreasonable to assume that those parks together would fetch a visitation demand per year of around 900,000 foreign tourist visits. This is little less than thrice the projection under Scenario C (base case projection), around 35% more than the projection under Scenario B, and around 33% less than the most optimistic (Scenario A) projection<sup>29</sup>. Thus, it could be inferred that the projections made in this analysis could not be far away from what could be practically achieved; the most plausible projection being

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<sup>28</sup> Based on assumption that the graphically observed levelling off at around 400000 visitors per year (around 7000 visitors per mile<sup>2</sup>) is effectively the sustainable carrying capacity of Yala. This however needs further verification.

<sup>29</sup> Even if the average annual growth rate of foreign tourist arrival drops to half of the going rate, the visits that could be expected by the six parks together would not be less than the projection made under the Scenario B.

somewhere half-way between the scenarios A and B. The results of this analysis are depicted in the Table 3.

**Table 3 : Comparison of Scenario-Based Projections against Tourism Development Targets**

2013 (Actuals)	Horizon	2016	2020
1.27 Million	Total Foreign Tourists	2.5 Million	5.0 Million
341,227 (25%)	Foreign visits to national parks (Based on the estimated total foreign tourist visits)	625,000 (25%)	1.25 Million (25%)
243,821 (72% of all parks)	Foreign visits to selected six parks (Based on the estimated total foreign tourist visits)	900,000 (72% of all parks)	
	Projections of foreign tourist visits to six parks Scenario A (carrying capacity fully exploited) Scenario B (less optimistic scenario) Scenario C (Base case: Recent trends extrapolated)	1,359,786 668,632 308,914	

Thus, Sri Lankan wild-life parks could reasonably set strategies to host around 1.2 Million foreign tourists (around 850,000 in the selected six parks and around 350,000 in the others), while the minimum possible fall back would be somewhere around 900,000 foreign tourists.

### ***Potential economic gains***

Economic gains associated with a wild-life tourism development drive leading to the above projected visitation levels can be estimated in three different stages, namely (i) direct income gains at national parks, (ii) off-park income from tourists during their stay in the country, and

(iii) the multiplier effect of added foreign exchange spent within the economy.

The above projections correspond to an additional gross foreign exchange earning potential ranging between USD 380 Million (minimum estimate) and USD 620 Million (most plausible estimate) based on the same average number of days of stay (7.8) per foreign tourist visit to Sri Lanka, and the same average foreign exchange spending per day (USD 103) per tourist, as what was recorded in 2013. A net foreign exchange gain of USD 300 million to USD 500Mn could be expected if a 20% average level of foreign exchange outflow is assumed on imported inputs.<sup>30</sup> The in-park income increase (at the prevailing park entrance fee levels), though only a fraction of the overall exchange gain (Rs 1 to 1.5 Billion per year), would be substantial (between 160% and 240%) compared to current levels. The overall positive effect on the country's GDP of such an achievement would be between Rs 90Bn and Rs 140Bn by 2020 in real (2013) prices when the multiplier effect (at a multiplier of 2.2, quite closer to the multiplier of 2.4 used on Seychelles by the World Bank [4]) also is taken into consideration.

## **Conclusion**

This research has successfully demonstrated that Sri Lanka has a substantially high wildlife tourism development potential, hitherto not

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<sup>30</sup>Likely to be a high side assumption, even if the outflows pertaining to capital inputs also are included, as the outflow element on recurrent inputs is less than 10% of the exchange earnings

fully exploited. The wild-life parks, currently managed with an almost exclusive “conservation” interest, offer significant scope for adding economic value through sustainable wildlife tourism, to the tune of 1.3% to 2% of the country’s GDP in 2013, while the additional net foreign exchange earning potential would be equivalent to around 1% to 1.6% of the total foreign exchange out-flows on account of imports to Sri Lanka in 2013, or around one-eighth to one-fifth of the total foreign debt service payments in 2013.

The challenge, however, would be to strategies and plan for the pre-requisites (including resources, infrastructure and marketing) for healthy management of parks and also for hosting such high level of foreign visitation at the wild-life parks without letting the negative externalities nullify the eco-tourism benefits.

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**Session-5**  
**Industry and**  
**Service Sector**



[S5/01] **Measuring industrial interdependence to find an effective development strategy for Sri Lanka: an input-output modeling approach**

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**Abstract**

*This paper is aimed at measuring industrial interdependence using a symmetric input-output table for Sri Lankan economy to draw relevant policy lessons to find an effective development strategy for the country. The input-output model is constructed for thirty aggregated industrial sectors of the economy as a whole for the year 2006. The results obtained for output and value added multipliers show that there are six key industries of the Sri Lankan economy. The employment multipliers are highest in four sectors. We found that five industries (sectors) have strong upstream and downstream vertical integrations with the rest of the other sectors in the economy. As the lowest average, coefficient of variation is reported from the petroleum & chemical products sectors and higher prices charged on products such as petrol, diesel etc. in this sector would probably result in higher costs to most other sectors in the economy relatively equally. The results also reveal that, 'mining and quarrying, electricity, gas and water' sector has strong downstream linkages to other sectors in the economy, higher prices (or taxes) charged on the products such as electricity, gas and water would also probably result in higher costs than most other industries in the economy. On the whole, the results emphasise the importance of strengthening industries which have either upstream or downstream linkages or both. However, findings should be interpreted very carefully as the input-output model is subject to very strict assumptions and the impact of some sectors such as education cannot be practically measured in monetary terms only.*

**Keywords:** *an effective development strategy, input-output model, industry multipliers, forward and backward linkages*

## **Introduction and research problem**

A better understanding of the structure of a national economy is vital for the identification and implementation of an effective development strategy as it emphasizes the need of allocating scarce resources efficiently on sectors that generate more output, value-additions, employment, and have linkages with the domestic economy (Frédéric, 2010). One of the best ways of developing this understanding is to “build a data base-model (an input-output model) of the economy which uncovers these underline structures and connections” leading to have a complete picture of the economy (Epstein et al., 2010, p. 24-25; Frédéric, 2010, p. 1). The multipliers (output, value added, and employment) and linkage measures (upstream and downstream vertical integration of sectors) derived from an input-output model are considered as powerful tools that can be used to measure and assess national productive system and inter-sectoral relationships of an economy (Frédéric, 2010).

As a result of the innovation of input-output model by Professor Wassily Leontief in the late 1930s, researchers, policy analysts and practitioners have used (and still use) input-output models in economic impact analysis and economic development planning specially in the areas such as industrial, agricultural, environmental, energy, construction, transportation, tourism and educational sectors (Xinhao and Rainer 2007, p. 218-272). Miller and Peter (2009, p. 2) point out that “today, in the USA alone, input-output is routinely applied in national economic analysis by the US Department of Commerce, and

in regional economic planning and analysis by states, industry, and the research community”. Furthermore, Baumol (2000) considers input-output analysis as one of the most widely used applied methods in economics. However, the studies on the use of input-output models directed at policy related issues in Sri Lanka are, to some extent, limited. Rameezdeen, Zainudeen and Ramachandra (2005) examined the significance of the construction sector and its relationship between other sectors of the economy based on input-output tables compiled from 1970 to 2000. They argued that construction is a key sector of the economy as the backward and forward linkage measures were significant (above average) for this sector in forty-eight sectors of the economy in 2000. The other studies on application of I-O analysis and related issues include Athukorala and Bandara (1989), Hazari and Bandara (1989) and Bandara and Kelegama (2008).

Problem statement: Apparently, policy makers might misleadingly tend to identify the leading sectors of the economy as the sectors whose ratios of output and value added to GDP are high. Accordingly, they will allocate scarce resources to boost sectors based on their mere contribution. However, it is crucial for an effective development policy to identify channels by which a growth of a sector can support aggregate output, income, value addition and employment creation in the rest of the economy (Frédéric, 2010).

Following this line of reasoning, the aim of this paper is to quantitatively measure and assess the industrial interdependence using the latest 2006 symmetric input-output table for Sri Lankan economy to draw relevant policy lessons to find an effective development

strategy for the country. The input-output model is constructed for thirty aggregated industrial sectors to have a better understanding of the underline structures and connections of the economy as a whole.

## **Methodology**

As noted in the previous section, this study uses a symmetric input-output table (SIOT) for 30 sectors (industries) in the economy for the year 2006. The term: 'symmetric' means that the same classifications are used in both rows and columns" (ABS, 2000, p. 95). Accordingly, the present study uses industry by industry classification to make a square table that has industries in the columns and corresponding products in the rows. Table 1 given below presents the structure of the SIOT used in the study, which clearly shows how the transactions in an input-output table can be used for analytical purposes (Miller and Peter, 2009, p. 3).

A row in Table 1 shows how the output of each industry is distributed among industries (including its own) and other institutions (final demanders) whereas a column shows the origin of inputs (both primary and intermediate) from other industries (including its own) and institutions into an industry. The row total for an industry is equal to the corresponding column total of the SIOT (that is  $q_j = z_i$  for all  $j, i = 1, 2, \dots, 30$ ) as the output of an industry must be equal to the value of total inputs used in the production process (ABS 2000, p.99).

Table 1: Structure of the SIOT used in the present study											
<div>Industries (outputs) Products</div>			Ind. 1	Ind. 2	...	Ind. 30	Final demand			Total production (demand)	
							TFC	GCF	TE		
<i>Intermediate inputs</i>	Industry 1		X <sub>1,1</sub>	X <sub>1,2</sub>	...	X <sub>1,30</sub>	y <sub>1</sub>			Z <sub>1</sub>	
	Industry 2		X <sub>2,1</sub>	X <sub>2,2</sub>	...	X <sub>2,30</sub>	y <sub>2</sub>			Z <sub>2</sub>	
	...		...	...	...	...	...			...	
	Industry 30		X <sub>30,1</sub>	X <sub>30,2</sub>	...	X <sub>30,3</sub>	y <sub>30</sub>			Z <sub>30</sub>	
			0								
			(Intermediate usage)				(Final demand)				
<i>Primary inputs</i>	Final paym ents	C.E	ce <sub>1</sub>	ce <sub>2</sub>	...	ce <sub>30</sub>	(Primary inputs to final demand)			GDP(IA)	
		G.O.S	os <sub>1</sub>	os <sub>2</sub>	...	os <sub>30</sub>					
		Net Tax	nt <sub>1</sub>	nt <sub>2</sub>	...	nt <sub>3</sub>					
		Imports	m <sub>1</sub> m <sub>2</sub>	---		m <sub>30</sub>	(Primary inputs to production)				
Total production (supply)			q <sub>1</sub>	q <sub>2</sub>	..	q <sub>3</sub>	GDP (EA)				
Employment			e <sub>1</sub>	e <sub>2</sub>	.	e <sub>3</sub>					
			0								
Source: Constructed based on ABS (2000, p.99) and unpublished SIOT of DCS (2006), Sri Lanka											

Note: Where: C.E =compensation of employees, G.O.S = gross operational surplus, Net Tax= tax minus subsidies, TFC = total final consumption (government + private), GCF = gross capital formation (gross fixed capital formation +changes in inventory), TE = Total exports, GDP(EA) = gross domestic product (expenditure approach) and GDP(IA) = gross domestic product (income approach).

The core of SIOT is the inter-industry transaction matrix shown in the first quadrant (intermediate usage) where production relationships in

the economy are depicted by the elements,  $x_{ij}$ . For example, element  $x_{1,30}$  shows how much output of the 1<sup>st</sup> industry has been absorbed by 30<sup>th</sup> industry in its current production. Final demand category made up of elements  $y_i$  shows consumption behaviour of households, government, investors and exports. Final payment category includes basically two variables; value added ( $v_j$ )(the sum of C.E + G.O.S + Net tax) and imports. The value added vector shows each sector's contribution to the GDP.

The data related to these three quadrants in the Table 1 can be conveniently presented using matrix algebra as follows:

$$z_i = \sum_{j=1}^{30} x_{ij} + y_i \dots \dots \dots (1)$$

$$q_j = \sum_{i=1}^{30} x_{ij} + ce_j + gos_j + nt_j + m_j \dots \dots \dots (2)$$

Where  $z_i$  is the total demand for output of  $i^{th}$  industry and  $q_j$  is the total supply of  $j^{th}$  industry.  $x_{ij}$  are sales by sector  $i$  to sector  $j$ . The row sum of  $x_{ij}$  in equation 1 shows the total value of sales of industry 'i' to all industries (including sales of industry 'i' as well). The column sum of  $x_{ij}$  in equation 2 is the total value of purchases done by industry 'j' from all other 'i' industries (including purchases of output of industry 'j' as well) in the economy. The next step is to obtain the direct input-output coefficients matrix  $A$  that is made up of elements ( $a_{ij}$ ). The matrix  $A$  is obtained by dividing the elements in the industry transaction matrix ( $x_{ij}$ ) from respective column totals,  $q_j$ . That is,

$$a_{ij} = \frac{x_{ij}}{q_j} \dots\dots\dots (3)$$

Hence,

$$a_{ij} q_j = x_{ij} \dots\dots\dots (4)$$

Substituting  $a_{ij} q_j$  for  $x_{ij}$  and  $q_j$  for  $z_i$  (on the condition that output of an industry must be equal to the value of total inputs used in the production) in equation (1) yields the following equation:

$$q_j = \sum_{j=1}^{30} a_{ij} q_j + y_i \dots\dots\dots (5)$$

This is just for one sector and for 30 sectors this can be shown in a matrix form considering  $q_j$  and

$y_i$  represent 30 by 1 output and 30 by 1 final demand vectors respectively. Hence, it takes the form;

$$q_{j(30 \times 1)} = A_{(30 \times 30)} q_{j(30 \times 1)} + y_{i(30 \times 1)} \dots\dots\dots (6)$$

The elements,  $a_{ij}$ , in equation (6) in the direct requirement matrix  $A$  represent the direct inputs requirements from sector  $i$  per 1 million LKR (as the data are given in LKR millions) worth of final demand for the output of industry  $j$ . Rearranging equation (6), open total requirement matrix (Leontief inverse matrix) can be obtained as follows;

$$q_{j(30 \times 1)} = (I - A_{(30 \times 30)})^{-1} y_{i(30 \times 1)} \dots\dots\dots (7)$$

or

$$q_{j(30 \times 1)} = B_{(30 \times 30)} y_{i(30 \times 1)} \dots\dots\dots (8)$$

Now the elements,  $b_{ij}$ , in the open total requirement matrix  $B$  in equation (8) represent direct and indirect inputs requirements from sector  $i$  per 1 million LKR worth of final demand for the output of industry  $j$ .

Following the same method, but putting the row vector related to the household sector (compensation of employees) in the primary input matrix and the column vector of household consumption in the final demand matrix into the industry transaction matrix ( $x_{ij}$ ), closed total requirement matrix is obtained as follows;

$$q_{j(31 \times 1)}^* = B_{(31 \times 31)}^* y_{i(31 \times 1)}^* \dots \dots \dots (9)$$

Both  $B$  (open) and  $B^*$  (closed) inverse matrices are powerful tools that are used to measure the total impact on the economy for changes in final demand vector  $y$ . Furthermore, these matrices are also used to derive (open (Type I) and closed (Type II)) multipliers (output, value added and employment) and (closed) linkage (backward and forward) measurers.

The size of the elements of  $B^*$  are larger than that of  $B$  due to the impact of consumption induced demand on the level of output. All sectors are required to generate increased output levels to meet the consumption induced demand in the economy. Because of this reason, Type II multipliers are always larger than that of Type I multipliers. However, Miller and Blair (2009, 253) highlight that “it is generally conceded that Type I multipliers probably underestimate economic impacts (since household activity is absent) and Type II multipliers probably give an overestimate (because of the rigid assumptions about labour incomes and attendant consumer spending)”. Miller and Blair (2009,

253) further state that “some in between figure might be more realistic but deciding exactly where these two limits may be problematic”. Therefore, when industries are ranked based on the size of the multipliers to identify key sectors in the economy, both Type I and Type II multipliers are employed. The significance of industries on the overall economic performance (leading sectors) is determined based on the criterion that average value of both Type I and Type II multipliers for each industries should be above its overall average (Raufdeen et al 2005). This criterion is justifiable as its value is always placed in between both Type I and Type II multipliers.

## **Results and findings**

As shown in Table 2, only 12 sectors are satisfied with the criteria designed to identify key sectors in the economy. The highest average output multiplier (2.29) is reported from the sector called recreational, cultural, sporting services and other services. A LKR one million worth of final demand increase for the output in this sector would generate an additional LKR 1.29 million worth of output in the economy. The second leading sector in the economy is ‘the public administration and other services to the community’ followed by ‘manufactured products of food, beverages and tobacco’ and then air transport and so on. The education and health sector take the 7<sup>th</sup> and the 9<sup>th</sup> places in ranking of key sectors in the economy respectively. The significance of these sectors to the generation of output in the economy mainly rooted from the consumption induced impact.

Source: Author's calculation using IOW software based on unpublished SIOT of

<b>Table 2: Identification of leading sectors in the economy based on estimates of output multipliers</b>		
<b>Industry/Sector</b>	<b>Average output Multiplier [(Type I + II)/2]</b>	<b>Rank based on average output multiplier</b>
Recreational, cultural, sporting services and other services	2.29	1
Public administration and other services to the community as a whole	2.04	2
Manufactured products of food, beverages and tobacco	2.03	3
Air transport	1.95	4
Manufacture of Rubber & Plastic Products	1.94	5
Hotel and restaurants	1.89	6
Education	1.84	7
Land transport; transport via pipelines	1.83	8
Health and social work	1.83	9
Transport equipment	1.80	10
Water transport	1.80	11
Supporting and auxiliary transport activities; activities of travel agencies	1.78	12
Average output multiplier (Type I and II) for 30 sectors	1.70	

DCS (2006), Sri Lanka

Table 3 given below shows ranking of leading sectors based on the average values of value added multipliers. Accordingly, 'recreational, cultural, sporting services and other services' and 'manufacture of rubber & plastic products' sectors deserve to consider as two leading sectors of Sri Lankan economy.

<b>Table 3: Identification of leading sectors in the economy based on estimates of value added and income multipliers</b>		
<b>Industry/Sector</b>	<b>Value added multipliers</b>	
	<b>Average (Type I +Type II)/2</b>	<b>Rank</b>
Recreational, cultural, sporting services and other services	4.47	1
Manufacture of Rubber & Plastic Products	2.90	2
Air transport	2.52	3
Manufactured products of food, beverages and tobacco	2.44	4
Health and social work	2.42	5
Manufacture of metallic, non-metallic and mineral products	2.33	6
Petroleum & chemical products	2.20	7
Public administration and defense; compulsory social security	2.12	8
Hotels and restaurants	1.94	9
Construction	1.86	10
Land transport; transport via pipelines	1.86	11
Manufacture of paper and paper products & Printing	-	13
Average value added and income multipliers for 30 sectors	1.85	

Source: Author's calculation using IOW software based on unpublished SIOT of DCS (2006), Sri Lanka

Table 4 given below shows the ranking of key sectors based on the values of average employment multipliers. Accordingly, unlike the ranking of sectors based on output and value addition multipliers, real estate activities become the leading sector of the economy in terms of generation of employment opportunities. The second key sector is

‘manufacture of electric motors & electrical equipment’ and then ‘air transport followed by manufacture of petroleum & chemical products’ so on.

<b>Table 4: Identification of leading sectors in the economy based on estimates of employment multipliers</b>		
<b>Industry/Sector</b>	<b>Average employment Multiplier (Type I and II)/2</b>	<b>Rank based on average employment multiplier</b>
Real estate activities	23.43	1
Manufacture of electric motors & electrical equipment	9.93	2
Air transport	8.84	3
Manufacture of petroleum & chemical products	8.29	4
Water transport	7.88	5
Manufactured products of food, beverages and tobacco	5.30	6
Manufacture of rubber & plastic products	5.04	7
Financial intermediation and investment banking	4.63	8
Average employment multiplier (for 30 sectors)	3.62	
Source: Author’s calculation using IOW software based on unpublished SIOT of DCS (2006), Sri Lanka		

The results in linkage analysis (not shown here) shows that there are five industries (sectors) which have strong upstream and downstream vertical integrations with the rest of the other sectors in the economy. These sectors are: (1) recreational, cultural, sporting services and other services, (2) manufacture of rubber & plastic products, (3) hotels and restaurants, (4) manufacture of metallic, non-metallic and mineral products, and (5) petroleum & chemical products respectively. The

sectors with strong upstream and downstream linkages with other industries mean that they not only utilize a large amount of domestically produced outputs as inputs in their production processes but also their outputs are used in a greater extent by other sectors in the economy as inputs to produce final goods and services.

Based on the results of average coefficient of variations (not shown here) with regard to backward and forward linkages, it is found that relatively low variations are reported from sector 5, sector 3 and sector 1 respectively. This implies that the stimuli generated by investment in these three sectors are relatively evenly shared amongst all sectors in the economy. As the lowest average coefficient of variation is reported from the sector called petroleum & chemical products, higher prices charged on products such as petrol, diesel etc in this sector would probably result in higher costs to most other sectors in the economy relatively equally. Therefore, these sectors could be considered leading sectors in the economy as they are most connected with all industries in such a way that their output, employment, and value added multipliers would be influenced by strong domestic linkages, although other sector-specific factors such as the use of imported inputs, labour intensity of production, technology, and the level of productivity could also influence the size of these multipliers. For example, sector 4 and 5 mentioned above have relatively strong upstream and downstream linkages to other industries. However, as these sectors use more than one thirds of imported inputs (about 33% and 34% respectively) in their production process, this will reduce the domestic impact of these sectors on the Sri Lankan economy. A less dependency on imported inputs is reported from sector 3 (5.1%), sector 2 (6.2%) and sector

1(13%). As a result, the domestic impacts of these sectors on the Sri Lankan economy are relatively high.

### **Conclusions, implications and significance**

This paper was aimed at measuring industrial interdependence using a symmetric input-output table for the Sri Lankan economy for 2006 to draw policy relevant lessons to find an effective development strategy for the country. According to the output and value added multipliers, we found that there were six key industries of the Sri Lankan economy. Those were; (1) recreational, cultural, sporting services and other services, (2) manufactured products of food, beverages and tobacco sector, (3) air transport services, (4) rubber & plastic products, and (5) metallic, non-metallic and mineral products sectors.

The employment multipliers were highest in the (1) real estate services, (2) electrical products, (3) petroleum & chemical products, and (4) rubber & plastic products industries. Unlike the ranking of sectors based on output and value addition multipliers, real estate activities become the leading sector of the economy in terms of generation of employment opportunities.

There are five industries (sectors) which have strong upstream and downstream vertical integrations with the rest of the other sectors in the economy. These sectors are: (1) recreational, cultural, sporting services and other services, (2) manufacture of rubber & plastic products, (3) hotels and restaurants, (4) manufacture of metallic, non-metallic and mineral products, and (5) petroleum & chemical products

respectively. As the sector named 'mining and quarrying, electricity, gas and water', has strong downstream linkages to other sectors in the economy, higher prices (or taxes) charged on products such as electricity and water in this sector would probably result in higher costs to most other sectors in the economy. On the whole, the results emphasise the importance of strengthening industries which have either upstream or downstream linkages or both. However, the results should be interpreted very carefully as the impact of some sectors such as education cannot be practically measured in monetary terms and the input-output model is subject to a set of strict assumptions.

### **Limitations of the study**

First, I-O analysis ignores the supply-side and capacity constraints of the economy. Second, it ignores price changes of both commodities and factors of production and as a result input-output model might overestimate the "true" impact following some shock in final demand in any sector of the economy. Third, it ignores the economies of scale in the production process. Fourth, it is based on highly aggregated versions of sectors (30) which could in turn lead to underestimate or overestimate of the real situation of an economy. Though these limitations are there, input-output models are highly used in development planning and sectorial policy designing processes.

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[S5/02] **An Investigation of the Trend Orientation of Sri Lankan Value Fashion Retailers and Consumers**

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**Keywords:** *Sri Lankan fashion industry, Value retailers, Consumer behaviour, Trend orientation*

### **Introduction and Research Problem**

Fashion is a skilful mechanism which gives room for people to adjust collectively and orderly to a rapidly changing and moving world full of possibilities of anarchy (Blumer, 1969). Further, to be in fashion, adapting latest trends is essential. Blumer (1969) asserts that fashion trends are highly important yet a neglected area of study.

The context of this study is the Sri Lankan fashion market. Unlike few years back, the fashion retail sector has shown extensive growth potentials especially due to the stable macro environmental conditions of the country (Superbrands, 2014). According to Dias (2011) local retailers are expanding their scale and scope whilst global retailers continue to enter. When examining the hierarchy of fashion market levels, it can be identified that mass market based value level market sector plays a prominent role in the industry (Ibrahim, 2009). According to the initial research and assumptions made, female consumers who belong to the value market level are keen on adhering to the latest trends (Goworek, 2010). However as stated by Ibrahim

(2009) majority of the value retailers pay less attention on trend forecasting. Therefore, it is important to investigate as to what extent value market retailers provide trend oriented clothing and whether they have a proper mechanism to incorporate global trends for their offering. At the same time it is equally important to examine consumer perception towards trend orientation as well.

In this perspective the main research objectives are;

1. To examine how much Sri Lankan value retailers are trend oriented and to explore whether they are equipped with a mechanism to adapt to global trends.
2. To examine the extent of consumer trend awareness

## **Methodology**

Qualitative method was adapted to analyze trendiness of clothing offered by the Sri Lankan value retailers and check whether they are equipped with a proper mechanism to adapt to upcoming fashion trends. Women's casual wear has been selected as the product category because of the high purchase frequency. Four formal Interviews were conducted with subject experts from selected retailers (designers/ marketing managers).

Consumer perception and opinions towards trend orientation too were explored. Certain behavioural aspects were identified through an observational research. Insightful data were stemmed through a questionnaire survey. Stratified sampling method of the probability

sampling criteria was selected. The core stratum based on both demographical and geographical variables were, gender (female) age group (18-30) and region (Colombo and sub urban). Self-administrative questionnaire was developed through consumer behaviour literature. Survey generated 80 responses.

## Results and Findings

**Table 1: Summary of qualitative research**

	Forecasting fashion trends		Equipped with a mechanism to adopt fashion trends		Level of exposure (shops visits/trade fairs)		Future strategies	
	Negative	Positive	Negative	Positive	Negative	Positive	Negative	Positive
Retailer A	X		x		x			x
Retailer B		x	x		x			x
Retailer C	X		x		x		x	
Retailer D	X			x	x		x	

*(Source: constructed by the author based on the interview data, 2013)*

**Table 2: Summary of quantitative research**

	Yes	Sometimes	No
Do you buy casual wear according to the seasons?	54%	20%	36%
Do you think you follow trends when it comes to casual wear?	10%	62.5%	27.5%
Do you watch any international fashion programs?	53%	10%	37%
Do you watch local fashion programs?	35%	5%	60%
Consumer adaptation on new trends	40%	20%	40%
I am not afraid to be the first to wear something trendy which came to the market very recently	17.5%	22.5%	60%
Wearing trendy casual clothes is a part of leading a good life	45%	20%	35%
I follow my fashion icon regardless of the style not being accepted in Sri Lanka	21.25%	20%	58.75%
In this period of rising prices, spending excessive amounts of money on trendy casual wear clothes is a waste	36.25%	31.25%	32.5%
I am confident of my awareness about trends	26.25%	13.75%	70%

*(Source: constructed by the author based on the survey data, 2013)*

Results of the study reveal that value retailers are not critically concerned on encapsulating trends into women's casual wear. Moreover from the study it is proven that the value retailers rarely refer reliable trend forecasting sources (please refer table 1). Thus, it is quite obvious that designers who design for these retailers do not design trend oriented clothing and also the buyers of these retailers are not concerned with buying trend-oriented fashion for their retail stores.

Moreover the study proves that these retailers are not equipped with a proper mechanism to adapt to global trends and fit them into the Sri Lankan market.

On the other hand female consumers who belong to the value market sector aged between 18 and 30 in Colombo are believed to be more fashion conscious and process with the knowledge of ongoing trends. However the study outcome was much more different than what we believed in. The findings proved that the majority of consumers are not trend oriented. Furthermore, the study proves that fashion innovators as well as early adopters in the value market are quite less (refer table 2)

### **Conclusion, implications and significance**

The research concluded that value retailers are not equipped with a proper mechanism to follow up coming fashion trends. One of the key findings of this study is that value retailers rarely refer reliable trend forecasting sources.

At the same time it concluded that the selected consumer segment for this study does not have a thorough awareness on upcoming fashion trends. Further, the study proves that there are only a few fashion innovators as well as early adopters in the local marketplace.

Literature on the fashion market sector as well as consumer behavior is largely lacking. Therefore this research fills certain gaps of the literature and contributes to the development of the fashion retail industry.

This study can be further extended to identify a model to encourage value retailers to introduce a mechanism to promote trend oriented fashion. Research was limited to a certain market level of the fashion market hierarchy. Thus it can be further expanded to other levels as well, for an instance into the middle or luxury market levels. Moreover, consumer perception too can be identified through various customer segments such as male and adults. Research was limited to a core product category. Thus it can be further expanded to various other product categories as well for an example into things like occasional wear or sportswear.

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## [S5/03] **Public–Private Wage Differential in Sri Lanka: Application of Endogenous Switching Regression Model**

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**Key words:** *Wage gap, wage differentials, returns to education, switching model*

### **Introduction**

Understanding the wage differential between public and private sectors is vital for labour economists as well as to policy makers in Sri Lanka. It is vital not simply because it helps policy makers in directing employment policy of the country. Understanding wage differential is also important in addressing the issue of public sector job preferences in Sri Lanka.

Assuming workers are randomly distributed between the public and private sectors Blaise (2002), Dustman *et.al* (1998), Katz and Krueger (1991), Mueller (1998), Nielsen and Rosholm (2001) have estimated Mincer earning function using OLS method to explore the wage gap between public and private sector. Rosen (1979), Willis (1979), Griliches (1981), and many others have criticized this on “selectivity bias”. It is argued that workers are not randomly distributed between the public and private sectors. Therefore, unless the correction is done for self-selection the wage gap between two sectors will be biased upwards or downwards. Lee (1978) has introduced endogenous switching regression model to correct the selectivity bias. Hartog and

Oosterbeek (1993) and Morton *et.al* (2000) have applied this technique to analyse Public-Private wage differences. In this paper the same method is applied to explore the wage differentials in Sri Lanka.

**Objectives:** The main objective of this paper is to estimate wage differential between public and private sectors in Sri Lanka. Specifics objectives are,

- To identify the graduate and non-graduate wage gap between private and public sectors
- To estimate the rate of returns to education in public and private sectors

## **Methods**

According to the Mincer (1974) earning function Public and Private sector wage equations can be expressed as follows.

$$\ln w_1 = X_i\beta_1 + U_{1i} \quad (1)$$

$$\ln w_2 = X_i\beta_2 + U_{2i} \quad (2)$$

In the equation 1 and 2  $\ln w_j$  is natural log of wage in sector  $j$ ,  $\beta_j$  is the vector of coefficients associated with independent variables and  $U_j$  is a disturbance term, where  $j$  can take only two values, 1 and 2 for public and private sectors respectively. The above two equations can be estimated using OLS method and can predict average wages in the two sectors. An assumption in this approach is that the expected value of error term ( $U_i$ ) is zero. This assumption may be violated when workers are not randomly distributed between two sectors. When there is a wage differential workers may prefer one sector over the other sector.

Equation 3 summarizes selection process between public and private sectors. The selection decision is a function of personal characteristics ( $Z$ ) of individuals.

$$l_i = Z_i\gamma + e \quad (3)$$

$$l_i = 1(\text{Public sector}) \text{ if } I \geq 0$$

$$l_i = 0(\text{Private sector}), \text{ otherwise}$$

The predicted average wages based on the OLS estimation is unbiased if error term of selection equation ( $e$ ) is uncorrelated with  $U_{1i}$  and  $U_{2i}$ . If this assumption is violated wage comparisons based on OLS are misleading.

Data available from the Quarterly Labour Force Survey (QLFS) 2010 of Department of Census and Statistics was used to estimate the above equations. Monthly wage from primary and secondary occupations was the dependent variable in the wage equation where level of education, experience and experience square were independent variables in two wage equations. Other than the variable in wage equation, gender was also included as an independent variable in selecting the equation.

## Results

The result of OLS model and switching model are presented in table 1. All coefficients related to level of education are significant and positive which implies that there is a positive relationship between monthly wage and level of education in both public and private sectors. However the benefit of education is different between the two sectors.

**Table 1: Public and private sector wage equations and sector selection function**

	OLS				Switching Model					
	Public Sector		Private Sector		Public Sector		Private Sector		Selection function	
	Coef.	t	Coef	t	Coef.	t	Coef.	t	Coef.	t
Constant	8.28*	117.8	8.49*	202	7.91*	89	8.27*	173	2.01*	22.0
Primary (1-5)	.21*	3.0	.07*	1.98	0.21*	2.98	0.09*	2.13	0.13	1.28
Junior secondary (6-9)	.61*	9.0	.26*	7.07	0.63*	9.2	0.34*	8.0	0.38*	2.6
Senior Secondary (10-11)	.97*	14.7	.44*	11.95	1.02*	15.9	0.61*	14.4	0.62*	3.4
Collegiate (12-13)	1.19*	17.9	.78*	19.88	1.32*	19.1	1.19*	26.2	1.23*	5.7
Degree and above	1.42*	20.9	1.5*	27.5	1.62*	21.9	2.26*	36.2	1.85*	7.34
Experience/100	2.56*	9.3	2.8*	16.1	3.56*	11.4	5.21*	25.5	8.52*	22.6
Experience square /100	-2.68*	4.9	-4.9*	15.9	-4.24*	7.2	-8.37*	23.2	-12.85*	18.4
Gender									-0.45*	18.9
$\rho_1$					0.35*	0.05				
$\rho_2$					0.82*	0.01				
N					3,784		8,072		11,856	
Wald chi2(7)					1271.73					
Log likelihood					-15939.66					
Prob> chi2					0.00					
R2	.33		.19							
*Significant at 5% level										

According to the OLS results coefficients of primary education, secondary and collegiate level of education are higher in public sector compared to the private sector. This indicates that the rate of returns to education below degree level is higher in public sector than that in the private sector. Contrary to that, university graduates receive higher rate

of returns to education if they are employed in the private sector than public sector. The coefficients of experience squared shows well – know parabolic experience –wage profile in both sectors.

Except the coefficients of primary level of education in the selection equation, all other coefficients are significant. Preference for public sector jobs has increased with the level of education. When compared to the individuals in other education groups, graduates prefer public sector jobs than private sector jobs. Female are more likely to be employed in the public sector than males.

$\rho_1$  and  $\rho_2$  are the correlation of the wage equation disturbance term in sector  $i$  with the selection function of that sector. As the correlations are significant the OLS estimates are biased. Therefore, comparison of average wage between two sectors based on the OLS results is not realistic. Following Table 2 shows the calculated conditional expected wage in both sector using the endogenous switching regression model.

**Table 2:Expected average public and private sector wage per month (Rs.)**

	Degree and above	Collegiate	Senior secondary	Junior secondary	Primary
<b>Public sector workers</b>					
In public sector	24,515	19,732	16,317	11,849	8,266
In private sector	56,460	21,162	12,964	10,342	8,184
<b>Private sector workers</b>					
In public sector	28,282	26,108	25,848	20,537	15,677
In private sector	32,208	14,044	9,779	8,349	6,843

Table 2 compares predicted average wages between sectors and between worker types. First two rows present average wage of workers

employed in the public sector. First row reports average of actual wages of employees in public sector. Row 2 reports the conditional expected wage of the workers currently in the public sector if they were employed in the private sector. The other two rows should also be interpreted accordingly.

According to the above findings present allocation of workers over sectors is inefficient. Public sector workers with education collegiate level of above can increase their wages by shifting to the private sector. Following a similar pattern, Table 2 shows that it is better for workers without a degree qualification to shift to the public sector.

## **Conclusion**

The wage differential between public and private sectors can be observed in all education groups. Except at degree level, public sector wages are higher than private sector wages. Though the wage rate of graduates in the public sector is low as compared to the private sector, still there is a preference for public sector jobs. This may be due to non-wage benefits in the public sector and the certainty of wages in the public sector compared to the uncertainty of wages in private sector.

The present allocation of workers over sectors is inefficient from the point of view of earning maximization. At least some workers can maximize their earning by changing their sector of employment.

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## [S5/04] Identifying Consumer Perceived Value of Tourism Product

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### Abstract

*Tourism has been identified as a major growth area in post-conflict development in Sri Lanka and it was aimed to attract 2.5 million tourists by 2016. Consumer perceived value is a complex theoretical construct that can be defined as the worth a particular product or service is in the mind of the customer. Therefore in order to grasp this extremely potential market opportunity and to gain competitor advantage, local retailers should identify the core attributes and benefits that tourist customer value for choosing a product, service and vendor. In this context this research sought to examine the relationship of customer perceived value in the tourism products (apparel and related). Employing a multi-dimensional approach the study measured various CPV dimensions of a purchase by conducting a quantitative research. The identified seven value dimensions through literature were functional, emotional, social, sacrifice, epistemic, service and store. Judgmental sampling method of the non-probability sampling criteria was chosen. Data stemmed from questionnaire survey addressed to 155 tourists. The results provide insights for potential research and theory development in value literature and tourism retailing. Moreover the findings could facilitate Sri Lankan retailers to understand how to put more effort to give more value to their tourist clients.*

**Keywords:** Consumer perceived value, Sri Lankan tourism industry, Apparel product

## **Introduction and research problem**

The concept of customer-perceived value (CPV) can be defined as consumer's overall assessment of the utility of a product based on perceptions of what is received and what is given (Zeithamal, 1988). It emerged in the 1990's and the concept has gained extensive research interest in the present day as the creation of CPV is one reason for the organization's survival and certainly for its success in the fiercely competitive market place (Sanchez et al., 2006).

In recent years CPV has been the object of attention by researchers in the tourism sector. Ryan (2002) described that the creation and transmission of value to tourists has become a competitive advantage in environments characterized by globalized competition and by tourists who are more and more demanding. Tourism is a fast growing industry in Sri Lanka which had been identified as a major growth area in post-conflict development. According to SLTDA (2014) 2.5 million tourists were aimed to be attracted by 2016. Therefore, in order to grasp this high potential market opportunity and to gain competitor advantage, local retailers should identify the core attributes and benefits of the tourism consumer value for choosing a product and vendor.

Thus, this study sought to examine the relationship of customer perceived value in the tourism product. The selected product scope was apparel and related products not only because of the rapidly growing nature of the retail sector but also because of the rising consumer

demands (Superbrands, 2014). In this context the aim of this study was to measure the CPV of a tourism product purchase via seven value dimensions.

In this perspective the main research objectives are;

3. To examine how much Sri Lankan value retailers are trend oriented and to explore whether they are equipped with a mechanism to adapt global trends.
4. To examine the extend of consumer trend awareness

## **Methods**

Marketing researchers had studied the concept of CPV in greater depth. After going through a comprehensive empirical study on various concepts and dimensions of CPV proposed by many theorists, multidimensional construct has been considered to measure perceived value of a tourism product purchase by conducting a quantitative research. Reasons for choosing multidimensional construct are because it attempts to explain CPV aspects by taking in to account both the cognitive and affective behavior of perceived value (Fernandez & Bonillo, 2007).

Judgmental sampling method of the non-probability sampling criteria was chosen. Data stemmed from the questionnaire survey given to 155 tourists. The questionnaire consisted items that were derived from consumer behavior literature which was designed on a five point likert scale. The composition of the group was heterogeneous with different

demographic and geographic variables such as education, socio-economic classes as well as country and ethnicity. Questionnaire was distributed equally when it comes to gender and age (More than 18 years of age). Two famous tourist destinations were selected which are Sri Lanka's business capital Colombo and down south Galle (SLTDA, 2014).

## **Results and findings**

The research measured seven value dimensions that are applicable in tourism retailing for apparel product while exemplifying how important functional value (price) and emotional (experience) are in relation to tourism retailing. (please refer table 1).

**Table 1: Level of acceptance**

<b>Functional</b>	Product price	Product quality	Product styling	Product variety
	96%	86%	57%	29%
<b>Emotional</b>	Experience	Affective states		
	93%	43%		
<b>Social</b>	Self-Image value	Acceptance	Belonging	
	29%	16%	58%	
<b>Sacrifice</b>	Monetary sacrifice	Time sacrifice	Social sacrifice	
	79%	83%	13%	
<b>Epistemic</b>	Experienced curiosity	Novelty		
	57%	80%		
<b>Service</b>	Staff professionalism	Merchandise knowledge of staff	Process efficiency	Appearance of staff
	32%	27%	32%	15%
<b>Store</b>	Merchandise displays	Shop fittings	Window displays	Store location
	30%	18%	22%	72%

Research validated seven value dimensions that can be applied for apparel products. It exemplified how important the functional value and product price is in relation to tourism retailing. Also the quality of the tourism product is another vital aspect retailers should pay special attention to. Furthermore research justified that leisure gain activities such as tourism need to resort to fantasies, feelings and emotions to explain purchasing behaviour as products contains intangible aspects beyond quality or price. Therefore with regards to the business implementation retailers should pay attention on factors that affect value creation from physiological and psychological perspectives. Research findings also proved that the level of social value in terms of image value and acceptance value in tourist consumer buying behaviour is considerably low. Moreover results justified the importance of sacrifice value which is viewed as a part of the most commonly accepted definition of value. It has validated several types of sacrifice tourist customers have to make in order to acquire products or services. Among them time sacrifice was the highest. However it was revealed that monetary sacrifice was lower than time sacrifice. Furthermore the study revealed that epistemic value which related to experienced curiosity, novelty or gained knowledge, novelty value was considerably high. Thus retailers must find ways to satisfy customers who are motivated by the epistemic value. Out of all the seven value dimensions service value was the lowest. Among the four store value variables which are merchandise displays, shop fittings, window displays and store locations, the value of store location was the highest. Thus retailers should set up proper distribution channels and make their products readily available to tourist consumers.

## **Conclusions, implications and significance**

After reviewing literature on multi –dimensional approach of CPV, seven major CPV dimensions were identified based on both cognitive and affective views of perceived value (Sweeney & Soutar, 2001; Sanchez et al., 2006; Zethimal, 1988; Fernandez& Bonillo, 2007).They were functional, social, emotional, sacrifice, epistemic, service and store .Following the method proposed by Churchill (1979) identified CPV dimensions were validated through a quantitative study.

The research contributes to the value literature by means of identifying validating and measuring seven value dimensions which revealed the worth that a product or service in the mind of the tourist consumer. On managerial implementation it can be concluded that this study contributes to the development of the apparel retail as well as tourism sector. As exemplified by the study retailers should put more effort to contribute more value to their tourist clients especially concentrating on product price, experience and novelty. One limitation of this study was it has taken only apparel and related products as the tourism product. This could be further extended to other tourism products and services as well for example handicraft souvenirs.

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**Session-6**  
**Money in the**  
**Economy**



[S6/01] **Long-run Relationship between Exchange Rate  
and Trade Balance of Sri Lanka**

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**Abstract**

*While Sri Lanka benefitted from the open market policies in many different ways, its trade balance continued to deteriorate year by year after liberalizing the economy in 1977. Starting from a US Dollar 41 Million surplus in 1977, the trade balance reported a speedy downturn of US Dollar 9,710 Million by 2012, which is almost equivalent to the total export earnings of the country. This paper examines the long run relationship between the trade balance of Sri Lanka and the real exchange rate with annual data from 1960-2012 using bound testing or autoregressive distributed lag (ARDL) and the cointegration procedure developed by Pesaran and Smith (2001). The bounds test result revealed the presence of a cointegration relationship suggesting long-run equilibrium for the trade balance. Estimated long-run coefficients suggest that 1% devaluation in the real exchange rate causes 0.32 % improvement in the trade balance given that all the other factors remain unchanged. Furthermore, the results conclude that 1% increase in trade openness leads to 0.43% deterioration in the trade balance given all the other factors remaining unchanged. This implies that the possible gain of export promotion through currency devaluation is partly set off by encouraging imports due to trade openness. In the Error Correction representation for ARDL model, the error correction term estimated to be -0.6145 at 1% per cent*

*significant level suggests that 61% of any short-run deviation will be corrected at one time period and converge to a long run equilibrium.*

*Key words; ARDL, Cointegration, Trade Balance, Trade openness, Sri Lanka*

## **Introduction**

While Sri Lanka benefitted from the open market policies in many different ways, its trade balance continued to deteriorate year by year after liberalizing the economy in 1977. Starting from a US Dollar 41 Million surplus in 1977, the trade balance reported a speedy downturn of US Dollar 9,710 Million by 2012, which is almost equivalent to the total export earnings of the country. Using annual data from 1960-2012, this paper examines whether a long run relationship exists between the trade balance and its determinants using bounds testing method. It attempts to answer whether currency devaluation would improve country's trade balance and whether trade openness really matters.

The objectives of this study are of three folds: (a) To examine whether long-run level relationship exists between trade balance of Sri Lanka and its determinants using recent bounds testing techniques for cointegration. (b) To examine how rapidly any short-run disequilibrium gets back to an equilibrium position using ARDL and EC models (c) To evaluate trade openness and exchange rate devaluation as a solution to the balance of trade problem in Sri Lanka.

This study employs the standard “Two County” trade model as stipulated by many studies in literature (see Rose and Yellen (1989); Rose (1990); Bahmani-Oskooee (1991); Shirvani and Wilbratte (1997) with slight variation to add the trade openness. The standard two country trade model assumes that the demand for imports by domestic residents ( $D_m$ ) depends upon the domestic income ( $y$ ) and the relative price of imported goods to the domestically produced goods ( $rp_m$ ) both expressed in home country currency terms. Additionally, we assume that the trade balance is affected by the degree of trade openness ( $top$ ) of that economy. The super script  $f$  denotes the foreign counterpart of the analogous variables. Thus, the theoretical model was derived through set of equations standing for demand and supply of both exports and imports and eventually deduced the real trade balance to a function of

$$TB = TB(y^f, y, q, top) \dots\dots\dots (01)$$

This study applies the bounds testing or autoregressive distributed lag (ARDL) cointegration procedure developed by Pesaran and Smith (2001). We employ bound testing method for several valid reasons. Firstly, the bounds testing procedure does not require the pre-testing of the variables for unit roots and the test procedure can be applied irrespective of whether the regresses are integrated  $I(0)$ ,  $I(1)$  or mutually cointegrated as long as they are not cointegrated  $I(2)$ . Secondly, the bounds testing procedure is relatively more efficient in small or finite sample data, where the number of observations by nature is small. Thirdly, both short-run and long-run parameters can be estimated simultaneously. Furthermore, as opposed to other multivariate cointegration techniques such as Johansen and Juselius

(1990), the bounds test procedure is simple as the OLS can be used to estimate cointegration relationship once the lag order of the model is identified using appropriate information criterion.

Above theoretical model was then converted to

$$TB = f(GDP, GDPW, NREX, TOP, OIL) \dots\dots\dots (02)$$

Where, TB is the ratio of real exports to real imports both measured in USD millions. Measuring TB as a ratio of exports over imports deserves at least three advantages. It becomes unit less, non-negative allowing log transformation, and is normalized to one when trade is balanced. GDP is Gross Domestic Product of home country and GDPW is the sum of GDPs of the top 20 export destinations of Sri Lanka<sup>31</sup>. NREX is the real exchange defined as the product of the relative price of importables into nominal exchange rate measured in terms of domestic currency price for one unit of USD. TOP is the sum of real exports and imports defined as a percentage of GDP, which is a proxy representing the degree of trade openness.

The model was then transformed into a double log function and extended to include OIL dummy to capture world oil crises in 1973 and a time (T) variable for detrending data.

$$\ln TB = \beta_{0TB} + d_1 T_t + d_2 OIL_t + \beta_1 \ln REX_t + \beta_2 \ln GDP_t + \beta_3 \ln GDPW_t + \beta_4 \ln TOP_t + e_t \dots\dots\dots (03)$$

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<sup>31</sup> U.S.A., U.K., India, Italy, Belgium, Germany, Russia, U.A.E., Japan, Iran, France, Netherlands, Canada, Turkey, Australia, China, Syria, Hong-Kong, Mexico, Singapore, Switzerland. These countries account for 80.77% of Sri Lanka's total exports

Where,  $\ln$  is natural logarithm and  $e_t$  is the error term which is white noise. Based on the equation (03) the following autoregressive distributed lag models (ARDL) were specified to identify the existence of a long-run cointegration relationship. TB, GDP, REX, TOP were considered endogenous variables and GDPW and dummy variables were taken as exogenously determined.

$$\begin{aligned} \ln TB_t = & \beta_{0TB} + \beta_{1TB}T_t + \beta_{2TB}OIL_t + \beta_{3TB}\ln GDPW_t + \sum_{i=1}^n \alpha_{1TB} \ln TB_{t-i} + \\ & \sum_{i=0}^n \alpha_{2TB} \ln GDP_{t-i} + \sum_{i=0}^n \alpha_{3TB} \ln REX_{t-i} + \sum_{i=0}^n \alpha_{4TB} \ln TOP_{t-i} + \varepsilon_{TBt} \end{aligned} \quad (3.1)$$

$$\begin{aligned} \ln GDP_t = & \beta_{0GDP} + \beta_{1GDP}T_t + \beta_{2GDP}OIL_t + \beta_{3GDP}\ln GDPW_t + \sum_{i=1}^n \alpha_{1GDP} \ln GDP_{t-i} + \\ & \sum_{i=0}^n \alpha_{2GDP} \ln TB_{t-i} + \sum_{i=0}^n \alpha_{3GDP} \ln REX_{t-i} + \sum_{i=0}^n \alpha_{4GDP} \ln TOP_{t-i} + \varepsilon_{GDPt} \end{aligned} \quad (3.2)$$

$$\begin{aligned} \ln REX_t = & \beta_{0REX} + \beta_{1REX}T_t + \beta_{2REX}OIL_t + \beta_{3REX}\ln GDPW_t + \sum_{i=1}^n \alpha_{1REX} \ln REX_{t-i} + \\ & \sum_{i=0}^n \alpha_{2REX} \ln GDP_{t-i} + \sum_{i=0}^n \alpha_{3REX} \ln TB_{t-i} + \sum_{i=0}^n \alpha_{4REX} \ln TOP_{t-i} + \varepsilon_{REXt} \end{aligned} \quad (3.3)$$

$$\begin{aligned} \ln TOP_t = & \beta_{0TOP} + \beta_{1TOP}T_t + \beta_{2TOP}OIL_t + \beta_{3TOP}\ln GDPW_t + \sum_{i=1}^n \alpha_{1TOP} \ln TOP_{t-i} + \\ & \sum_{i=0}^n \alpha_{2TOP} \ln GDP_{t-i} + \sum_{i=0}^n \alpha_{3TOP} \ln REX_{t-i} + \sum_{i=0}^n \alpha_{4TOP} \ln TB_{t-i} + \varepsilon_{TOPt} \end{aligned} \quad (3.4)$$

In equation 3.1, where real trade balance is the dependent variable  $f_{TB}(TB|GDP, REX, TOP)$  the null hypothesis of no cointegration amongst the variables is  $H_0: \alpha_{1TB} = \alpha_{2TB} = \alpha_{3TB} = \alpha_{4TB} = 0$  against the alternative hypothesis  $H_1: \alpha_{1TB} \neq \alpha_{2TB} \neq \alpha_{3TB} \neq \alpha_{4TB} \neq 0$ . In equation 3.2, where GDP is the dependent variable,  $f_{GDP}(GDP|TB, REX, TOP)$  the null hypothesis of no cointegration is  $H_0: \alpha_{1GDP} = \alpha_{2GDP} = \alpha_{3GDP} = \alpha_{4GDP} = 0$  against the alternative hypothesis  $H_1: \alpha_{1GDP} \neq \alpha_{2GDP} \neq \alpha_{3GDP} \neq \alpha_{4GDP} \neq 0$ . In equation 3.3, where REX is the dependent variable,  $f_{REX}(REX|TB, GDP, TOP)$  the null hypothesis of no cointegration is  $H_0: \alpha_{1REX} = \alpha_{2REX} = \alpha_{3REX} = \alpha_{4REX} = 0$  against the

alternative hypothesis  $H_1: \alpha_{1REX} \neq \alpha_{2REX} \neq \alpha_{3REX} \neq \alpha_{4REX} \neq 0$ . Similarly in equation 4, where TOP is the dependent variable,  $f_{TOP}(TOP|TB, GDP, REX)$  the null hypothesis of no cointegration is  $H_0: \alpha_{1TOP} = \alpha_{2TOP} = \alpha_{3TOP} = \alpha_{4TOP} = 0$  against the alternative hypothesis  $H_1: \alpha_{1TOP} \neq \alpha_{2TOP} \neq \alpha_{3TOP} \neq \alpha_{4TOP} \neq 0$ .

This study uses annual data from 1960-2010 (keeping data for 2011-2012 for forecasting). GDPW contains author's calculation using GDP data from International Financial Statistics (IFS). All the other data are from the Annual Reports of the Central Bank of Sri Lanka. GDP and export import data series were deflated in 2005 constant price.

The ARDL bounds approach requires the variables not to be integrated at an order higher than one. Therefore, it is of crucial importance to verify that the order of integration is not of I(2). To test the null hypothesis of unit root against the alternative of stationary, two unit root tests namely Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) test (Phillips and Perron, 1988) were performed but results are not reported for brevity. As per both ADF and PP test results all the variables were found I(1) in levels, I(0) in first difference and more importantly, no evidence were found for I(2). Hence, the variables are qualified to be used in bound testing procedure.

## **Empirical Results**

In the bound testing approach to ARDL,  $F$ -statistic is used to test the existence of long-run relationships. The  $F$ -test used for this procedure, however, does not follow standard  $F$ -distribution. Thus, the Pesaran *et al.* (1996) computed two sets of critical values for any given

conventional significance level. One set assumes that all variables are integrated in order  $I(0)$ , and the other set assumes that they are all integrated order  $I(1)$ .

**Table-1 Result of Bound Testing for Cointegration in ARDL Model**

ARDL Model	Akaike Information Criterion		Conclusion
	ARDL Lag Length	F-Statistics	Presence of Cointegration
$F_{TB}(TB TOP, GDP, REX)$	1,2,2,1	6.6842***	YES
$F_{TOP}(TOP TB, GDP, REX,)$	1,0,2,1	1.6558*	NO
$F_{GDP}(GDP TOP, TB, REX)$	2,0,1,2	5.0474*	NO
$F_{REX}(REX GDP, TOP, TB)$	1,1,2,1	1.8186*	NO

\*\*\* Above the 95% Upper bound critical value

\*\* In-between the 95% bounds

\* Below the 95% Lower bound critical value

If the calculated  $F$ -statistics exceeds, the upper bound critical value, then the  $H_0$  of no cointegration will be rejected favoring the alternative that cointegration among the variables. On the other hand, if the calculated  $F$ -statistic is less than the lower bound critical value, then  $H_0$  of no cointegration among the variables cannot be rejected. If  $F$ -statistic falls within the bounds, then the test result is inconclusive and long-run relationship is indeterminate.

As summarized in Table-1, the bounds test for cointegration concludes that there is a long-run relationship when and only when the TB is dependent variable. Accordingly, long-run level coefficients were estimated and results are depicted in Table-2.

Table-2 Estimated Long Run Coefficients using the ARDL Approach  
 ARDL(1,1,2,0,2) selected based on Akaike Information Criterion

Regressor	Coefficient	T-Ratio[Prob]
REXR	.3255	4.0757[.000]
GDP	.6299	.3898[.699]
GDPW	1.6050	1.4172[.166]
TOP1	-.4301	-1.7358[.093]
C	-29.9661	-1.2266[.229]
T	-.0786	-.9729[.338]
OIL	.189	.9834[.333]

Estimated long-run coefficients suggest that 1% devaluation in the real exchange rate causes 0.32 % improvement in the trade balance given all the other factors remain unchanged. Further the results show 1% increase in trade openness leads to 0.43% deterioration in the trade balance given all the other factors being equal. This implies that the possible gain of export promotion through currency devaluation is partly set off by encouraging imports due to trade openness.

In the Error Correction representation for ARDL model, the error correction term (results not shown for brevity)estimated to be -0.6145 at 1%significant level suggests that 61% of any short-run deviation will be corrected at one time period and converge to a long run equilibrium.

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[S6/02] **Securitization and the Global Financial Crisis  
(GFC): What Went Wrong?**

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**Abstract**

*The GFC which erupted in 2007 is the worst financial hit since the Great Depression. Much of the blame for the current GFC has been attributed to securitisation, Credit Default Swaps (CDSs) and to the former U.S government's mandate to financial institutions requiring relaxed lending criteria on U.S home loans so that voters could be granted home loans when they could otherwise be unable to do so. The problem lies not with securitization but securitizing "lemons" and betting over defaults of those lemons. In contrast to conventional insurance CDSs which are intended for sophisticated investors, lack in the insurable interact thus results in a financial bet which ultimately ends up with a catastrophic systemic risk. Incorporating principles of insurance inter alia insurable interest would solve most of the problem. Further to be on the safer side, a proper risk retention mechanism is a must to discourage lenders assuming excessive risk as facilitated by the modern 'originate to distribute' market model. Using an economic analysis of law approach, this paper looks in to the manner as to how the legal provisions and market provisions which existed prior to the GFC, paved the way for a financial crisis. As far as the market conditions which consisted then are concerned, the 5% risk retention provisions introduced by Dodd-frank act are least capable of answering the actual questions raised by the GFC.*

**Keywords:** Securitization, CDS, GFC, originate-to-distribute, AIG.

## **Introduction and research problem**

In 2002 President George W. Bush expressed his political ambition of creating at least 5.5 million new houses by the end of 2010. The project *inter alia* includes providing tax rebates for house builders together with a fund to facilitate down payments for intended buyers (The White House, 2002). Prior to the GFC, lenders overwhelmed by the increasing house prices engaged in providing loans for ‘sub-prime’ applicants who would not be eligible for conventional mortgages under normal circumstances. Lowering their conventional standards, in line with the government’s political vision; Fannie Mae, Fannie Mae and private banks engaged in securitizing subprime mortgages (Fishbein, 2006).

Securitization on the other hand coverts illiquid assets into liquid securities. The process involves lender (commonly a bank) moving the assets ( it could be home loan mortgages, commercial mortgages, aircraft leasing etc.) to a bankruptcy remote, ‘orphan’ Special Purpose Vehicle (SPV), deliberately setup in a tax haven (e.g: Cayman Islands, British Virgin Islands, Bermuda). The SPV will then re-bundle all the mortgages it has been assigned and tranche them in to Collateral Debt Obligations (CDOs). The CDO structure typically comprise up to three or more tranches. Since the SPV is in a different jurisdiction from its originator, SPV will not be taxed in the originators jurisdiction (say the originating bank is in U.S, if the SPV is established in U.S, SPV will be taxed separately in U.S since it is a separate company from its

originator). The SPV will issue notes to ‘sophisticated’ investors around the world, based on the underline assets. Credit Default Swaps (CDSs) have been used as a means of insuring the notes issued by the securitiser. In a CDS the lender of money buys a protection against the default of the borrower. Thus a CDS is an agreement designed to shifting credit risk between parties. Among other benefits of CDSs, banks are able to reduce their capital reserve requirements, provided their landings are protected by a CDS. Prior to the GFC, CDSs were coupled in massive scale with mortgage backed securities and traded all over the world. When the initial house prices started declining, subprime borrowers started defaulting paving way for a crisis to spread around the world (Fishbein, 2006; Legg & Harris, 2009). This paper examines the manner in which the legal mechanism behind securitization paved the way to the GFC. We have come up with a regulatory framework in order to prevent a similar crisis in future.

## **Methodology**

This paper adopts an economic-analysis-of-law, embedded in the second best efficiency criteria, following the tradition of Mishan (2007), Little (2002) and Kolsen (1968). The law creates incentives for regulatory ‘arbitrage’ opportunities to which securitization schemes are but one response. Data for this research will be actual securitization contracts, applicable legislation, and company and policy reports.

The paper analyses actual securitization arrangements and compares these against theoretically optimal contracting and regulatory arrangements derived from the welfare-and financial economics literatures, which are used as benchmarks for analysis. Significant shortfalls between actual and theoretically optimal arrangements form the basis of recommendations for reform to law or practice, either in the interests of ‘better’ contractual design or (perhaps) more effective regulatory design, whether within or between jurisdictions. The formulated benchmark (or in other words, the theoretically best provisions) may not be achievable in the practical world due to constrain (i.e consumer protection considerations). Thus our analysis essentially follows the second-best efficacy criteria.

## **Results and findings**

A typical Securitization scheme is vulnerable to changes in asset prices. When the borrower defaults and the house prices decline the secured investors become partially unsecured. On one hand the ‘originate-to-distribute’ model suggests that banks lack incentives to screen their borrowers since loans are made not to retain but to sell in contrast to the conventional ‘originate-to-hold’ financial practice. Lack of insurable interest associated with CDS contracts results in shifting the mode of a CDS contract from a typical insurance to a ‘bet’.

This same phenomenon resulted in bankruptcy in big corporate players like AIG and Lehman Brothers, ultimately spreading the financial collapse from one company to the other and from one country to another, resulting in the GFC. Lenders lack interest in *ex-ante* and *ex-*

*post* monitoring the borrower, due to the fact the CDSs cover the risk of default. Further, we suggest that the 5% risk retention rule enacted by the *Dodd-frank Act* is ineffective, since even prior to the GFC lenders did not sell subordinate notes (known as toxic waste in financial jargon) of a securitization scheme. It had been the practice prior to the GFC for sponsoring banks to hold toxic waste in their balance sheets, since it is not possible to gain an insurance cover for this high risk and unrated notes. On the other hand these notes yield a higher interest compared to other senior notes. However this practice did not prevent the lender assuming successive risk, though the same practice has been enacted as the *Dodd-frank Act* recently. Post GFC literature on CDSs insurance (some classify it as non-traditional insurance) identifies that CDSs result in systemic risk in financial distress.

### **Conclusions, implications and significance**

In this manner the mechanism behind securitization identifies two main issues with securitization which paved the way to the current GFC. Firstly, securitising lemons and then secondly, by betting over securitized lemons. The first includes the disease into the system and the latter spread the disease. Now the question arises “as to whether there a possibility of a similar crisis again?” The answer to the question is ‘yes’.

The GFC was fuelled by sub-prime lending in the United States. Regulatory arbitrage, financial innovation coupled with excess liquidity contributed in building the housing bubble. When the bubble

burst the crisis spread to the rest of the world via contagion and contractual interdependency. Fixing the contractual loopholes (in case of contractual interdependency) and optimal regulation (in case of contagion) are crucial to prevent a similar crisis in the future. Thus reframing CDSs as ‘proper’ insurance which was proposed by the *Derivative Markets Transparency and Accountability Act of 2009* (which was not enacted however), with insurable interest in utmost important to prevent CDSs business turning into a bet, which is essential to protect the CDSs provider (e.g. AIG or Lloyds of London) in a case of multiple defaults. Application of the principle ‘excess’ (similar to conventional insurance) would result in the lender having skin in the game, and thus discourage to assume excessive risk as an alternative to non-effective risk retention rule made by the Dodd-frank Act. We further recommend a precautionary principle, similar to the rule exercised by the Chinese regulatory authorities which prevents any financial innovation entering the market without prior approval of the financial authorities.

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[S6/03] **Are monetarists' arguments on the demand for broad money valid in the Sri Lankan context?**

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**Abstract**

*This paper examines the validity of the monetarist version of money demand function for Sri Lanka using the quarterly data for the period from 1988:Q1 to 2012:Q4 generated from interpolation techniques developed by Goldstein and Khan (1976). As all the variables in the study are integrated in order one at levels, this study uses Johansen and Juselius (1990) multivariate method and Granger's (1987) two-step method to derive co-integration relationships. Our findings suggest that broad money demand in Sri Lanka is unitary income elastic under both co-integration approaches used and hence coincides with monetarists' version of money demand function. This means that 1% change in real GDP cause equal 1% change in demand for real money balances. Furthermore, it reveals that the real demand for broad money decreases by 0.06% when the inflation rate increases by 1%. Similarly 1 % increase in Treasury bill rate leads to 0.03% decrease in money demand. This implies that the public in Sri Lanka tend to substitute money for more real assets than alternative financial assets during the time of high inflation. Also, we found evidences that the income velocity is constant over time and broad money demand function is stable over time.*

**Key Words:** *Cointegration, Money demand, Income lasticity, income velocity, Sri Lanka*

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*Authors are grateful to useful comments given by anaonimous referees.*

## **Introduction and Research problem**

This paper is focused on the practically testing of theoretical arguments made by monetarists on the demand for money. The income and interest rate elasticity's of money demand are at the core of the most basic macroeconomic models such as the IS-LM model where the effectiveness of monetary policy depends on the elasticity of money demand. For any country, a stable demand for money function is necessary to conduct an effective monetary policy if a monetary aggregate is targeted. It helps to select correct and efficient policy instruments in order to influence the final goal via the appropriate intermediate targets.

A stable demand for money function helps to understand the behaviour of the monetary transmission mechanism of the economy. This means that the channels or mechanism whereby the monetary influences are transmitted to other sectors of the economy particularly to both financial and commodity markets. Furthermore, the structural coefficients of the demand for money function give important policy guidelines. For example, according to the quantity theory of money (QTM), income elasticity must be unity so that the excess money supply can operate the expenditure mechanism in the economy and to test the constancy of velocity that is a key assumption of the monetarist view. However it should be emphasized that although the income elasticity equals unity, it is not a necessary condition for the velocity to be constant over time.

Therefore, following three issues are addressed in this paper;

- (i). Is the income elasticity of money demand unity in terms of broad money ( $m_2$ ) demand relationship?
- (ii). Is the inverse velocity constant over time in terms of broad money?
- (iii). Is the broad money demand function stable over time?

Estimation of money demand functions are extensively explored area in empirical research. But a limited number of studies are available in relation to the Sri Lankan experience. Among those studies, Dheerasinghe (1990) had used error correction approach (Engle - Granger (1987) two step method) to the money demand modelling in Sri Lanka based on quarterly data from 1971-1985. Other Sri Lankan studies in terms of money demand function have been paid only for identifying factors that determine money demand. These studies include Jayatissa (1984), Ranaweera (1971)Weliwita and Ekanayake(1998), and Wijewardena (1985). However, these papers are not focused on the important issues that are directly related to the the monetarist arguments except the studies done by Dharmaratne (2009) and Gunasinghe (2006).

## **Methods**

The demand for money relevant to this paper is the aggregate demand for broad money ( $m_2$ ) of the public (people, firms... etc.) as a whole. According to Friedman the following are the key determinants of the money demand function: total **wealth** ( $W_t$ ), **expected alternative rate**

of return on money ( $R_{bt}$ ), and expected rate of return on other assets ( $inf^e$ ).

That is;  $m_{2t} = f(W_t, R_{bt}, inf^e)$

Therefore, broad money demand function can be specified as following;

$$m_{2t} = \beta_{1y_t} + \beta_{2inf^e} + \beta_{3R9ITB_t} + \varepsilon_t \dots \dots \dots (1)$$

Here all the variables are in real terms except inflation. Income and money supply are in logarithms except the three-month real Treasury bill rate ( $R9ITB_t$ ). The unobservable expected inflation,  $inf^e$ , is replaced by an observable  $inf_t$  since  $et = inf - inf^e$ ,  $et \sim I(0)$ . Hence the final equations take the following form;

$$m_{2t} = \beta_{1yt} + \beta_{2inf_t} + \beta_{3R9ITB_t} + u_t \dots \dots \dots (2)$$

Where  $u_t = \varepsilon_t - \beta_{2e_t} \sim IDD(0, \Omega)$

Based on equation 2 four models are estimated:

$$m_{2t} = \beta_{1yt} + u_t \dots \dots \dots (Model -1)$$

$$m_{2t} = \beta_{1yt} + \beta_{3R9ITB_t} + u_t \dots \dots \dots (Model -2)$$

$$m_{2t} = \beta_{1yt} + \beta_{2inf_t} + \beta_0 + u_t \dots \dots \dots (Model -3)$$

A time variable,  $t$ , is included in the fourth model to capture the input growth and technical progress in the financial market (Hendry and Mizon 1993) as follows.

$$m_{2t} = \beta_{1yt} + \beta_{2inf_t} + \beta_{3R9ITB_t} + \beta_t + u_t \dots \dots \dots (Model-4)$$

Finally, all four models mentioned above are estimated based on following test equation;

$$\Delta X_t = \Pi X_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \Delta X_{t-i} + \mu + \varepsilon_t \dots \dots \dots (3)$$

Where  $X_t = (m_{2t}, yt, inf, R91TB_t, t)'$  and  $t$  runs from 1 to  $T$ .  $\mu$  is a  $4 \times 1$  matrix of unknown

Coefficients.  $\Gamma_i = -\sum_{j=i+1}^{p-1} \phi_j$  for  $i = 1, 2, p-1$  ( $\phi$  denotes parameters of

VAR model comprising  $4 \times 4$  matrices).  $\varepsilon_t \sim (0, \Sigma)$  and  $\Pi = \alpha\beta'$  is a  $4 \times 4$  matrix whose rank determines the number of co-integration vectors among four variables in vector,  $X_t$ .  $\alpha$  and  $\beta'$  are  $4 \times r$  and  $r \times 4$  matrices respectively.  $r$  is the number of cointegration vectors to be determined by Max and Trace testes.

### The sample and data

The sample period of the study ranges from 1998:Q1 to 2012:Q4. Quarterly data were derived from annual observations for relevant variables using the method proposed by Goldstein and Khan (1976). GDP deflator (1996=100) is used as the general price index to convert nominal values into real values of respective variables and to measure the rate of inflation of the economy. Following are the variables used in the study:

LRM2t = Logged values of real broad money supply (M1(cash held by public and demand deposits held by public at commercial banks) + times and savings deposits held by public at commercial banks)

LRGDPt = Logged values of real gross domestic product (or logged of real income)

$R91DTB_t$  = 91 days real treasury bill rate (alternative rate of return of money)

$LINF_t$  = inflationrate ( $\ln(GDP\ def._t / GDP\ def._{t-1})$ )

## Results and analysis

The results for ADF tests (not given here) for each variable confirm that all the variables in the study are integrated of order one meaning that each variable has a unit root at levels. This is further confirmed by rejecting the null hypothesis that the first differenced value of each variable does not have a unit root. That means that they are integrated in the order zero at the first difference. Hence, these variables can be used in testing for a co-integration relationship(s) using either Johansen and Juselius (1990) or Engle and Granger (1987) method or both.

**Table 1: Co-integration results for real broad money demand (LRM<sub>2</sub>) for model 4**

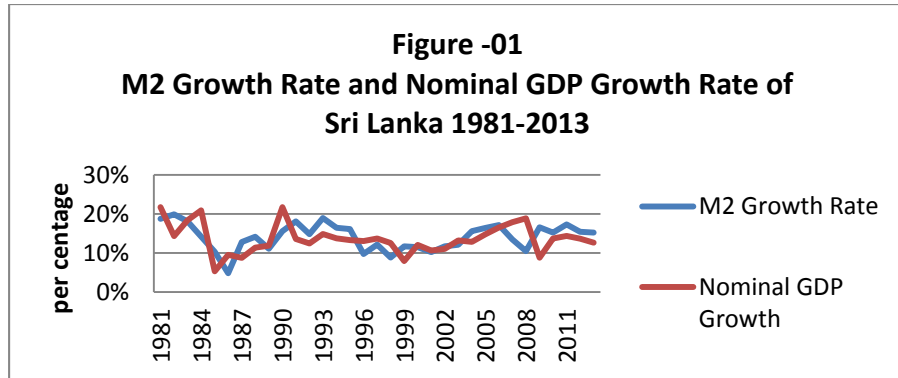
Ho:	Ha:	Statistic	Critical and Probability values		Ho:	Ha:	Statistic	Critical and Probability values	
$r^1$		$\lambda_{trace}$	0.05	Pro.	$r^1$		$\lambda_{max}$	0.05	Pro.
$r = 0$	$r >= 1$	82.098	63.876	0.0007	$r = 0$	$r = 1$	38.078	32.118	0.0083
$r <= 1$	$r >= 2$	44.020	42.915	0.0386	$r <= 1$	$r = 2$	20.951	25.823	0.1932
$r <= 2$	$r >= 3$	23.070	25.872	0.1074	$r <= 2$	$r = 3$	14.167	19.387	0.2431
$r <= 3$	$r >= 4$	8.903	12.518	0.1864	$r <= 3$	$r = 4$	8.903	12.518	0.1864

Source: Authors calculations based on Eviews version 5,  $r^1$  = number of co-integration vectors

Only the results of Johansen's cointegration test related to model 4 are given in Table 1. The results given above show that the model has a single long run relationship under max test whereas it has two long run relationships under trace test.

The estimation results obtained using both Johansen's and Granger's methods for four models specified before are given in Table 2 and 3. The results of model 1, 2 and 3 given in Table 2 (first three columns) show that not only the estimates attached to the real income variable in the money demand function are exactly equal to one but also they are highly significant with the correct signs. The same estimate in model 3 is also close to one with a very high t-value meaning that it is an extremely significant determinant in the money demand function. This further means that when the real GDP increases by 1% per a quarter the demand for real broad money also increases by the same percentage per a quarter. These findings support to the monetarist's claim that the income elasticity of broad money demand is equal to one.

In terms of policy, it suggests that Central Bank should keep money supply increasing at a rate equal to the real GDP growth rate to the maintain price level constant. Any increase of money supply in excess to real GDP growth will be added to inflation. In other words, growth rate of money supply follows the growth rate of nominal GDP when income elasticity of money demand is unity. This theoretical conclusion is apparent in Sri Lankan context in most of the years during the study period (See figure- 01).



Source: Central bank reports (various years)

In the recent past the Central Bank of Sri Lanka continued to ease the monetary policy. The REPO and ReREPO rates, which are the main policy rates of the central bank, were gradually brought down to its historic lowest at 6.5 and 8.5 percent respectively. The SRR too has now reduced to 6 percent, which is the lowest ever recorded. As can be seen from figure 1, easy monetary policy implemented from 2010-2013 caused to increase M2 growth resulting nominal GDP to follow same path though at a lower rate.

The estimates attached to inflation and 91 days real Treasury bill rate (R91TB) in model 2, 3 and 4 not only bear the theoretically expected signs but also they are statistically significant except the estimate of R91TB in model 2. For example, when the inflation and R91TB in model 4 increase by 1% per a quarter, the demand for real broad money decreases by 0.06% and 0.03% per a quarter respectively. It seems that when the inflation goes up people in Sri Lanka tend to substitute money for more real assets than the alternative financial assets.

**Table 2: Estimation results obtained using Johansen's multivariate method**

Dependent variable: Logged of real broad money (LRM2t)				
Method: Johansen and Juselius (1990) multivariate cointegration technique				
t-values are given in parenthesis				
Independent variables	Model-1	Model -2	Model-3	Model-4
LRGDP	<b>1.02</b> <b>(36.00)</b>	<b>0.97</b> <b>(32.00)</b>	<b>1.00</b> <b>(52.36)</b>	<b>0.86</b> <b>(4.56)</b>
LINF	-	-	<b>-0.07</b> <b>(-5.57)</b>	<b>-0.061</b> <b>(7.15)</b>
R91TB	-	<b>-0.017</b> <b>(-1.16)</b>	-	<b>-0.027</b> <b>(3.29)</b>
Constant	-	-	<b>-1.10</b> <b>(-4.55)</b>	-
Trend	-	-	-	<b>0.0016</b> <b>(0.6)</b>

*Source: authors calculations based on Eviews version 5*

The results obtained by employing Granger's method for four models are given in Table 3. It is very interesting to note the results in Table 3 are almost similar to those in Table 2. Furthermore, it has been proven that when variables in levels are cointegrated in Engle and Granger (1987) method, the OLS estimates become super consistent. Therefore, as variables in all four models mentioned below are cointegrated, their estimates are super-consistent.

Therefore, these results repeatedly confirm the strong acceptance of The stability of the money demand function, which is a crucial requirement to make correct and reliable policy forecasts, was tested based on recursive coefficients and cumulative sum of squared residuals (CUSUM) of model 4 which was estimated using Granger's

two-step approach to cointegration (results are not shown here). The results revealed that the broad money demand function (Model 4) holds the stability properties. The result also finds an important link between the velocity of money and the stability of money demand function.

**Table 3: Estimation results obtained using Granger's (1987) two-step method**

Dependent variable: Logged of real broad money (LRM2t)				
Method: Johansen and Juselius (1990) multivariate cointegration technique				
t-values are given in parenthesis				
Independent variables	Model-1	Model -2	Model-3	Model-4
LRGDP	<b>1.06</b> <b>(90.30)</b>	<b>1.05</b> <b>(80.32)</b>	<b>1.05</b> <b>(91.86)</b>	<b>0.90</b> <b>(626.65)</b>
LINE	-	-	<b>-0.013</b> <b>(-2.97)</b>	<b>-0.012</b> <b>(-2.63)</b>
R91TB	-	<b>-0.0095</b> <b>(-1.99)</b>	-	<b>-0.0068</b> <b>(-1.46)</b>
Constant	<b>-1.86</b> <b>(-12.30)</b>	<b>-1.70</b> <b>(-10.39)</b>	<b>-1.76</b> <b>(-12.20)</b>	-
Trend	-	-	-	<b>0.002</b> <b>(10.07)</b>
Error term in Granger's method:	<b>I(0)</b>	<b>I(0)</b>	<b>I(0)</b>	<b>I(0)</b>
Conclusion	Variables are cointegrated in levels in four models			

*Source: authors calculations based on Eviews version 5*

## **Conclusions, implications and significance**

This paper examines the validity of the monetarist version of money demand function for Sri Lanka using Johansen and Juselius (1990) Multivariate and Engle and Granger (1987) two-step methods for cointegration. Our findings suggest that the broad money demand in Sri Lanka is unitary income elastic and hence coincides with monetarists' version of money demand function. It reveals that the real demand for broad money decreases when the inflation rate increases. Similarly, increase in Treasury bill rate leads decrease in broad money demand. This implies that public in Sri Lanka tend to substitute money for more real assets than the alternative financial assets during the time of high inflation. These findings are novel in the Sri Lankan context and thus will be useful in monetary policy formulation. Also, this study provides evidences that the income velocity is constant over time and broad money demand function is stable over time.

However, these results are completely different from findings in Dharmaratne's (2009) study where he confirmed that broad money demand (M2) is not cointegrated with any of the independent variables selected such as real income and interest rate.

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[S6/04] **Impact of Interest Rate on Investment, in the Sri Lankan Context: A Study on the Effectiveness of Monetary Policy**

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**Abstract**

*The study investigates whether interest rates affect negatively on investment led economic growth. In this study, private and public corporation capital formation (PPCCF) is taken as the dependent variable and Central Bank Rest (CBR) and real gross domestic income (RGDP) are taken as independent variables. The civil war which was experienced in the country is used for the analysis as a dummy variable. The data from the period ranging from 1978- 2013 is used for the study. Vector Error Correction test through Co-integration methodology is applied to estimate the long-run model and the short-run dynamics of investment. The variables; interest rate (CBR) and income (RGDP) are positively related with investment in the long-run in the Sri Lankan context. The positive coefficient of income is significant and consistent with the hypothesis. Positive coefficient of interest rate is significant but inconsistent with the insights. The inverse relationship between investment and interest rate is not there in the Sri Lankan context. According to short run dynamics represented in the Vector Error Correction Model, 85% of the disequilibrium ) in investment is adjusted towards equilibrium within a one year period. Interest rate, income and the civil war jointly affected investment expenditure in Sri Lanka.*

**Keywords:** *Interest rate, private and public corporation capital formation, Real Income, Vector Error Correction methodology, Co-integration methodology.*

## **Introduction and research problem**

The study focuses on to investigate the effectiveness of interest rate to encourage investment through the monetary policy for achieving economic stability of the country. If interest rate elasticity of investment<sup>32</sup> is negative, expansionary monetary policy can achieve higher economic growth through higher investments and higher employment performance which will increase the aggregate demand. In period of recession, policy makers consider an expansionary monetary policy lowering interest rates to increase investment and aggregate demand and then achieve higher economic growth. Lower interest rates encourage investments due to the low cost of investment funds.

To meet the expectations of monetary policy there should be a negative relationship between interest rate and investment expenditure. Examining whether there is a negative relationship between interest rate and investment is important to the effectiveness of monetary policy in the context of Sri Lanka. In the Sri Lankan experience, expansionary monetary policy through low interest rates implemented in the recovering period of the crisis does not make any significant influence on investment. As the experiences show the banking sector has been unable to expand lending on investment as expected in the periods conducted under the expansionary monetary policy. This situation makes a doubt as to whether investment is not sensitive to changes in interest rate in the Sri Lankan context.

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<sup>32</sup>The responsiveness of investment to changes in interest rate

### **Objectives of the study:**

- To investigate interest rate sensitivity of investment.
- To investigate income sensitivity of investment.
- To investigate whether the ethnic crisis has affected investment or not.
- To investigate the effectiveness of the interest rate channel of monetary transmission mechanism in Sri Lanka.

This study works on the hypotheses that (1) Interest rate affects a change in aggregate expenditure and changes output and price level and (2) The income elasticity of investment is positive.

### **Methodology**

The study uses the Dickey-Fuller test (DF test)<sup>33</sup> to confirm the stationary of the variables and the test results show that all variables; (PPCCF), (CBR), and (RGDP) are non-stationary (I (1)) variables. If multiple individual time-series variables are non-stationary integrated of order one (I(1) series), The vector error correction (VEC) model through co-integration test is employed to estimate the both long run relationship and the short run dynamics among the variables in the investment model from the period 1978 to 2013. VAR method does not capture non-linear elements that exist with certainty in level variables because a VAR is a linear model. The better way to respond

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<sup>33</sup> In statistics, the Dickey-Fuller test tests whether a unit root is present in an autoregressive model. (To check whether series are stationary or non-stationary) It is named after the statisticians D. A. Dickey and W. A. Fuller, who developed the test in 1979

to this problem is to linearize the data by taking the logs of the levels. For this testing purpose, the original data of all series: PPCCF, CBR, and RGDP were transformed to log, and the new variables are named as log of private and public corporation capital formation (LPPCCF), Log of Central Bank Rate (LCBR) and Log of Real Gross Domestic Product (LRGDP). Akaike information criterion test is applied to select the lag length and Granger Causality test is done for cross check the causality between series.

Johansson co-integration methodology is conducted using Eviews 07 to test whether there are any long run relationships among the set of non-stationary variables; LPPCCF, LCBR, and LRGDP.

## **Results and findings**

According to the lag length criteria, Akaike information criterion showed that lag length should be one, and granger causality test proved that there is one-way causality between PPCCF and RGDP and there is no causality between investment and interest rate. Because the Engel Granger two way tests proved that three series are integrated, all three variables are used to run the co-integration test and the test results are given below.

**Table 01 Result of the co-integration test 1**

<b>Hypothesized No. of CE(s)</b>	<b>Eigenvalue</b>	<b>Trace statistics</b>	<b>5%critical value</b>	<b>probability</b>
None *	0.639058	46.81611	29.79707	0.0002
At most 1	0.213240	12.16884	15.49471	0.1490
At most 2 *	0.111371	4.014574	3.841466	0.0451

\* denotes rejection of the hypothesis at the 0.05 level

**Table 02; Result of the co-integration test 2**

Hypothesized No. of CE(s)	Eigenvalue	Maximum Egan statistics	5%critical value	probability
None *	0.639058	34.64727	21.13162	0.0004
At most 1	0.213240	8.154270	14.26460	0.3632
At most 2 *	0.111371	4.014574	3.841466	0.0451

\* denotes rejection of the hypothesis at the 0.05 level

Co-integration test proved that variables are co-integrated and that there is a one co-integration relationship among the variables. It leads to the running of the vector Error Correction test. The presence of one co-integration vector implies that Granger-causality should exist in one direction among the variables. The long run equilibrium equation of investment which is estimated by the co-integration test is written below.

$$LPPCCF = -28.59 + 0.66LCBR + 2.75LRGDP + \mu 1_{t-1}$$

[-7.35944] [-53.0386]

The Vector Error Correction model was estimated is given below.

$$D(LPPCCF) = C(1) * (LPPCCF(-1) - 2.75270839571 * LRGDP(-1) - 0.656570847977 * LCBR(-1) + 28.5926781047) + C(2) * D(LPPCCF(-1)) + C(3) * D(LRGDP(-1)) + C(4) * D(LCBR(-1)) + C(5) + C(6) * DUMMY$$

**Table 03; Vector Error Correction Test**

	Coefficient	t-statistics	Probability
C(1)	-0.851455	-3.570133	0.0013
C(2)	0.157129	0.940231	0.3551
C(3)	0.882471	0.631993	0.5325
C(4)	-0.189781	-1.001355	0.3252
C(5)	0.113154	1.211977	0.2356
C(6)	-0.029431	-0.468253	0.6432

R-squared                      0.326625

F-statistic                      2.716313

Prob(F-statistic)              0.040152

$$DLPPCCF = 28.59 - 0.85 (\mu 1_{t-1})$$

$$(-3.570133)$$

85% of the disequilibrium ( $\mu 1_{t-1}$ ) in fixed investment will be adjusted towards equilibrium within a one year period. This is a high rate of adjustment. 32% in Investment is explained by the model, and model has not been good fitted. Interest rate and ethnic crisis are not affected individually but they affect investment jointly in the short run according to the F statistics. Residual test results show that there is no serial correlation, heteroskedasticity problems and normality is proved.

### **Conclusions, implications and significance**

The variables; Interest rate (CBR) is positively related with Investment in the Sri Lankan context during the sample period. This result is inconsistent with the theoretical explanation but is significant. Interest rate channel of monetary policy transmission mechanism is not effective to maintain growth and price stability in Sri Lanka with the absence of a negative relationship between them. The positive sensitivity of Savings to interest rate may be the reason for a positive coefficient of interest rate pertaining to the model. Savings would be encouraged by higher interest rates, and investments should be equalled to savings. This reason should be the reason for a positive relationship between investment and interest rate.

Furthermore, the estimated results show that real income (RGDP) in the economy makes a more powerful positive impact on Private and Public corporation capital formation (PPCCF). This coefficient is

highly significant and consistent with the hypothesis. Higher income affects positively on savings and investment would be equal to investment. Ethnic conflicts situation does not affect in investment. According to short run dynamics, 85% of the disequilibrium ( $\mu 1_{t-1}$ ) in fixed investment will be adjusted towards equilibrium within a one year period. Estimated long run and short run models can explain the weakness of interest to encourage investment and to conduct monetary policy.

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[S6/05] **Effectiveness of the Credit Channel for Curbing Inflation in Sri Lanka**

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**Abstract**

*This study mainly aims to investigate the viability and the effectiveness of credit channel of monetary policy transmission mechanism to maintain the price stability in Sri Lanka by especially focusing on the bank lending channel. A VECM model preceded by a co-integration test has been developed to pursue this objective by using the annual data for the period from 1980 to 2012. The conclusion of the study reveals that the particular bank lending channel is effective in Sri Lanka during the period covered by the study and further found that a positive and statistically significant relationship exists between total credit to private sector and the general price level. Same as it has avowed that the effect of credit availability on the general price level is much stronger than that of interest rate and the exchange rate on the general price level.*

**Keywords:** *Bank Lending Channel, Co-integration Test, Price level, Unit Root Test, Vector Error Correction Test,*

## **Introduction and research problem**

Central Bank of Sri Lanka (CBSL) has as its primary goal the maintenance of growth and price stability. In order to achieve these goals, especially the latter, different monetary policy instruments are used taking into consideration the channels through which the monetary policy operations are transmitted to the macroeconomic variables such as the rate of inflation and the GDP. In the Sri Lankan context, the most popular and highly valued monetary transmission channel is the interest rate channel. But recent research findings have identified and proved empirically that the interest rate channel is less effective. Following these observations, this study intends to test another important channel ie. Credit channel of the monetary transmission mechanism with special reference to Sri Lankan experiences in the last 30 years.

Mallikahewa (2013) has evaluated the effectiveness of interest rate channel for controlling price level in the Sri Lankan context. From this study Mallikahewa has come to a conclusion which opposes that conventional view on interest rate channel emphasizing that higher fixed deposit interest rate leads to higher price level and higher interest rates persuade people to save money in fixed deposits in Sri Lanka. An important fact relating to the present study has been revealed by this study. This study indicates the fact that "credit channel of monetary policy transmission mechanism is more effective than interest rate channelling to achieve the price stability as well as growth stability in relation to Sri Lanka" (Mallikahewa 2013). This study aims to test whether the credit channel of the monetary policy is effective or

not in the Sri Lankan context by mainly focusing on the bank lending channel.

## Methodology

Annual data for the period ranging from 1980 to 2012 which have been taken from various CBSL annual reports, will be used in the inflation model of this study. The variables used as proxies to build the model include the level data of Colombo Consumer Price Index (CCPI), Fixed Deposit Rate (FDR), Total Credit to Private Sector (TCPS) by the commercial banks and the Exchange Rate (Exchange Rate). CCPI with different base years will be converted in to one specific base year which is 2002. Exchange rate has been taken in terms of the domestic rupee value for the US dollar. In order to avoid heteroscedasticity problem all the variables will be converted in to log values. Time series data will be initially subjected to unit root test in order to see whether the time series data are stationary or non-stationary. In order to identify the long run relationship between variables, the cointegration test will be employed. Vector Error Correction model will be applied to build up the model which captures both long run and short run dynamics.

Following equation shows the long run inflation function which is based on the theoretical and empirical findings of the other related studies.

$$LCPI = \beta_0 + \beta_1 LTCPS - \beta_2 LFDR + \beta_3 LER + u_{t-1}$$

$\beta_0$  - Constant of the Inflation function

$\beta_1$  - Credit elasticity of Inflation

- $\beta_2$  - Interest rate elasticity of Inflation
- $\beta_3$  - Exchange rate elasticity of Inflation
- $u_{t-1}$  - Deviation of inflation from long run equilibrium in the previous year

## Results and findings

The Augmented Dickey Fuller unit root test was used to test the stationarity of each time series data including a constant in to the model. As such all the time series are stationary at their first differenced form and they are so called I(1) processes .Johansson approach for co-integration test has been adopted to evaluate the long run relationship among variables and the results obtained through the test revealed that the variables are co-integrated and one co-integrated equation exists at the 5% significant level.

**Table 1 – Maximum Eigen value test of the Johansson approach**

Hypothesized No. of CE(s)	Eigen value	Max-Eigen Statistic	Critical Value 5%	Prob.
None *	0.711836	38.57098	28.58808	0.0019
At most 1	0.393076	15.47992	22.29962	0.3368
At most 2	0.356354	13.65881	15.89210	0.1087
At most 3	0.115484	3.804153	9.164546	0.4420

\* denotes rejection of the hypothesis at the 0.05 level

The co integrated equation founded under co integration methodology can be presented as below.

$$LCPI = 4.34 + 0.5094 LTCPS + 0.3159 LFDR + 0.3342 LER + u_{t-1}$$

(13.36)      (6.89)      (4.21)      (1.75)

According to the results obtained by Wald Test, none of the variables have short run causality on LCPI as shown by the p- values which are more than 5% in each case.

### **Conclusions, implications and significance**

The study reveals that credit channel is effective in Sri Lanka during the period covered by the study. It found out that there is a positive and statistically significant relationship between total credit to private sector and the general price level. It has further revealed that the effect of credit availability on the general price level is much stronger than that of interest rate and the exchange rate on the general price level.

On the basis of the above conclusions, one may state that in order achieve the principal objective of the central banks, namely, curbing inflation, the central bank may deploy credit channel effectively. So, direct control of credit by imposing high reserve requirements and/or credit ceilings may produce better results than raising interest rate in an inflationary situation.

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**Session-7**  
**Peace and**  
**Development**



[S7/01] **Post War Resettlement and Social Cohesion in  
Sri Lanka**  
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**Abstract**

*Relationship between the concept of social development and Social cohesion is relatively new. Social cohesion is an end product of a good policy of social development. At the end of the day, threats to social cohesion stems from bad policies of social development which is one-dimensional and exclusionist. On the contrary, sustainable policies encompass social cohesion at its core. Social cohesion is the capacity to ensure welfare of all citizens. This paper examines whether the government resettlement policy of post war Sri Lanka ensures the welfare of all citizens and thereby promotes social cohesion. To achieve this objective, the study examined the composition of social cohesion components and the factors defined in the notion of belonging such as multiculturalism, trust, participation, expectation of mobility and social solidarity in a resettled community in Suthanthirapuram Grama Niladari Division (GND), Tellipalai District Secretariat Division (DSD) in Jaffna District. The research collected the relevant data through mixed methodologies which were both qualitative and quantitative in nature. The study finds that the civilian population of the Suthanthirapuram are dissatisfied with the governments' resettlement policy as it lacks social cohesion components. Majority of the respondents identified military involvement in the civil administration associated with the resettlement process and the exclusion of local population in developing the rural economy as the key factors that limit social cohesion among the resettled families. Therefore the government resettlement policy should adopt strategies to enhance the sense of belonging among the citizens living in former war affected areas.*

**Keywords:** *Jaffna, Resettlement policy, Social Cohesion, Sri Lanka, Suthanthirapuram*

## **Introduction and research problem**

After five years of ending the three-decade civil war, Sri Lanka's immediate economic plan is to reach the status of an upper middle income country by the year 2016. The Sri Lankan Government ended the war on May 2009 after militarily defeating the LTTE. From 2009-2013, Sri Lanka has achieved an average annual economic growth of 6.66 percent. Immediate areas of concern for the Government of Sri Lanka after ending the Elam war (IV) were on how to address the psychological trauma of war affected families, issue of accommodating large number of Internally Displace Persons (IDPs) and their welfare issues related to the rehabilitating of ex-LTTE cadres and reintegrating them to the society, demining and the reconstruction of infrastructure and other basic facilities in the war affected areas. The Sri Lankan government claims that when resettling people, it has followed the basic norms and guidelines for IDPs, which included one of the following options of (a) return to their place of origin, (b) integration in the area of displacement and (c) the settlement in another part of the country (Annual Report, 2013, p.52, Ministry of Finance and Planning). According to the Ministry of Resettlement 225,970 families (76,2120 persons) were resettled in the war affected areas in the Northern Province of Sri Lanka as of 31<sup>st</sup> March 2014. This study attempts to capture the composition of social cohesion components in the government resettlement process in post war Sri Lanka based on the resettled community in Suthanthirapuram GramaNiladari Division (GND), Tellipalai District (Valikamam North) Secretariat Division (DSD) in Jaffna District. The concept of social cohesion is increasingly

used to understand and assess sustainability of development initiatives. Therefore, this study is important in identifying emerging and extant issues in the government resettlement process. The findings present key insights on the need to comprehensively address factors pertaining to social cohesion when drafting resettlement policies in conflict affected countries.

### **Methodology**

Mixed methodologies were applied to analyse the objectives of the study, which is to examine whether the government resettlement policy of post war Sri Lanka promotes social cohesion by ensuring welfare of all citizens. Data collection consisted of both qualitative and quantitative tools. An individualised survey questionnaire was given to 100 resettled people in the Suthanthirapuram GramaNiladari Division (GND), Tellipalai District Secretariat Division (DSD) in the Jaffna District. This questionnaire was drafted and based on the system of social cohesion indicators, its components and factors set by Jenson (2010). Social cohesion of belonging was measured by using the variables of multiculturalism, trust, participation, expectation of mobility and social solidarity. These variables were operationalized by basing them on people's perceptions about the level of normalcy pertaining to life after settling in Suthanthirapuram and getting feedback on issues about land, law and order, police protection, legal assistance, personal safety and opportunities for participation. The survey also examined basic facilities of water, electricity, housing and its conditions, education, health, communications and transport facilities offered to resettled people. Primary research also gathered information on economic activities both at village and provincial level

of those resettled. Secondary information was gathered from a literature survey carried out by reading recent research, along with government and donor agency reports although related material is somewhat limited.

## **Results and findings**

The study found that the socio economic background of resettled communities has not changed significantly over the past few years. Resettled communities have access to basic needs and there is progress in obtaining housing, water, electricity, communication, education, and transport and health facilities. While majority of the respondents appreciated access to basic amenities, the bulk of respondents in the resettled communities were not satisfied with the manner in which they were involved in the resettlement process or how they were allowed to participate in the resettlement process. They also expressed distrust of those who lead the process including a reluctance to seek assistance from the police, legal authorities and the military. Significantly, they highlighted that most security structures are composed of personnel from a different ethnic group. Furthermore, respondents did not feel a sense of belonging as they were not part of the significant efforts to promote multiculturalism and social solidarity. Majority of the respondents were dissatisfied with the limited access they had in actively participating in the local economy and development. Overall, the people are not satisfied with the manner in which the resettlement process was implemented and hence the Government of Sri Lanka is yet to achieve social cohesion as an outcome of its resettlement policies.

## **Conclusions, implications and significance**

The study found that the civilian population of Suthanthirapuram are dissatisfied with the government resettlement policy as it lacks the social cohesion components of multiculturalism, trust, participation, expectation of mobility and social solidarity that define the concept of belonging. Majority of the respondents identified military involvement in civil administration pertaining to the resettlement process and the exclusion of the local population in developing the rural economy as key factors that limit social cohesion among the resettled families. Therefore, the government's resettlement policy should adopt more strategies to enhance the sense of belonging among the citizens living in formally war affected areas. Specifically consultation of local communities and diversifying the ethnic composition of security personnel in the region along with the creation of an economically viable environment for the resettled families may mitigate the damages already caused by a centralized resettlement process.

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[S7/02] **Household Entitlements in the Eastern Province of Sri Lanka: With Special Reference to Female Headed Households**

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**Abstract**

*During periods of violent conflict, females and female headed households face heightened levels of vulnerability and asset based depletions. These trends have a tendency to be carried into the post conflict periods reducing household entitlements and undermining economic growth and development. This study focus on developing an asset based index to study the existing levels and patterns of asset distributions of the households form rural Trincomalee. Using a principal components analysis (PCA) to generate household asset-based indices the study finds that there is both gender based inequalities and ethno-gender inequalities in asset distributions. Uncovering and addressing such inequalities can bring about social and economic justice and increase economic growth and development.*

**Keywords:** *Female household headship, Principal component analysis, Post war Sri Lanka, Trincomalee*

## **Introduction and research problem**

During periods of violent conflict females and female headed households face heightened levels of vulnerability and asset based depletions (Cabezas, Reese, and Waller 2007; De Alwis 2002; Ruwanpura & Humphries 2005; Tribe & De Silva 1999). These trends have a tendency to be carried into the post conflict periods further reducing assets and access to assets to females (Alldén 2008; Krishna 2001) and consequently increasing gender based injustice leading and to overall underdevelopment (UN Women 2012).

This study focus on developing an asset based index to study the existing levels of entitlements and patterns of asset distribution amongst the households in rural Trincomalee. Assuming that female headed households are diverse in character, the study is significant due to several reasons. Firstly, as empirical research has found, assets in the hands of women have the potential of increasing children's schooling (Katz & Chamorro 2003), reducing domestic violence (Panda & Agarwal 2005; Srinivasan & Bedi 2007; Friedemann-Sánchez 2006), and an increasing aggregate growth (Agarwal 1994). Understanding the existing asset distribution across gender can help the post conflict recovery initiatives. Secondly, this study is useful to understand both horizontal (across ethnicity and gender) and vertical inequalities (within diverse groups of female headed households) that could exist in post conflict societies.

## **Methods**

The study uses primary data collected from a sample of 144 households, in the Seruvila divisional secretariat division. This included 85 female headed households and 59 male headed households from Sinhalese, Tamil and Muslim ethnic groups.

The Oxford Poverty and Human Development Initiative (OPHI) variable definitions for improved drinking water, electricity, improved sanitation, education (Alkire et al. 2014) and United Nations and United Kingdom's Department for International Development's definitions for shelter (Gordon 2005) were used when designing variables for the collection of data on assets. Furthermore, variables that capture household income adequacy, livestock assets, land use patterns and indicators for livelihood physical capital assets are used in this analysis. Such variables are common to composite indices for living standards and to understand household assets (Pampalon et al. 2009; Messer et al. 2006; Vyas & Kumaranayake 2006).

This study employs a principal components analysis (PCA) to generate household asset-based proxy wealth indices. PCA is a factor analysis methods and is an indicator reduction technique to analyse observed variables that would result in a reasonably small number of interpretable components (group of variables), which account for most of the variance in a set of observed variables (Jolliffe 2005).

The method used here is justifiable in relation to this work as it has the power to identify interpretable factors (reducing and compositing the

variables) which explain the data based on their variances properly. After examining the screen plot results and by using the eigen rule, factors with values greater than 1 were extracted through the correlation coefficients. This resulted in only four factors being extracted for analysis. Due to the nature of the variables a Varimax rotation was also used.

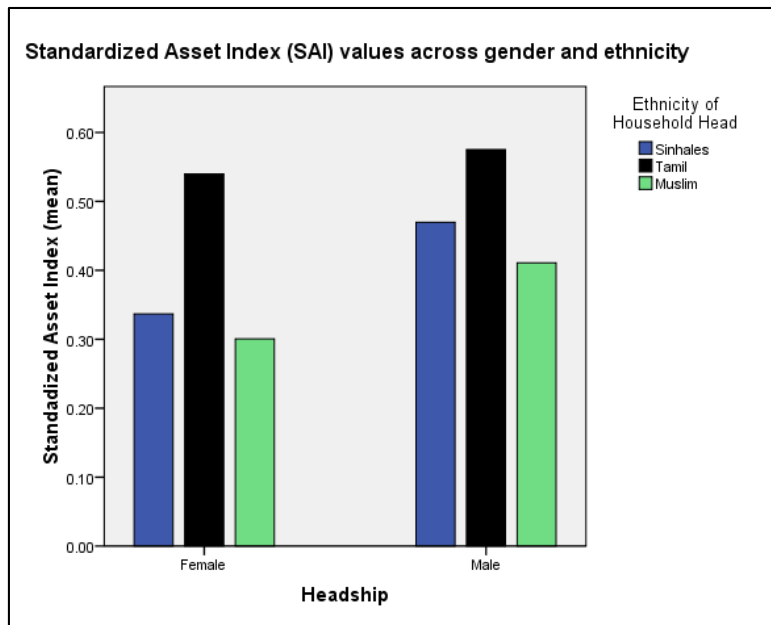
Using the Factor loadings and their corresponding percentages a standardized index was calculated. Similar methods have been used by Brien et al. 2004, Antony & Visweswara Rao 2007 and Krishnan 2010.

## **Results and findings**

The four factors, 1) factor1: household specific physical capital, 2) factor2: natural capital and social capital, 3) factor3: financial and human capital, 4) factor4: livelihood specific physical capital; combinedly accounted for 54.3% of the total variance. The 1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup> and 4<sup>th</sup> factor components explained 23.1%, 10.5%, 10.4% and 10.2% of the variance respectively. Using the proportions of these percentages as weights a Standardized Asset Index (SAI) was developed. The index values ranged between 0-1, with 1 denoting a higher quantity and quality of household assets.

The eta-square analysis of variance indicated a strong effect size between household headship and the SAI (eta-square=0.45. The mean value of the SAI for female headed households stood at 0.39 and for male headed households at 0.47. Using these results, it can be seen that the male headed households had more access to household assets than

the female headed households. Among the female headed households, this study found that Muslim female headed households possess the least amount of assets (SAI=0.30) compared to the Tamil (SAI=0.53) and Sinhalese (SAI=0.33) households in the Serunuwara DS division (See Graph 1).

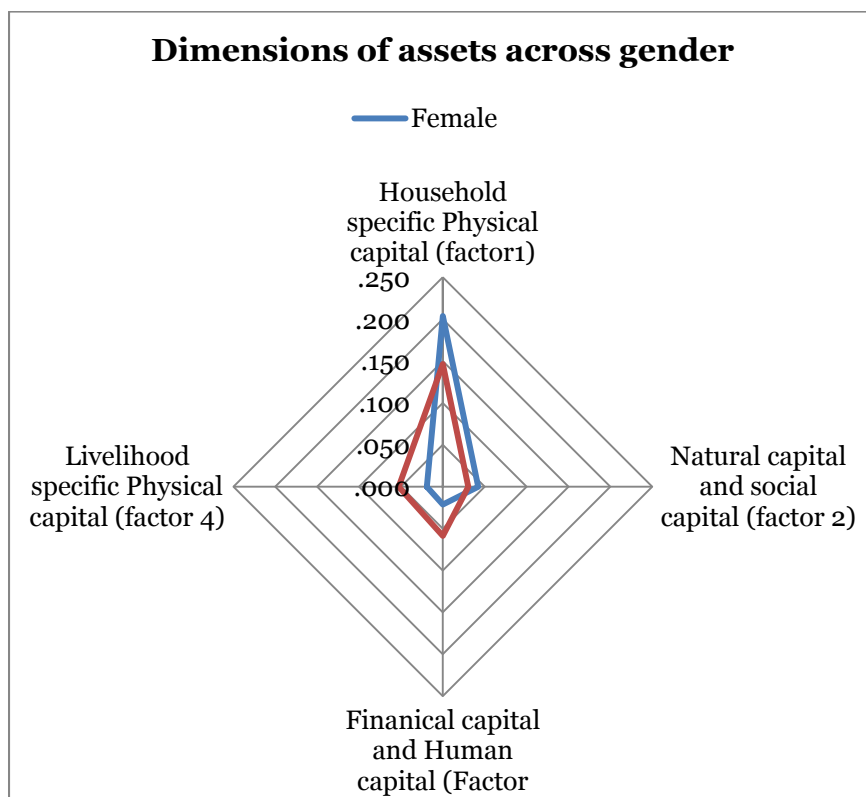


**Graph 1: SAI values across gender and ethnicity**

Across ethnicity, households headed by older females had comparatively lower amount of assets than those headed by younger female heads. Interestingly, households headed by de-facto household heads also had more assets compared to de-jure female household heads.

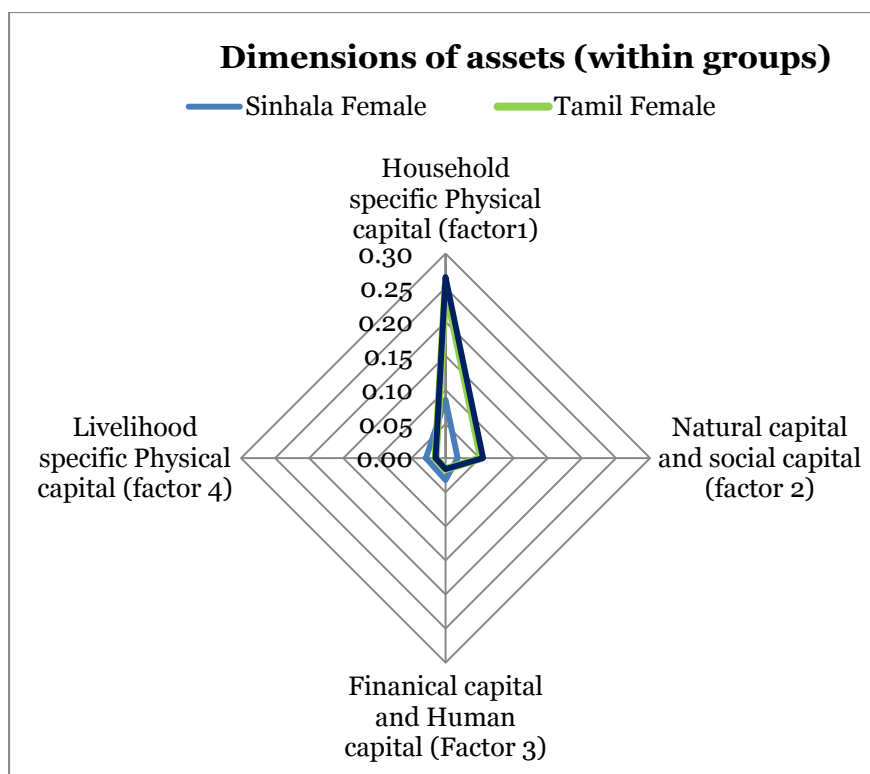
The weighted factor scores were used to analyse data relating to individual factor dimensions. From these it can be found that female headed households owned more household specific physical capital

assets , natural and social capital assets (1<sup>st</sup> and 2<sup>nd</sup> factors) than male headed households, but lower in the other two dimensions (See graph 2).



**Graph2: Dimensions of assets across gender**

However, ethnized entitlements indicate that Sinhalese females owned lesser amounts of household specific physical capital assets , natural and social capital assets (1<sup>st</sup> and 2<sup>nd</sup> factors) than the Muslims and Tamils however, scored higher in livelihood specific physical capital assets (factor 4) and human and financial capital dimensions (factor 3) (See graph 3).



**Graph 3: Dimensions of assets within female household headship**

### **Conclusions, implications and significance**

Data during war and post war years suggests that interventions by state and donor organizations have been successful in increasing assets to households and creating more access to assets. However, more attention needs to be paid to hidden segments of the population, such as to the households headed by females between ages of 46-60 and above 60 years and to households headed by Muslim females. Interventions to increase human, financial and livelihood specific physical capital assets to Muslim and Tamil female headed households and household specific physical capital (electricity, water, sanitation, durable assets etc.) and natural based assets (such as access to lands)

to Sinhalese female headed households can also reduce the inter group and intra group asset inequalities.

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## [S7/03] **Buddhism as a Way of Reconciling Post War Sri Lanka**

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### **Abstract**

*Sri Lanka has reached an important juncture of the ethnic conflict after the military victory over the LTTE. It is a very clear fact that the war has seriously affected the social and ethnic harmony of the country in vast spaces in recent decades. Therefore Sri Lanka is now facing the huge challenge of bridging the gaps among ethnicities. This divided society can only build its shared future out of its divided past by having a well guided reconciliation process. Reconciliation is an approach which consolidates peace, breaks the cycle of violence by preventing the possibilities of the use of the past as the seed of renewed conflict. It brings about the personal healing of survivors, the reparation of past injustices, the building or rebuilding of non-violent relationships between individuals and communities. Buddhism can play a pivotal role for peace building in post war societies. Cambodia provides a promising initiative for using religion as a tool of post conflict peace building. 'Dhammayietra' program which is being introduced by Rev. Maha Ghosananda is an ideal initiative for the grassroots peace building in post war Cambodia. By critically examining the 'Dhammayietra' program, this paper discusses the possibility of using such an approach for the post war reconciliation process in Sri Lanka. Paper finds that need of Buddhism to go beyond the ethnic boundaries by promoting interreligious linkages for achieving ethnic harmony in post war Sri Lanka.*

**Keywords -** *Post War Reconciliation, Buddhism, Dhammayietra, Cambodia, Sri Lanka*

## **Introduction and research problem**

Sri Lanka has a strong Buddhist tradition which was introduced in the 2nd century BCE by the Venerable Mahinda. Estimates generally state that seventy per cent of the Sinhalese are associated with the '*Theravada*' school of Buddhism. Buddhism is a religion well known for its teachings about nonviolence and empathy (Bilodeau, 2000). Hence, Buddhism can be well utilized in the post war peace building since *Theravada* Buddhism provides a strong foundation for peaceful coexistence. When analyzing the above theme this paper is divided into two major parts. In the first part of the paper, it discusses theoretical dimensions on reconciliation and the possibility of using Buddhism for the post conflict peace building and reconciliation. In the second part, the paper discusses the capability of utilizing Buddhism for the post conflict reconciliation process in Sri Lanka, with the comparative analysis of the Cambodian experiences in post war peace building.

## **Methods**

This paper is mainly based on a literature research. Utilization of the literature of the paper can be divided into four main categories. Firstly it analyses literature on the concept of reconciliation. Secondly paper focuses on the literature on the Buddhists analysis of reconciliation. Thirdly it examines the literature on Cambodian reconciliation approach. Fourthly the paper focuses on the literature on the role of Buddhism in the post war reconciliation process in Sri Lanka.

## **Results and findings**

When analyzing the potentiality of using Buddhism as a mechanism of post war peace building three main points can be considered. Firstly Buddhism shows the potential of breaking down the vicious circle of violence. Secondly Buddhism promotes forgiveness which can be an essential feature of reconciliation (Collins, 1998). Thirdly by rejecting the structural violence Buddhism provides space for the restorative justice in the post conflict societies.

When compared with Cambodia many similarities can be observed in the Sri Lankan context. In both countries there is a strong relationship between the state and the religion. In Cambodia, Monks and monk administrators (*Achars*) have traditionally played central roles in moral education and conflict resolution in rural Cambodia (Adams, 2011). In Sri Lanka also Buddhist monks traditionally played a vital role in the day today conflict resolution processes in the rural areas (Tilakaratne, 2003).

When compared to with Sri Lanka it is a clear fact that Buddhism in Cambodia has played a useful role in the reconciliation process. Furthermore such peace attempts grab the international attention. This was resulted by the training opportunities provided for them (Brounéus, 2007). Buddhist peace workers and conflict resolution educators trained in both Buddhism and peacemaking tended to hold broader concepts of peace that go beyond individual peace and harmony. But in Sri Lanka, internationalization was really lacking since the western peace building concepts were not being welcomed by the Sinhala nationalists. In contrast to this, Cambodian Buddhist leaders were keen to provide conflict resolution skills and training opportunities for their followers. One of main products of the

*Dhammayietra* movement has been the training of a number of monks and nuns in community conflict resolution (Ghosananda, 1992).

Accommodative nature of the Cambodian Buddhism was another great strength in the peace attempt led by Buddhists leaders. Buddhist monks maintained a good relationship with other religious organizations. For example *Dhammayietra* program has been cooperatively sponsored by several Christian NGOs. Furthermore they worked cooperatively with number of NGOs such as The Cambodian Development Research Institution (CDRI), The Active and Non-Violence Working Group (ANVWG), The Weapons Reduction Group and several human rights organizations. In spite of the few of attempts made by organizations such as Congress of Religions, non- accommodative nature of the Buddhism in Sri Lanka has been a huge barrier for having a proper reconciliation process (Imtiyaz, 008).

The non-accommodative nature of Buddhism is caused as a result of the Buddhist monastic tradition which has not provided any room for the development of a civil society characterizing virtues such as pluralism and universalism. However with the arrival of UN peace approaches in Cambodia, many Buddhist monks have enthusiastically learned and taught about human rights. But in Sri Lanka this was almost absent due to the fact that there is no influential role from the Buddhist women here. Further, in Cambodia, Rev. Maha Ghosananda was a charismatic leader since he has had a profound influence upon movements for peace around the globe through his advisory role in such NGOs as the International Network of Engaged Buddhists (INEB), the Buddhist Peace Fellowship (BPF), and the Ponleu Khmer,

the citizens' advisory council to the Cambodian Constitutional Assembly (Poethig, 2002).

The peace process in Cambodia nevertheless faced a number of challenges. First there was a lack of influential and active Buddhist leaders to encourage and direct Buddhist education. Some of the Buddhist leaders were seen by the public as working for a political party having a low level of Buddhist education. Some Key monk leaders suffer from the lack of knowledge of Buddhist philosophy. Even though some Buddhists monks made efforts for the post conflict peace building in Cambodia, some of the efforts carried out by the ordinary citizens failed because they didn't have a proper knowledge of Buddhism. Furthermore the importance of spiritual education was not being well identified by some NGOs and funding agencies. The resistance from the government was also identified as another limitation of the peace process. To avoid politicization, Yos Hut Khemacaro advocated them to follow the "Middle Path", the traditional metaphor for the Buddhist way - neither joining the fight nor hiding from it (Treasury of Truth, 2013). When Sri Lankan peace attempts faced problems due to the political polarizations, Buddhist leaders were unable to develop such fruitful mechanisms and strategies to tackle them (Frydenlund, 2005).

### **Conclusions, implications and significance**

The paper reveals the fact that Theravada Buddhism has a negative view towards violence. Therefore the vision of a peaceful life portrayed in the *Pali* canon can thus be useful for contemporary

Buddhist communities to understand the nature of human conditioning and realize the danger of emotional involvements in conflicts. The Buddhist message can transform violent contexts into more creative positive actions that are suitable for creating positive peace. In this way, Buddhism can be a useful tool for the post conflict reconciliation. The key issue faced by the current Sri Lankan society is how to build on and preserve that elusive peace. The paper suggests that Buddhism can be well utilized for building the war torn society in Sri Lanka. Therefore Buddhist monks and Buddhist activists should play a key role in sustaining the reconciliation process in Sri Lanka as in Cambodia. In this task greater attention should be paid to broadening the training of Buddhist monks regarding conflict transformation and peace building. Furthermore since there is an insistent need of Buddhism to go beyond the ethnic boundaries, interreligious linkages should be further strengthen. Finally, Buddhist scholars also have an ethical as well as an academic responsibility to interpret the clear meaning of the Buddhist message which promotes genuine peace in the society.

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# **[S7/04] Foreign Aid vs. Economic Development: Exploring the Empirical Linkage for India and Sri Lanka**

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## **Abstract**

*This study empirically examines the causal relationships between foreign aid (ODA) and economic development for India and Sri Lanka using the annual data 1960-61 to 2010-11. The study also aims to test the causal relationship among foreign aid with other macroeconomic variables such as domestic investment, financial sector development and trade performance of these countries. The empirical results show that there is a long run equilibrium relationship existing between foreign aid and economic development in both countries. However, the direction of inter-linkage between foreign aid and economic development contradicts to each other in case of India and Sri Lanka.*

**Keywords:** *Foreign Aid, Economic Development, India, Sri Lanka*

## **Introduction and research problem**

Foreign aid refers to external assistance from third parties - usually by the multilateral organizations and advanced economies to support a country's economic growth. The form of foreign aid is classified as humanitarian aid, where relief supplies and personnel are provided to support the immediate needs of a nation. This generally refers to the provision of emergency supplies of food and medicines in a war-torn

or disaster-struck country. The second form of foreign aid is known as Official Development Assistance (ODA) which supports to alleviate poverty for a longer period. Typically, ODA comes in the form of financial or technical support that develops a country's physical infrastructure such as education and health sector. There have been some instances where the recipients of ODA have utilized these funds to develop the nation's primary industries or to spur sufficient structural changes to attain long-term economic growth and development. South Asian region is the second poorest region in the world after Sub-Saharan Africa. It is the home of more than 1.59 billion population (22.9 % of total world population), which makes it both the most populous and most densely populated geographical region in the world (World Bank Report, 2011). It is a home to the half of the worlds' poor. Most countries of this region depend on foreign capital in general and on foreign aid in particular for their development process. Among these countries, India and Sri-Lanka are two major emerging developing nations of this region that attracted foreign aid. According to the World Bank, Sri Lanka has received a total of USD18.2 billion of net ODA since 1960. Despite of the social improvements, especially with regard to health and education, Sri Lanka's economic development still lags behind that of many of its East Asian neighbors. Furthermore, there are pockets where poverty has become increasingly entrenched, thus making income inequality even more pronounced. This trend questions the role and the sustainability of ODA in Sri Lanka's future economic growth. This study empirically examines the causal relationships between foreign aid (ODA) and economic development for India and Sri Lanka using the annual data 1960-61 to 2010-11. The study also aims to test the

causal relationship among foreign aid with other macroeconomic variables such as domestic investment, financial sector development and trade performance of these countries.

## **Methodology**

This study attempts to analyze, the impact of foreign aid on economic development of two selected aid recipient South Asian countries namely; India and Sri Lanka. In order to examine the impact of aid on development, annual time series data on some selected macroeconomic variables have been collected from 1960-61 to 2010-11 both in India and Sri Lanka. The variables include, in case of India, such as, Official Development Assistance (ODA), Gross Capital Formation (GCF) as a proxy of domestic investment, Trade, Per capita GDP (PcGDP) as an indicator of economic development, WPI as a proxy of inflation rate and Bank Credit (BC) as the proxy of financial development. In case Sri Lanka, the study uses same variables except Gross Fixed capital formation (GFCF) as domestic investment and Consumer Price Index (CPI) as inflation rate. These two countries are lower middle income developing nations in the south Asian region. Both the countries are dependent on foreign assistance for their economic development. We employ Johansen and Juselius (JJ) (Johansen and Juselius, 1990) procedure of testing for the presence of multiple co- integrating vectors. JJ method of multivariate approach is a well-established model to trace out co-integrating relationship between the time series variables. We use this approach to find out the co-integrating relationship between ODA, trade, bank credit, per capita GDP and WPI. The maximum likelihood approach of Johansen and

Juselius (1990) is used to establish whether there is a long-run relationship between the variables in the model. The model is based on the error correction representation.

To set the stage of causality test, the order of integration of the variable is initially determined using the ADF test. The testing procedures of ADF are based on the null hypothesis that a unit root exists in the autoregressive representation of the series. The result of unit root for all the variables in India and Sri Lanka are reported in table 3. It is clear that all the variables of India and Sri Lanka are non-stationary at levels and become stationary at first difference. Hence, hence all variables are integrated in order,  $I(1)$ .

## **Results and findings**

Having established the long run relationship (Engle and Granger, 1987), the next subsequent step for our analysis is two estimate causal relationships between our sample variables. In doing so, we have to employ pair wise Granger-causality test (Engle and Granger, 1969). Before that, it is necessary to select the optimal lag length by using different criteria. While determining lag length, econometricians have either fixed the lag length arbitrarily or chosen it through some statistical procedure. It is advisable to choose the lag length by using some selection criterion. Here, the study uses five lag order selection criterion such as Likelihood Ratio (LR), Final Prediction Error (FPE), Akaike Information Criterion (AIC), Schwarz Information Criterion (SIC) and Hannan-Quinn Information Criterion (HQIC).

The Granger-causality test is used to ascertain the direction of causality between ODA, GCF, Trade, WPI, BC and PcGDP in case of India and ODA, GFCF, BC, Trade, CP and PcGDP in case of Sri Lanka. This test assumes that the underlying time series data are stationary, i.e.,  $I(0)$  processes. Therefore, it is imperative to examine whether ODA, GCF, Trade, WPI, BC, GFCF, CP and PcGDP are stationary. Augmented Dickey-Fuller (ADF) test is employed to check the stationary property of these two variables. The test of co-integration ignores the effect of the past values of one variable on the current value of the other variable. So, finally, we tried the Granger causality test to examine such possibilities. Since the reliability of results of the Granger causality test depends on whether the variables are stationary or not, we first tested unit root of the variables using ADF test. The result of the unit root test is reported in table 1. It shows that all the variables are stationary on first difference. It is well-known that Granger causality test is sensitive to the choice of lag length.

In this paper, we have set four hypotheses to find out the causality. First, PCGDP has causal relationship with ODA, which indicates the economic development of the country attract more ODA inflows. The result shows that, we can reject the null hypothesis that PCGDP does not Granger cause ODA at 5% level, whereas the null hypothesis that ODA does not Granger cause PCGDP at 1% level. Thus, there is one-way causality between two variables. This result seems to reinforce, the hypothesis of complementarity between PCGDP and ODA for India. On the other hand, we didn't find any causality in either direction between ODA and PCGDP. This result is interesting and supports our theory. The economic development (PCGDP) in India

attracts more foreign aid (ODA) inflows through and foreign aid (ODA). It is clear that, there is an evidence of uni-direction Granger causality between BC and ODA. This result supports our theoretical debate. Further, it suggests that the performance of financial development (BC) stimulates more ODA inflows in India and also foreign aid (ODA) inflows encourage trade and economic development of the country. The financial development in the country encourage ODA inflows whereas, the reverse is not true.

Thus, ODA inflows into India are not motivated automatically, but rather motivated by pull factors i.e. the development financial infrastructure and liberalize external sector policy. Third, we find there is bidirectional causality between trade (TR) and ODA. These results also support our theory. It shows that, more ODA inflows encourage trade performance of the country. The trade liberalization and trade performance of the country attract more ODA inflows in last two decade. Fourth, the result of Granger causality test between the domestic investment (GCF) and foreign aid (ODA) for India indicates that there exists uni-directional causality between two. However, the causality between GCF and ODA indicates that the domestic investment is stronger in India which helps to attract more ODA inflows. On the other hand, ODA inflows into India have not much significant impact on domestic investment. We also find the casual relationship exist among the few pair of macroeconomic variable such as GCF with BC, PCGDP with BC, TR with BC, WPI with BC, PCGDP with GCF, GCF with trade, WPI with ODA and TR and PCGDP.

### Long run Equation:

#### Equation (1)

$$\text{LODA}_t = 57.71 + 11.57 \text{LPCGDP}_{t-1} - 0.980 \text{LGCF}_{t-1} + 2.712 \text{WPI}_{t-1} - 0.942 \text{LBC}_{t-1} - 5.202 \text{LTR}_{t-1}$$

(2.51)                      (-0.42)                      (3.29)                      (-0.82)                      (-4.16)

The results in equation (1) denote the long run relationships between foreign aid and explanatory variables. It is empirically found that both economic growth (PCGDP) and inflation (WPI) have positive and significant impacts on foreign aid in the long run, while trade openness (TR) has adverse significant effect on aid. On other hand, although both capital formation (GCF) and financial development (BC) are negatively influencing the foreign aid but their effects are insignificant. Moreover, the positive effects of growth and inflation on foreign aid could be due to the presence of better economic environment.

We also test four hypotheses in case of Sri Lanka. First, we find ODA has causal relationship with PCGDP, which indicates the foreign aid has positive impact on economic development of Sri Lanka. Sri Lanka's economic development is fully depending on foreign capital and particularly foreign aid (ODA). The economy is highly depending on foreign aid from both bilateral donor and multilateral donor. The result shows that, we can reject the null hypothesis that ODA does not granger cause PCGDP at 5%, whereas the null hypothesis that PCGDP does not granger ODA at 1% level. This result contradicts with in case of India. Second, our hypothesis is to find out the causal relationship between ODA and BC. It is clear that, there is an evidence of uni-direction Granger causality between ODA and BC. The result supports our theory. More ODA Inflows to Sri Lanka helps the financial

development. The financial development in Sri Lanka is so weak which unable to attract more ODA flows. However, the more ODA inflows directly help the financial development of the country. This result also contradicts with India. Third, ODA has causal relationship with trade (TR). The ODA inflows into Sri Lanka enforce the trade performance. The trade performance and trade liberalization policy in Sri Lanka is so weak which unable to attract more ODA inflow. It shows the trade performance in Sri Lanka is not like India. Fourth, the result of Granger causality test between ODA and domestic investment (GFCF) for a Sri Lanka indicates that there exists uni-directional causality between two. However, ODA inflows into Sri Lanka help for the domestic investment. We also find the casual relationship exist among the few pair of macroeconomic variable in this study such as BC with CP, CGCF with CP, ODA with CP, TR with CP, GFCF with BC, PCGDP with BC, TR with BC and TR with GFCF. Aid helps in raising the GDP growth rate through structural transformation of the economy, laid foundations of the industrial and agricultural sectors, provided technical assistance, helps in implementing various developmental projects, bringing various policy advice and modern technology, assisted in overcoming the budget deficit. On the other hand, its underutilization and unproductive uses, raises the fear of debt burden for future.

### **Long run Equation**

$$\text{LODA}_t = 131.60 - 5.43 \text{LPCGDP}_{t-1} + 4.40 \text{LGCF}_{t-1} + 5.89 \text{LCP}_{t-1} + 5.80 \text{LBC}_{t-1} - 2.71 \text{LTR}_{t-1} \quad (2)$$

(-1.33)
(-3.75)
(4.15)
(3.99)
(-1.69)

The result in equation (2) explains the foreign aid (ODA) have no effect on financial development, inflation (CP) and negative effect on

capital formation (GCF). Higher the foreign aid inflows help for the financial development and consequently it induces inflation (CP) of the country. More foreign aid inflows have negative and significant effect on capital formation of Sri Lanka economy. This result is very interesting and supports the theories of foreign aid on development. However, foreign aid (ODA) negatively affects the economic development (PCGDP) and trade openness (TR) of the country.

#### **4. Conclusions, implications and significance**

It is clear that foreign aid is one of the major factors contributing to the development process of both India and Sri Lanka. Both the countries need to maintain high growth to create more employment opportunity and to reduce poverty. Considering the long run causal linkage among foreign aid, trade performance, financial sector development, domestic investment and economic growth, both the countries should focus on the efficient utilization of foreign aid where the rate of return should be greater than rate of investment. The study suggests that the government has to be more concerned about its efficient utilization rather than its amount of inflows. The government of India should further try to raise its growth rate and liberalize its external sector to attract foreign capital i.e. foreign aid and FDI inflows. The government of Sri Lanka should focus on the efficient utilization of foreign aid in some productive activities, directly linked with the welfare of the people. Both the countries adopt outward-looking development strategy through appropriate measures such as more flexible labour market, political stability, infrastructural facilities, human capital generation, institutional efficiency and good macro-economic policies

to attract more foreign capital. The empirical results for India reveal that higher economic development contributes to more inflows of foreign aid. Adding to this, financial sector development, better trade performance and domestic investment act as motivational factors to attract more amount of foreign aid to India. In case of Sri Lanka, the situation is just reverse. The empirical result shows that foreign aid has significant positive impact on economic development of Sri Lanka. The result also shows that higher amount of foreign aid inflows lead to higher economic development, better trade performance, development of financial sector and supplements to domestic investment in Sri Lanka.

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**Session-8**  
**Statistical**  
**Models for**  
**Agro-Products**



## [S8/01] Assessing the Production vs. Price of Black Tea in Sri Lanka: An Application of Koyck's Geometric-Lag Model

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### Abstract

*The quantity of food and agricultural products manufactured depends on various agronomic and socio-economic factors that are exogenous and endogenous to the production function. However, amongst all determinants, own price of the product in concern plays a significant role. Price analysis of key food and agricultural products involved with trade is, therefore, crucial for economic decision making. In light of this, tea being a major contributor of the Sri Lankan economy, the purpose of this study was to examine the potential relationship between the production and prices of black tea in Sri Lanka. Time series data, on monthly basis from January 1991 to December 2011 (n=252), on production and prices of black tea was analysed using the Koyck's Geometric-lag model considering the geometric decline of past and current effects of price. STATA (version 11) statistical software was used to evaluate the price to production responses in three main elevations, i.e. High, Mid, and Low grown tea. The results show that prices fetched at the Colombo auction impose a great impact on production levels. Further, the time taken for an advance in price to have a complete effect on production was an average lag period of two to three months. The outcome of analysis, further, indicates that the actual and expected levels of production were almost similar in most of the months during this period, and the gap between actual and estimated production increased throughout the period, i.e. an increasing trend.*

**Keywords:** Agricultural price analysis, Black tea, Koyck's Geometric-lag Model, Time-series data

## **Introduction and research problem**

Tea, being one of the main foreign exchange earning agricultural products in Sri Lanka, is of high importance to the economy. Currently, it accounts for about 2% of the Gross Domestic Product of the country. Sri Lankan tea, historically, is divided into three groups based on the geographical location as: High, Mid, and Low grown. The production of tea in Sri Lanka in 2012 was 328.4 Mn. Kg. On average, more than 90% of tea produced in Sri Lanka is exported. Tea is primarily sold in auctions, where the auction prices vary with both quality and quantity on offer, and the demand at any given time. The average price for black tea was Rs. 391.64 per Kg in 2012, and the price fetched at the auction for a 1 Kg of black tea shows a decreasing trend during the past two decades (Ministry of Plantation Industries, 2012).

Economic theory assumes that, under perfect market conditions, an improvement in prices received in the market would result in an increased output. This phenomenon, i.e. the “reaction” of agricultural production to the market price, is considered in many different empirical assessments carried out in the discipline of food and agricultural economics, since it is claimed that for most of the agricultural products, especially those plantation crops like tea that takes a relatively long time to complete its production cycle (i.e. from planting to plucking), this mechanism does not take place in the way it is hypothesized, and alternatively, it might show a “cob-web” type behaviour. In fact, historically, for the case of production of black tea, it was evident that the production fluctuations were greater than the prices and vice-versa for different periods of time. In light of this, the

study was aimed to capture, from econometric point of view, the potential relationship between production and prices of black tea, and in turn, to determine the time it would take for a change in price to have a complete effect on production.

## Methodology

As per economic theory, during the period of high prices, producers tend to produce more. Hence, the current and recent past prices affect the current production. Due to this structural feature, production versus price can be studied using Distributed Lag Models (Gujarati, 2004). In light of this, L. M. Koyck (1954) suggested a method on the assumption that lags in the independent variable affect the dependent variable to some extent and the weight decrease geometrically such that:

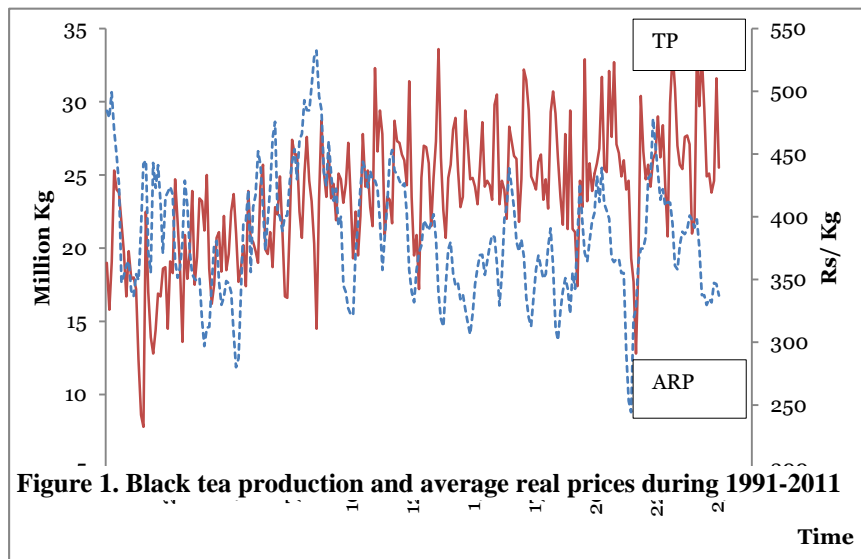
$$Y_t = \alpha (1 - \lambda) + \beta_0 X_t + \lambda Y_{t-1} + (u_t - \lambda u_{t-1}) \dots \dots \dots (1)$$

Where, for the purpose of this analysis:  $Y_t$  – black tea production;  $X_t$  – black tea price;  $u_t$  and  $u_{t-1}$  – error term;  $\alpha$ ,  $\beta$  and  $\lambda$  – parameters. The average lag length proposed by the model is:  $\lambda / (1 - \lambda)$ , which is the time period required for a unit change in the defining variable to have a detectable effect on the dependent variable (Koutsoyiannis, 1977). Having specified this model with all relevant variables and specifications, the Classical Least Square methods were used to estimate the parameters of the Koyck's Geometric-lag model using STATA (*version 11*) statistical package.

The secondary data on monthly black tea production during the period of 1991 to 2011, for each elevation (i.e. Low, Medium, High) covering 252 months reported in the Statistical Bulletin (2011) published by the Sri Lanka Tea Board along with the Colombo Consumer Price Index (CCPI) for each month from in the Annual Reports of Central Bank of Sri Lanka were used.

## Results and Findings

Changes in the black tea prices result in fluctuations in the production over the period of concern; however, the prices show a decreasing trend, while the production demonstrates an increasing trend (Figure1).



The outcome of the econometric analysis suggests that  $R^2$  values, which reflect the overall goodness-of-fit of the model specified for the total national production was 79.8%. Further, the price coefficients

were positive and significant where, a 1 Rs. /Kg increase in black tea price increased the production of which by 0.01 Mn. Kg. Lagged production coefficients were seen to have a positive and significant effect on production, where, an increase of 1 Mn. Kg of black tea production in the previous month increased the black tea production of the current month by 0.72 Mn. Kgs.

According to the Mean Lag number, the time required for changes in black tea prices to have a significant and detectable effect on black tea production was 2.5 months. Overall, the outcome of analysis highlights that black tea production responds to black tea prices within a very short lag.

### **Conclusions, implications and significance**

The potential relationship between black tea production and prices was studied in this analysis for the period of 1991 – 2011 using the Koyck's geometric-lag model, where the amount of tea produced was taken as the dependent variable, and black tea price and lag value of black tea production were the defining variables. Overall, the results suggest that the price had a positive influence and a lagged effect on production. Black tea prices, in particular, have a significant and a detectable effect on its production, which showed a two and a half month lag, on an average. The average lag length of 2.57 for the total national production suggests that, it adjusted to the average tea price within a relatively short time as well. In conclusion, considering the average lag period, this proves that black tea producers were responding quickly to

the black tea prices; hence, price uncertainties result in fluctuations in the black tea production industry.

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[S8/02] **Are Healthy Foods Expensive in Sri Lanka?  
Implications for Food Trade Policy**

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**Keywords:** *Healthy Food, Energy density, Energy cost,  
Trade liberalization*

### **Introduction and research problem**

The developing world currently experiences a dual burden of malnourishment, i.e., under- nourishment and over-nourishment. Changing dietary patterns due to food trade liberalization, urbanization, liberalization of media advertising, supermarketization etc. is considered as one of the primary factors causing this health burden. Popkin (1997) suggests that the world is witnessing a nutrition transition and this rapid change in diet is linked with rapid increase in chronic diseases specifically in the lower and middle-income countries. Further he explains nutrition transition addresses a broad range of socioeconomic and demographic shifts that bring rapid changes in diet.

Sri Lanka provides an interesting case in this global debate. On the one hand, nearly half of the population(50.71%) remains on less than minimum level of energy consumption per day and on the other hand, 71% of all deaths are due to non-communicable diseases\* in 2001. These trends suggest that chronic non-communicable disease mortality rate is rapidly increasing over the past decades. Intake of unhealthy diets that are high in sugar content, high in salt content, high in trans fatty acids and saturated fat are considered as the main risk factor for non-communicable diseases (National Policy and Strategies Framework for Prevention and Control of Chronic Non-Communicative Diseases, 2009). Higher dietary energy density is associated with unhealthy food choices (Bolaric and Satalic, 2013) and it was found that unhealthy foods such as red meat increase the risk of heart disease, stroke and diabetes (Department of Public Health, Harvard University, 2014).

The country is heavily depending on imports to meet its food requirement and imports are subjected to various tariff and para-tariff restrictions. It has been claimed that food import liberalization increases accessibility of unhealthy food.

The objective of this study is to investigate the extent to which the access to healthy food items is influenced by food trade policies of the country by taking a sample of commonly consumed food items in Sri Lanka. Energy density is considered as a proxy for healthiness of food

item and cost of unit energy and the effect of tax structure on prices are used to explain affordability in terms of price.

## Methodology

A higher dietary energy density is associated with unhealthy food choices and energy density is an indicator for food quality. Thus, Energy density which is expressed in kJ/gram, a measure of available energy per mass unit of a particular food is considered as a proxy to indicate healthiness of food items (Bolaric and Satalic, 2013). Data on Energy density of food items were collected from Nutrient data by USDA SR-21 available at <http://nutritiondata.self.com/facts>. Where appropriate, nutrition information declared on the food product was used for the information of energy density.

Data on food prices and amount of food consumed was gathered from the Household Income and Expenditure Survey (HIES) preliminary report of Department of Census and Statistics 2012/2013 and calculate the energy cost (Rs/kJ) in order to explain the food affordability in terms of energy cost and to establish the relationship between energy density and energy cost computing Pearson correlation. Finally, the impact of trade taxes charged on importable food items was compiled and the extent to which trade taxes escalated food prices was examined. Data on import taxes was collected from publications of Department of Customs.

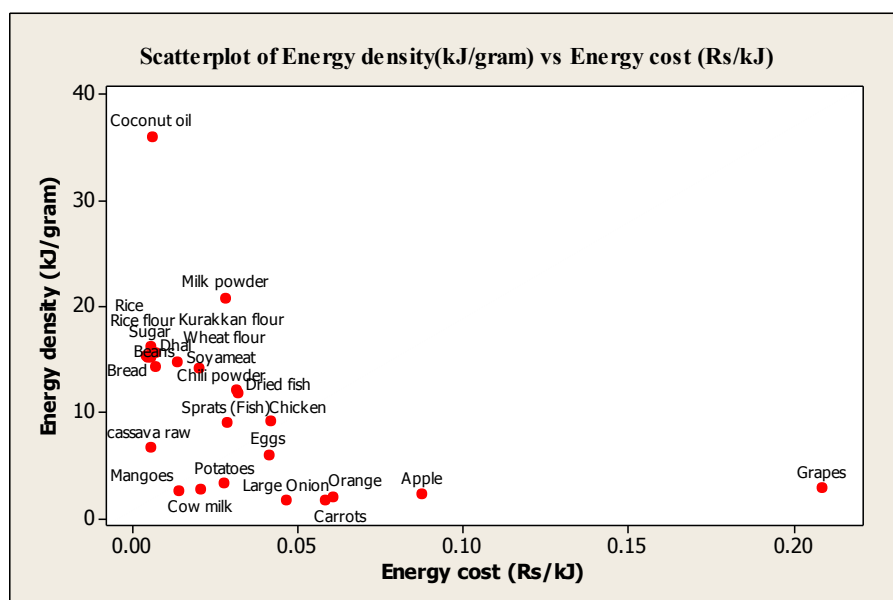
*\*Non-communicable diseases (NCDs), mainly cardiovascular diseases, cancers, diabetes, obesity and chronic respiratory diseases, represent a leading threat to human health and human development in today's world (World Medical Association)*

## **Results and findings**

The results of the budget share calculations reveal that rice, milk powder, coconuts, chicken, bread, sugar, wheat, dhal and edible oil are the top most energy sources of the country comprising with higher budget shares. Price changes of commonly consumed food items were calculated to understand the price fluctuations of food items in general. Results indicate that there is a price hike for most of the food items including wheat flour, bread, coconuts, sugar, fish and for fruits such as mango and apple. However, there is a price dropdown for cow milk, dhal and rice.

The analysis of relationship between energy cost and energy density for commonly consumed food items reveal that there is a negative correlation between energy density and energy cost. This depicts food items that are high in energy density are cheaper compared to food items with low energy densities. For instance, items having lower energy densities are costly (grapes and apples) and low energy cost items have higher energy densities (Kurakkan and cassava).

Further, a disaggregated level analysis was carried out for different food groups according to the categories specified by HIES. Results reveal that there is a positive relationship for energy density and energy cost for cereals, fats and oils, meat and fish which implies higher the energy density higher the cost in consuming above food items. Conversely, a negative correlation is observed for milk products, pulses, vegetables, yams, eggs, condiments, fruits and confectionary food items.

**Figure 01: Relationship between energy density and energy cost for selected food items**

Though a similar relationship is visible for importable, the results reveal that their consumption levels can be regulated through import taxes.

**Table 1: Food energy price and energy cost**

Food category	Correlation coefficient
All (n=135)	-0.180**
Cereals (n=14)	0.105
Milk Products (n=7)	-0.717*
Fats and oils (n=3)	0.900
Pulses (n=8)	-0.073
Vegetables (n=33)	-0.466***
Yams (n=6)	-0.267
Meat (n=5)	0.157
Fish (n=14)	0.238
Eggs (n=2)	-1.000
Fruits (n=19)	-0.214
Confectionaries (n=5)	-0.199
Condiments (n=11)	-0.710**

\*\*\* for significance at 1%, \*\* for significance at 5%, \* for significance at 10%

Rice which is the highest expenditure item with a budget share of 32.92% has a very high energy density. However it is a least cost calorie source. Milk powder which is the second highest expenditure item has a very high energy density with considerably lower cost. Bread has a relatively higher budget share and high energy density but very low cost calorie source. Apples and oranges have very low energy densities and hence are not prominent in the diet as they are costly due to the high tax rates. Coconut oil and sugar are very high in energy densities and are prominent in the diets and are relatively cheap because they are currently taxed at lower levels.

**Table 02: Tax rates of selected food items**

<b>Commodity</b>	<b>Budget Share (%)</b>	<b>Energy density (kj/gram)</b>	<b>Energy Cost (Rs/kJ)</b>	<b>Tax</b>
Rice	33%	15.27	0.0041	38%
Milk Powder	11.23%	20.75	0.0284	7%
Bread	6.10%	15.1	0.0056	30%
Apples	0.46%	2.18	0.0877	53%
Orange	0.17%	1.97	0.0607	93%
Edible oil	4.67%	36.07	0.0062	56%
Sugar	6.47%	16.19	0.0058	12%
Wheat Flour	2.71%	15.23	0.0045	37%

Source: Survey Data

In summary the highly energy dense items (edible oil and sugar) have relatively smaller taxes (7% - 30%) and less energy dense foods (apples, oranges and grapes) are having larger taxes (50% - 100%). Therefore reducing import taxes from exotic fruits and charging high import taxes from coconut oil, sugar and milk powder considering trade-offs among health, economic efficiency and poverty issues is

important to promote a healthy diet through government regulations.

### **Conclusions, implications and significance**

The relationship between energy density and energy cost is negative for commonly consumed food items in Sri Lanka which is a common scenario in the contemporary world and this is shown by many researches (Drewnowski and Specter, 2004; Bolaric and Satalic, 2013). This means that healthy food items that are low in energy density are expensive and therefore less affordable compared to unhealthy food items that are high in energy density. High price of unhealthy food items can be considered as an incentive to consume unhealthy foods since consumers are primarily price sensitive in the developing world context.

This negative relationship is true not only for locally consumed food items but also for importable. However the price of imported food items escalated through the imposition of taxes. According to the findings higher tax rates are associated with low energy density food items that are healthier. Moreover, taxes are imposed on healthy food items (especially fresh fruits) compared to unhealthy food items and ultimately the government is indirectly influencing the rise of demand for unhealthy food unconsciously and unintentionally.

Therefore, a visit of import tax schedule (charging higher taxes on unhealthy food and visa-versa) can be suggested in order to increase

the healthy food consumption as a practical and applicable strategy along with other necessary steps.

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## [S8/03] **Forecasting Fish Prices in Colombo with SARIMA Model**

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### **Abstract**

*Fish is a major animal based protein source which provides more than 50% of animal protein requirement of people in the country. However it is claimed that fish prices are increasing day by day. Frequent price fluctuations of fish has created many marketing issues in fish industry. Thus studying price behaviours and forecasting future fish prices will be very important for economists, policy makers, traders, consumers, fishermen, importers and processors for various purposes and these were the main objectives of this study. The time series econometric techniques based on SARIMA models were employed in finding a parsimonious model for better forecasts. It was found that some higher order SARIMA models were able to parsimoniously track the dynamic behaviour of conditional mean real fish prices with acceptably accurate forecasts. Moreover, it was revealed that, although nominal fish prices were increasing, real prices looked steady. A Seasonal pattern of fish real prices were found where higher prices were observed during the middle months of the year.*

**Keywords:** Fish industry, Forecasting, Real prices, SARIMA model

## **Introduction and research problem**

The fisheries sector plays a vital role in the economy of Sri Lanka contributing to around 1.8% to the GDP (Anon, 2012). Fish products are an important source of animal protein, providing around more than 50% of the animal protein consumed in the country. The contribution of the marine fisheries segment to the fisheries sector is around 86%. The major characteristics of the consumption patterns of fresh fish reveal that most commonly preferred varieties of large pelagic were Skip jack tuna, Sail fish and Yellowfin tuna. Among small pelagic species, Trenched Sardinella and Sardine were the most commonly preferred varieties. The average quantity of fresh fish consumed by a person was reported as 18.28g per day (Anon, 2010). Moreover, different fisheries sector sources mention that wholesale and retail prices of fish has gradually increased over last five years and prices of fish considerably higher than other animal based food commodities (Anon, 2012).

Modelling and forecasting fisheries prices is important to all the stakeholders engaged in the sector for better decision making. Various techniques *viz.* decomposition techniques, Ordinary Least Square method (OLS) and Box-Jenkins Autoregressive Integrated Moving Average (ARIMA) models have been used to explain the forecasting performances of prices in economics. However ARIMA model cannot handle the seasonal variations. Although decomposition methods and smoothing techniques have been commonly used for this purpose rigorous theoretical justifications and underlying model structures are

not available. Floros and Failler (2006) have used Seasonal Autoregressive Integrated Moving Average (SARIMA) models for forecasting monthly fisheries prices in UK which can handle seasonal variations also. However there are no such rigorous and updated models available in the literature for forecasting and studying the dynamic behaviour of fish prices in Sri Lanka. With this background this study was carried out with the objective of identifying appropriate time series models for studying dynamic behaviour and forecasting of fish prices.

### Methodology

The average weekly Colombo retail prices of five commonly used fish types, namely Sail fish, Trenched Sardinella, Seer, Sardine and Skipjack tuna were collected during the period from 2000 to 2013 from Hector Kobbekaduwa Agrarian Research and Training Institute (HARTI) and used in the analysis.

Nominal prices of fish were converted into real prices to avoid impacts of the inflation using Colombo Consumer Price Index (CCPI) as the price deflator. However, CCPI was available in two base years; 1952 and 2006/07. CCPI of 1952 base year was converted into 2006/07 base year using a conversion factor ( $\gamma$ ) which is depicted in equation 1.

$$\gamma = \frac{1}{T} \sum_{t=1}^T \frac{CCPI_{j,1952=100}}{CCPI_{j,2006/7=100}} \quad (1)$$

where,  $t=1,2,\dots,T$

Suppose, nominal price at time  $t$  is  $pn_t$  and real price at time  $t$  is  $pr_t$ , where  $t = 1, 2, \dots, T$ . Then  $pr_t$  can be defined as depicted in equation 2.

$$Pr_t = \frac{Pn_t}{ICCPi_t} \quad (2)$$

where,  $ICCPI_t = \frac{CCPI_t}{CCPI_T}$ . ICCPI<sub>t</sub> can be interpreted as the ratio between CCPI at time t and CCPI at time T which is the most recent value of CCPI in series.

Preliminary investigation was done using summary statistics, time series plots, Autocorrelation Function (ACF) and Partial Autocorrelation Function (PACF). Stationarity was checked using Augmented Dickey Fuller (ADF) test, Kwiatkowski Phillips Schmidt Shin (KPSS) test, AFCs and PACFs. Seasonality and stationarity with respect to seasonality were identified using respective ACFs and PACFs. Seasonal indices were calculated employing the decomposition techniques.

In this study we fitted the SARIMA model (Shumway and Stoffer, 2006) to the real fish prices since it can handle the seasonal variations over the ARIMA model. The underlying model structure can be describe as depicted in equation 3

$$\Phi_P(B^S)\phi(B)\nabla_S^D\nabla^d y_t = \alpha + \theta_Q(B^S)\theta(B)\varepsilon_t \quad (3)$$

where,  $\varepsilon_t$  is a Gaussian white noise process.  $\phi(B)$  and  $\theta(B)$  are the ordinary autoregressive and moving average operators of orders p and q.  $\Phi_P(B^S)$  and  $\theta_Q(B^S)$  are respectively seasonal autoregressive and moving average operators of order P and Q. Ordinary differencing component is defined as  $\nabla^d = (1 - B)^d$  while seasonal differencing component is defined such that  $\nabla_S^D = (1 - B^S)^D$ .

Preliminary models were identified using respective ACFs and PACFs while identifying appropriate order of differencing based on results of tests for stationary. Model fitting was done using R package “tseries”. Model selection was done based on least Corrected Akaike Information Criterion (AICc). Diagnostic checking of the selected model was done through a residual analysis based on residual plots, normal probability plots of residuals, ACFs, PACFs of residuals, squared residuals and Ljung-Box test on serial dependencies. Based on results of diagnostic checking final models were selected. Forecasting and forecasting efficiency based on least Mean Absolute Percentage Error (MAPE) was obtained. For computing MAPE, data from 2000 to 2012 was regarded as the training data set while data from 2012 to 2013 was used for validation.

## **Results and Findings**

Average real prices of Sail fish, Trenched Sardinella, Seer, Sardine and Skipjack tuna were rupees 820.09, 334.45, 1160, 203.81 and 485.61 respectively. Seer showed the highest average prices with a high standard deviation and Sardine was reported the least average price. Most of the minimum fish prices were seen in the first few weeks of 2005. It might be due to “negative consumer reaction” on the domestic consumer demand for fresh fish during the post tsunami days (Subasinghe, 2005). Kurtosis refers to the degree of peak in a distribution which was lesser than 3 for all types of fish. It can be interpreted that distributions of fish prices were flatter than the standard normal distribution which indicated wider spread of real prices around its average price.

Although nominal fish prices showed a clear increasing trend, there was no such increasing trend in real fish prices in the time series plots. Consequently, the trend perceived in the nominal fish prices as a consequence of rising inflation. This matter should be considered by the policymakers when sectorial policies are made especially regarding pricing and regulatory policies.

According to the ADF test all real price time series were stationary. However, KPSS test reported that except Trenched Sardinella and Sardine series, other real price series were non-stationary. By matching these results with ACFs and PACFs, found that except the Sardine, all other real price series were non-stationary. Once first order differenced real price series of fish prices, except for Sardine was investigated by using ADF, KPSS tests and ACFs and PACFs, it was found that first order differencing is adequate to make respective series stationary. Moreover, the ACFs and PACFs of first order differenced series were indicated that seasonal differencing is required for all series.

The best fitted models of Sail fish, Trenched Sardinella, Seer, Sardine and Skipjack tuna were  $(4,1,3)(0,1,1)^{52}$ ,  $(3,1,3)(1,1,1)^{52}$ ,  $(4,1,3)(0,1,1)^{52}$ ,  $(3,0,4)(0,1,1)^{52}$  and  $(4,1,3)(0,1,1)^{52}$  consequently. These models selected based on least AICc were 6848.18, 6681.10, 8192.89, 6388.77 and 6953.99 respectively. Fairly high orders for ordinary AR and MA parts of the models were indicated present real prices are significantly serially dependent on the variability of real prices prevailed during past few weeks. The variability of real fish prices observed in several weeks at present would diffuse into the next

week fish prices. This is very important information for stakeholders engaged in the sector for planning and making decisions better. As depicted in the seasonal component of models, present seasonal variability in real fish prices was dependent on the variability observed in the previous season where the seasonal length is 52 weeks.

**Table 1. Price forecasts and actual prices**

Fish Type	Point Forecast	Confidence Interval (95%)		Actual Price
		Low	High	
Sail fish	859.06	790.91	927.20	869.39
	862.20	779.99	944.41	861.85
	849.90	760.81	938.98	864.59
	837.71	745.35	930.06	814.11
	828.31	731.29	925.32	814.45
Trenched Sardinella	316.05	254.70	377.39	306.38
	335.33	266.64	404.02	302.02
	331.07	258.55	403.58	315.09
	328.61	253.12	404.09	297.17
	340.88	262.32	419.44	313.19
Seer	1408.00	1222.00	1594.00	1457.00
	1391.00	1172.00	1611.00	1437.00
	1399.00	1165.00	1633.00	1278.00
	1303.00	1061.00	1544.00	1197.00
	1326.00	1074.00	1578.00	1149.00
Sardine	183.97	134.68	233.26	194.31
	189.53	132.73	246.32	190.96
	176.29	117.58	235.00	195.66
	180.68	119.26	242.09	168.44
	182.16	117.95	246.37	155.42
Skipjack tuna	579.60	504.70	654.49	553.79
	580.03	492.79	667.27	531.48
	587.01	494.53	679.49	503.79
	550.96	455.26	646.66	422.51
	567.37	467.65	667.08	433.69

MAPE of Sail fish, Trenched Sardinella, Seer, Sardine and Skipjack tuna were 8.53, 13.83, 8.26, 20.11 and 11.07 respectively. Models of Sail fish and Seer are good indicators that these models would produce more accurate forecasts. Models of Trenched Sardinella and Skipjack tuna real prices have comparatively high forecasting accuracy compared to Sardine. Price forecasts for first five week in year 2014

are given in Table 1. Forecasts were acceptably close to their actual figures. All actual prices were included in 95% confidence limits of the price forecasts. Seasonal indices of real prices indicate the seasonal behaviour. According to that all fish prices were tend to be high during the middle few months of the year.

### **Conclusions, implications and significance**

The apparent increasing trend in fish prices is governed by the rising inflation rather than issues in the fish industry which should be considered by policy makers. Fish prices would tend to be high during the midyear. The findings suggest that SARIMA models can be used for forecasting fish prices reliably. It can be concluded that the price information available in few present weeks (3-4 weeks) would diffuse into the next week determining fish prices of the week. This can be utilized by stakeholders of the industry for planning and making efficient decisions. However more research is needed to determine the reasons for the seasonality and behaviour of prices explained by the models and their consequences.

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[S8/04] **Estimating technical efficiency of vegetable farmers in the Anuradhapura district in Sri Lanka**

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**Abstract**

*Promotion of economic efficiency is an important policy goal for the entire agricultural sector. This study aims at delivering empirical evidence on the level of technical efficiency of vegetable farmers by analysing farm level data covering approximately 450 vegetable farmers in Anuradhapura district in Sri Lanka. The study focuses only on commercial level vegetable farmers who cultivate only different type of vegetables varieties in their farms. The empirical results indicate that more than 80 % of the sampled farmers were less than 55% technically efficient. It was also found that farming experience, household size, agricultural extension services and level of educational attainment reduces technical inefficiency, while farmers' age increases technical inefficiency. Policies that would improve farmer's educational status through adult education and agricultural extension services would increase technical efficiency of vegetable farms in the long term.*

**Key Words:** *Technical efficiency; Vegetable farmers; Stochastic frontier production*

## **Introduction and research problem**

Technological innovation and the more efficient use of existing technologies are the main strategies of achieving higher level of output in agriculture (Hoang and Coelli, 2009). However, in developing countries most new agricultural technologies have only been partially successful in improving productivity. This is often due to a lack of ability or desire to adjust input levels by the producers because of their familiarity with traditional agricultural systems or because of institutional constraints (Binam et al., 2004). These considerations suggest that the best option to assist developing countries to raise productivity is increasing efficiency. If farmers are not effectively using existing technology, then efforts designed to improve efficiency may be more cost-effective than introducing new technologies. The presence of shortfalls in efficiency means that output can be increased without requiring additional conventional inputs and without the need for new technology. If this is the case, empirical measures of efficiency are needed to determine the magnitude of the gains that could be obtained by improving performance in agricultural production with a given technology. In this research farmers' ability to select a production system and its relationship with farm level technical efficiency is investigated.

There are several important reasons for measuring the farm level technical efficiency of agricultural production. Firstly, if farmers are not making efficient use of existing technologies, then efforts designed to improve efficiency would be more cost effective than introducing a new technology as a means of increasing output. Secondly, measuring

efficiency leads to sustainable resource savings, which has important implications for both policy formulations and farm management. Thirdly, it is only through measuring efficiency and separating its effects from the effects of the production environment that one can explore hypotheses concerning the sources of efficiency differential. Fourthly, identification of sources of inefficiency is important to the institution of public and private policies designed to improve performance of agriculture.

Vegetable is an important sector in Sri Lanka as it contributes to around 11% to the total agriculture production. Vegetables are cultivated by more than two million family units in the island. In Sri Lanka the total vegetable cultivated land area is approximately 150,000 hectares. It is 10.1% from the total agricultural land. This research project aims at delivering empirical evidence on the level of technical efficiency of vegetable farmers by analysing farm level data covering approximately 450 vegetable farmers in Anuradhapura district in Sri Lanka. The study focuses only on commercial level vegetable farmers who cultivate only different type of vegetables varieties in their farms. To the best of my knowledge, this is one of the first attempts at investigating farm level technical efficiency of vegetable farmers in Sri Lanka.

## **Methodology**

Empirical model of estimating technical efficiency in this study will be based on the stochastic production function proposed by Battese and Coelli (1995). In the first phase of the empirical analysis, technical efficiency effects on a cross section of farmers will be modelled in

terms of input variables in the production process. We used Cobb-Douglas production function and the estimation was performed using Frontier version 4.1 (Coelli, 1996). Accordingly, the stochastic frontier model to be estimated is defined by:

$$\ln Y_i = \beta_0 + \sum_{i=1}^4 \beta_i \ln X_i + V_i - U_i$$

where,  $\ln$  represent the natural logarithm. The subscript  $i$ , indicates the  $i^{\text{th}}$  farmer in the sample ( $i = 1, 2, \dots, n$ ).

$\ln Y_i$  represents the natural logarithm of the value of farm output

$\ln X_1$  represents the natural logarithm of the total area of land (in acres) under cultivation

$\ln X_2$  represents the natural logarithm of labour in man dates

$\ln X_3$  represents the natural logarithm of capital expenditure

$\ln X_4$  represents the natural logarithm of other cost: raw materials

$\beta_j$ 's are unknown parameters to be estimated

$V_i$ 's are assumed to be independent and identically distributed normal random errors having zero mean and unknown variance;  $\sigma_v^2$ ;  $U_i$ 's are non-negative random variables, called technical inefficiency effects, which are assumed to be independently distributed such that  $U_i$  is defined by the truncation (at zero) of the normal distribution with mean,  $\mu_i$  and variance  $\sigma_u^2$ . The model for the technical inefficiency effects specifies that the technical inefficiency effects of the stochastic frontier are a function of socio-economic and institutional factors (age, education, household size, number of separate plots, agricultural extension services, credit access, membership of a farm organization,

land ownership...etc.). Some of these variables are assumed to be directly related to farmers' management skills, while the others could impact on their technical efficiency through availability of labour for timely management of farming activities or incentives for increasing efficiency in farms. This can be written as:

$$U_i = \alpha_0 + \alpha_1 Z_{1i} + \alpha_2 Z_{2i} + \alpha_3 Z_{3i} + \alpha_4 Z_{4i} + \alpha_5 Z_{5i} + \alpha_6 Z_{6i} + \alpha_7 Z_{7i} + \alpha_8 Z_{8i} + \alpha_9 Z_{9i} + g_i$$

$Z_{1i}$  is the age of the responded in years (AGE)

$Z_{2i}$  is the formal education of the responded in years (EDU)

$Z_{3i}$  is the household size (HS)

$Z_{4i}$  is extend of irrigated area (RFH)

$Z_{5i}$  is farming experience in years (FE)

$Z_{6i}$  is agricultural extension services contacts(AEC):Dummy variables if Yes 1, else 0.

$Z_{7i}$  is credit access : Dummy variables if Yes 1, otherwise 2.

$Z_{8i}$  is member of a farm organization : Dummy variables if Yes 1, otherwise 2.

$Z_{9i}$  is the land ownership(LO); Dummy variable if owned 1, otherwise 0.

The econometric estimation strategy requires some of the assumption about functional forms and distribution of error components. Given functional and distributional assumptions, maximum-likelihood estimates (MLE) for all parameters of the stochastic frontier

production and inefficiency model will be simultaneously estimated using the program, FRONTIER 4.1. The technical efficiency of a farmer is between 0 and 1 and is inversely related to the level of the technical inefficiency effects (Battese and Coelli, 1995). Technical efficiency can also be predicted using the FRONTIER program, which calculates the maximum-likelihood estimator of the predictor for Equation 1 that is based on its conditional expectation, given the observed value of  $(V_i - U_i)$  (Battese and Coelli, 1988). More details about obtaining maximum-likelihood estimator is given by Coelli et al. (2005).

## **Results and findings**

The descriptive statistics show that the majority of the sample respondents are male (94 %). The mean age was 45 years. This implies that majority of the farmers were youth and they are in an economically active age that can make positive contribution to agricultural production. Most respondents (91%) are married. The household size of most respondents (99%) ranged between 1 and 6 members and approximately 41% of families include four members. A large household size also means more mouths to feed, such that for a given farm size large households could produce a smaller market surplus (Minot *et al*, 2006). The literacy level among the farmers in the study area is quite high. Most of the farmers have completed grade 11 at school. Approximately 35 % of respondents have passed ordinary level exam, 4 % have passed advanced level exam and 1 % are degree holders. Further, 89 % farmers' main occupation is farming. Average

family income is Rs.14851 per month and average spending for foods is 49 % of their total income. Majority of the respondents (65%) had more than 10 years of farming experience, and this shows that the managerial ability of the farmers can be inferred to be reasonably good. Approximately 84 % of the sample respondents cultivated more than 4 varieties of vegetables. Most farmers were cultivating vegetable varieties such as brinjal, long beans, Bittergards, Pumpkins and different types of Cowpea.

Table 1: Maximum-likelihood estimates for parameters of the production function

Variable	Ampara
	Coefficient
Constant	0.271 (3.28)*
Land	0.298 (4.85)*
Labour	0.252 (3.61)*
Capital	0.175 (3.74)*
Row Material	0.062 (2.13)*
Model Variance	0.752 (6.02)*
Variance Ratio	0.813 (10.01)*
Log Likelihood function	-266.083
Number of observation	450

Note: i. *t* ratios are given in the parenthesis.

\* denotes significant variables at 1% level

The production function estimates indicate the relative importance of factor inputs in agricultural production. The coefficients of all factors have the expected signs and magnitudes. Land appears to be the most important factor of production with the coefficient values of 0.29 and Labour appears as the second most important factor while capital is the third most important factor for vegetable farms in study area. The parameter  $\gamma = \sigma_u^2/\sigma^2$  lies between zero and one with a value equal to zero implying that technical inefficiency is not present and the ordinary

least square estimation would be an adequate representation and a value close or equal to one implying that the frontier model is appropriate. The values of  $\gamma$  are 0.81 and it is statistically significant at the one per cent level which implies that more than half of the residual variation is due to the inefficiency effect.

As the second step of the analysis, we examine the distribution of technical efficiency of farmers. The result shows that more than 80 % of the sampled farmers were less than 55% technically efficient. From the distribution, the most efficient farmers in terms of resource use have an index of 82 per cent and the least efficient farmers in the same district have a resource use efficiency of 21 per cent. As the final step of the analysis, the variables of the inefficiency model were modelled to explain the determinants of inefficiency of production among farmers in study area.

Table 2: Maximum-likelihood estimates for parameters of the inefficiency model

Variable	Ampara Coefficient
Constant	1.725 (1.96)
Age	0.012 (1.75)* *
Education	-0.215 (-3.29)*
HH size	-0.028 (-2.76)*
Irrigated land area	0.004 (1.57)
Experience	-0.024 (-1.78) **
Extension services	-0.259 (-3.76)*
Credit	-0.069 (-3.17)*
MFO	-0.045 (-1.63)***
Land ownership	-0.012 (-1.61)***

Note: *t* ratios are given in the parenthesis. \* denotes significant variables at 1% level and \*\* indicates significant at 5% level while \*\*\* denotes significant variables at 10% level of significant.

The sign of the variables in the inefficiency model is very important in explaining the observed level of TE of the farmers. A negative sign would imply that the variable had the effect of reducing technical inefficiency, while a positive coefficient would indicate increasing inefficiency. The results are presented in Table 2 and indicate that all the included variables except age had the expected sign.

The estimated coefficients in the inefficiency model are of particular interest to this study. This is because these estimated coefficients of the inefficiency function provide explanations for the relative technical efficiency levels among individual farms. Most of the coefficients of explanatory variables in the inefficiency model are found to have expected signs. The age coefficient is positive, which indicates that the older farmers are more inefficient than the younger ones. This variable is significant at five per cent level. The positive coefficient of age suggests that age led to technical inefficiency of the farmers (Ogunyinka and Ajibefun, 2004). A possible explanation could be that the general ability to supervise farming activities decreases as farmers advanced in age.

The negative estimate for variables such as education, household size, experience, agricultural extension services and credit access implies that these variables are very important to reduce the farm level technical inefficiency in the study area. For example education variable implies that farmers with greater years of schooling tend to be less inefficient. The relationship is relatively strong, because the coefficient is very high relative to its estimated standard error. The

coefficient of education is significant at one per cent level. It can therefore be assumed that farmers with greater years of formal schooling tend to be more technically efficient. The predicted coefficient of household size was negative and significant at one per cent level while the coefficient of extension contact is negative and significant, suggesting that such contact increases farm level technical efficiency because farmers are able to use modern techniques of farming involving land preparation, planting, application of agro-chemicals (for example, fertilizer) and harvesting. Other variables in the model can also be interpreted as the same way.

### **Conclusions, implications and significance**

This research is one of the first attempts to use the stochastic production frontier approach to investigate the technical efficiencies among vegetable farmers in Sri Lanka. The study provides an economic analysis of farm household efficiency among vegetable farmers. Using stochastic frontier analysis, the results show the potential of increasing education as a driving force for output growth. Econometric analysis of survey data shows that land size, labour, capital expenditure and expenditure on raw materials are important inputs and are strongly associated with the total output. The analysis reports evidence of farm level technical inefficiency and its determinants. Results of this study show the potential for large gains in real output if technical efficiency is increased. The results depict a wide gap between farmers who are relatively poor in their efficiency performance (20 per cent) and those who are highly efficient (more than 80 per cent). In particular this study shows that the output value

of farms in the study area can be increased with the current levels of inputs and technology if less efficient farmers are encouraged to follow the resource utilization pattern as well as farm types that have already been adopted by the most efficient farmers.

The overall findings of this research will help implement policies to reduce technical inefficiency among vegetable farmers in Sri Lanka. It also helps increase awareness and generates support for investment in increasing technical efficiency in the agricultural sector. This type of study can provide an economic analysis of farm household efficiency among commercial vegetable farms in Sri Lanka, where vegetable farming generates a large part of household income. The results show the potential of encouraging the methods of increasing more efficient farms in the country. Econometric analysis of survey data provides the information of current technical efficiency level as well as the factor which determine the technical efficiency in these farms. These determinant factors, in turn, can be used to make policies in order to reduce technical inefficiencies among vegetable farmers in the country.

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