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## Global Warming and Consumer Sensitivity in Rural and Semi-urban Areas

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### Abstract

The term, global warming, refers to the increase in the temperature and the related changes in the climate caused by accumulation of greenhouse gases in the lower atmosphere. The increase in greenhouse gases makes an inescapable harm to the living beings and the entire Earth. Having identified the problem, decisions have been taken to control the human activities to protect the environment with the interference of the international community. If the consumers are aware of the danger of the effect of the on-going climate change, they can make adjustments in their demand pattern and reduce or prevent the possible adverse effects on the environment. Therefore, this study aimed to identify the appropriate instrumental variables which are necessary to prevent or reduce the consumption of people that leads to global warming. The study revealed that People in slums and shanties cannot be effectively encouraged for an environmentally friendly consumption behavior unless they are settled in a better environment. The strongest variable that determines the consumer response was the consumption related global warming knowledge. If the people are well-educated on the problem, it is the most effective way of directing them for an environmentally friendly consumption. However, the global warming knowledge of people seems to have a significant interaction with education level of people and the socio-economic well-being. The study further revealed that female leadership in consumption decision is more environmental friendly.

**Keywords:** Global warming, Consumer response, Environmental friendly consumption

### Introduction

The term, global warming, directly refers to the increase in the temperature and the related changes in the climate caused by accumulation of greenhouse gases in the lower atmosphere. The creation of these gases shows an increasing trend mainly due to human activities such as deforestation and combustion of fossil fuels. Evidence shows that the main greenhouse gas, carbon dioxide, has increased by 275 to 285 ppm in the preindustrial era to 2005 (Indian Planning Commission, 2011) <sup>[7]</sup>. This is an increase of more than one-third. This is responsible for the continuous increase in the atmospheric temperature of the Globe. It has also been observed that the linear warming trend for the fifty years from 1956 to 2005 has been nearly twice compared to the 100 years from 1906 to 2005 (IPCC, 2007) <sup>[8]</sup>. The increase in greenhouse gases makes an inescapable harm to the living beings and the entire Earth. This change affects the existing weather pattern and the frequency and intensity of weather events such as storms, floods, earth slips and a rise in the sea level due to the melting of glaciers with the increase in the temperature level (CANARI, 2009) <sup>[2]</sup>. Hence, it is obvious that a serious consideration should be made for controlling and arresting the existing harmful human activities and promoting and generating activities that mitigate global warming.

Having identified the problem, decisions have been taken to control the human activities to protect the environment with the interference of the international community through the institutions such as The Earth Summit and Intergovernmental Panel on Climate Change (IPCC). A considerable number of countries, 140, came to a consensus to sign the Kyoto Treaty to limit greenhouse gas into the atmosphere (Holcombe, 2006) <sup>[6]</sup>. These institutions have already attempted to pass the messages to people on global warming and climate change, its possible harmful effects and the ways of preventing or reducing the adverse effects through the possible adjustments in the production, consumption and the overall

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behavior of the human beings. This is of utmost important in the process of preventing the global warming since the success depends on the changing of the way of people interacts with the environment through production and consumption. The consumption of people today is a result of an economic decision of individuals or households. Nearly all goods and services consumed by the majority of people are procured from the market. Even though, the suppliers can influence on the consumption through various strategies, the consumers have the power of controlling the production through their effective demand. As such, if the consumers are aware of the danger of the effect of the ongoing climate change, they can make adjustments in their demand pattern and reduce or prevent the possible adverse effects on the environment.

Contribution to global warming in Sri Lanka is at present very low. For example, per capita carbon emission is very low as 0.06 in Sri Lanka (Herath, n.a). However, in order to control the remaining activities and the possible increase in the global warming related climate change problems, every country and society should take necessary policy actions in advance. Apart from the normal policy, this should be included in the section of risk management policy (Schneider, 2006) <sup>[13]</sup>. In line with this argument, messages on climate change have already been announced at national and international levels with the interference of Governments, international organizations and NGOs related to environmental protection. This includes the messages on climate change, the causes of the climate change, effects of the climate change, the productions, economic activities and consumptions which are responsible for the climate change, etc. Therefore, this study attempted to solve the problem that how far the messages have reached the household level and, in turn, how far they have responded to the messages in making adjustments in the consumption, in the context of Sri Lanka.

The paper unfolds in six sections. After this section, Section 2 presents the aim and objectives of the study. Section 3 is a brief explanation about the significance of study. Section 4 is the methodology of the study. Section five is devoted for analysis and results which include both descriptive and model estimation parts. Finally, section 6 gives conclusions and recommendations.

## 2. Aim and Objectives

The aim of the study is to identify appropriate instrumental variables which are necessary to prevent or reduce the consumption of people that leads to global warming. In order to achieve the aim, the study based on the following three specific objectives:

- 1) To identify the determinants of consumer response for global warming messages at family level
- 2) To develop a family model for consumer response for global warming messages
- 3) To contribute to environmental policy through consumption-related recommendations

## 3. Significance of the Study

The significance of the study is mainly two-fold:

- i. The study focuses on one of the most important issues of the World today. Solving the problem of the study is

important in the attempts to control the global warming. The findings of the study can be used for preventing or reducing the contribution to global warming caused by the consumption of people.

- ii. The study covers a research problem which has not been properly touched by researchers in Sri Lanka.

## 4. Methodology

### 4.1 The Model

The study used the non-experimental observatory method which comes under the positivist paradigm in social science research. The study, being basically quantitative, employed two main methods in the analysis.

First, the study used descriptive statistics derived from primary data to examine the consumption behavior of households. This includes statistical tables, graphs and correlation analysis. This analysis was very helpful in identifying the kind of model, linear or non-linear that can be used for the study. Second, a model was estimated for explaining how the consumers at family level response to messages of global warming. The response was expected in three main forms as indicated below;

1. choosing consumer goods and services
2. choosing consumption-related practices, e.g. walking or cycling instead of traveling in a motor vehicle
3. choosing methods for consumption-related family affairs, e.g. fixing glass doors to windows instead of energy consuming lights

Some of the above three forms of activities or items were identified from the review of literature from different sources that gives information on environmental friendly consumption and practices. This includes websites, reports including research studies, papers published by different organizations and individuals. The main sources are Climate Change 2007: Synthesis Report IPCC (2007) <sup>[8]</sup>, Low Carbon Strategies for Inclusive Growth: An Interim Report. Government of India, National Climate Change Adaptation Strategy for Sri Lanka 2011 to 2016 (Ministry of Environment, 2010). Communicating climate change: A toolbox for local organizations in the Caribbean ANARI, 2009, Using official statistics to calculate greenhouse gas emissions (European Commission, 2010), What do people know about global climate change? (Read *et al.*, 1994), Integrating Sustainable Development and Climate Change in the IPCC Fourth Assessment Report. Colombo: Published for the IPCC by Munasinghe Institute for Development. (IPCC, 2003) and Climate change vulnerability data book (Ministry of Environment, 2011) <sup>[9]</sup>, Changing Pattern of consumption, (Chandrakumara, 2002) <sup>[3]</sup> and <http://globalwarming-facts.info>

However, the items of the consumption list were chosen as applicable to the Sri Lankan background. Hence, although there are a lot of such consumption-related activities/practices, it was careful to choose only the items that most of people have awareness due to the messages given by the Government, non-governmental organizations and other sources for considerable period of time. At this attempt, help of food, environmental and production experts was obtained in determining the items. The list of items is given below;

1	Replacing a regular light bulb with a compact fluorescent light bulb (CFL) (This will reduce carbon dioxides emission)
2	Choosing energy efficient appliances when making new purchases
3	Not leaving appliances on standby
4	Moving your fridge and freezer away from cooker
5	Defrosting refrigerator regularly
6	Using natural sunlight through windows and roof instead of energy consuming lights
7	Covering your pots while cooking
8	Using the washing machine only when you got sufficient cloths
9	Using less hot water
10	Using a clothesline instead of using a dryer whenever possible
11	Help recycling home wastes
12	Help recycling your organic waste
13	Choosing products with little packaging
14	Using green power (Renewable sources such as wind and solar)
15	Reusing your shopping or polythene bags
16	Purchasing refills whenever you can
17	Reducing waste (Eg. using a reusable lunch box instead of a disposable one, will save the energy needed to produce new lunch boxes)
18	Purchasing locally grown and produced foods
19	Purchasing fresh foods instead of frozen
20	Support local farmers markets when purchasing
21	Purchasing organic foods in so far as possible
22	Increasing the distance you walk and ride bikes instead of driving
23	Taking mass transit wherever possible
24	Checking your tires regularly to make sure they're properly blown
25	Adapting to telecommuting from home (Work from home, communicating with the workplace using equipment such as telephones, fax machines, and modems)

**Variables**

**Dependent variable**

CRI = Consumer Response Index:

Dependent variable of the model is an index prepared by using the response of informants to the items of the above list and denoted by CRI.

The method of calculation of the index is as follows;

$$CRI = \frac{\text{No. of items practiced} \times 100}{\text{No. of relevant items}}$$

Since some items may not be relevant for the some informants, when calculating the index, the number of items they actually practiced was taken as a percentage of only the relevant items.

**Independent Variables**

Independent variables selected for the model, based on the theoretical and empirical literature, are as follows;

CGI = Consumption-related global warming knowledge Index:

1. This is an index prepared by using the answers of respondents for the same items of the above list. If the respondents had known about an item of the list, it was considered that the consumer had knowledge on it. Same as in the calculation of CRI, this index was calculated using only the relevant items for the each respondent.
2. NMF = No. of Members of Family: In counting the number of family members, all who are living as a one spending unit including relatives, friends and servants were considered as the members of the family. This is rational according to empirical literature (Behrman *et al.*, 1995; Rao, 1990; Horton and Hunt, 1980) [1, 11, 5].
3. CEF = Per Capita Consumption Expenditure of Family (per month): This is an indicator of the family economic situation. Since informants are more reluctant to reveal

their income data, consumption expenditure was used for the same purpose.

4. ACL = Age of Consumption Decision Leader: Family consumption is not always determined by the Head of Family. The pilot survey revealed that there are some families whose consumption and most of the related practices are influenced or determined by either wife or another adult of a family. As such, the study selected the Consumption Decision Leader of a family even if he or she is not the proper or legitimate Head of Household.
5. ELC = Education Level of Consumption Decision Leader: This is an ordinal variable with four levels such as, 1. No schooling, 2. Primary and lower secondary, 3. higher secondary, and 4. higher education.
6. SOH = Size of House: This is a continuous variable which shows the extent or the number of square foot of a house. This variable was used as the literature revealed that size of house is important in determining the behavior of family members.
7. RAF = Residential Area of the Family: This is a categorical (nominal) variable that represents the three sampling areas of the study.
8. MIS = Main Income Source of Family: This is an indicator of both income source and the occupation related to the main income of family. This is also a categorical (nominal) variable with five nominal values, 1. Minor jobs, Executive jobs, 3. Teaching, 4. Business and 5. Farming.
9. GCL = Gender of Consumption Decision Leader: This is a categorical variable with two nominal values such as 1. Female and 2. Male. Consumption decision leader of a family may be a female mostly when the male Head of Family does not play that role.

Using all these variables, the possible consumer response was taken as a function as follows; CRI = f (CGI, MIS, NMF, RAF, CEF, SOH, ELC, ACL, GCL)

Therefore, the analysis started with the dependent variable, CRI, which was expected to have a relationship with one or more of the above nine independent variables.

**4.2. Data sources and collection method**

**Type of data and steps of data collection**

The study was mainly dependent on primary data. Steps of data collection can be divided into six steps.

**Step 1**

Sampling area of the study was the North Central Province (NCP) of Sri Lanka. The selection of the area was judgmental since this is the familiar physical area of the researcher for collecting data for the last several years. The cost of collecting data was expected to minimize by selecting this area while maximizing the accuracy of data.

**Step 2**

Second step was also based on a judgmental selection. Out of the two districts existed in NCP, Anuradhapura district was selected for the study as it consisted more urban characteristics in the town area while representing both traditional village and settlement village characterizes from nearby areas. However, the other district, Polonnaruwa, was more rural so that it had no suitable area to represent urban characteristics.

**Step 3**

Anuradhapura district consisted of two urban Divisional Secretariat Divisions (DSDs) and twenty rural DSDs. The researcher randomly selected one DSD, Eastern

Nuwaraganoalatha, to represent urban characteristics and one DSD, Galnewa, to represent rural characteristics.

**Step 4**

Eastern Nuwaragam Palatha DSD consisted of 29 Grama Niladari Divisions (GNDs) whereas Galnewa DSD consisted of 17 Mahaweli Settlement GNDs and 12 GNDs with traditional villages. Out of these, the researcher randomly selected three GN divisions as follows;

1. Wasama 2 of the step 1 (urban)
2. Karuwalagaswewa (settlement)
3. Kala-medawachchiya (traditional village)

**Step 5**

A pilot survey was conducted in the adjoining GND (Step-1 GND) in order to make necessary changes in the survey procedure and the questionnaire. When conducting the main survey, all families of each GND were undergone for a short period interview using PART-A and PART-B of the questionnaire in order to identify only the families who have got the message on global warming and known something on what to do in their consumption -related activities for reducing the harmful effects. Having surveyed the families at the first step, the researcher identified the families who had got the message about the problem of global warming and possible solutions available with their consumption-related practices. The number of families so identified from each sampling area is given in the first column of Table 1.

**Table 1:** Sampling and Demographic Information

	No of families identified/selected	No. of families of the GND	Population of the GND	Average family size*
Kala-medawachchiya (traditional village)	29	83	450	5.42
Karuwalagaswewa (settlement)	43	182	992	5.43
Wasama 2 of step 1 (urban)	78	375	2100	5.6
	150	640	3542	5.53

\* However, the definition given for a family in this study is different since it included some other members staying together as a separate spending unit.

**Step 6**

Finally, all 150 families were interviewed with the PART- C of the questionnaire in order to identify their response with regard to the consumption related activities or items of the list.

However, slums and shanties were excluded from the main survey, due to the following reasons identified from the pilot survey;

1. There is a large gap between the families in ordinary residential areas and the families in slumps and shanties in terms of reaching messages on global warming due to may complicated reasons. Therefore, a change in consumption which can occur in response to such messages cannot be expected from them.
2. The people in slumps and shanties leads a very miserable life so that they cannot think of the environment even if they some of them got the messages on global warming. As such, due to their insensitivity to policy messages, there is no point of thinking of a better response without settling them in suitable houses of a suitable environment.

**5. Analysis and Results**

**5.1. Descriptive analysis and results**

Descriptive analysis preceding the model estimation revealed the results necessary for selecting the type of model suitable for the study. The descriptive analysis followed the following steps:

1. Identification of the form of each variable through the univariate analysis (Appendix 1)
2. Identification of the form of relationship that independent variables had with the dependent variable through correlation matrix plots (Annex 1) and the spearman correlation test (Annex 2). The results revealed that all nine suggested variables had a significant correlation with the dependent variable.
3. Identification of the relationships between independent variables.
4. Minimizing multicollinearity: According to spearman test, it was found that five of the independent variables had been correlated with a high multicollinearity problem. It revealed that any of these five variables,

CGI, MIS, CEF, SOH and ELC, can represent the other four variables. As such, the variable CGI (Consumption-related Global

Warming Knowledge Index) selected for representing the variables which had multicolinearity with that variable.

- Determining the independent variables which can be considered for model development: The remaining five independent variables, CGI, NMF, ACL, RAF and GCL were brought forward to test the significance in terms of

the relationship they had with the dependent variable and to determine the final model.

**5.2. Model estimation**

Following the step-forward method the five independent variables, CGI, NMF, ACL, RAF and GCL entered in order to identify the responsiveness of the dependent variable, CRI, and significance of each variable in determining the CRI shows the following results:

**Table 2: Model Summary**

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.899 <sup>a</sup>	.809	.807	7.022
2	.915 <sup>b</sup>	.837	.834	6.505
3	.917 <sup>c</sup>	.841	.838	6.440

- a. Predictors: (Constant), CGI
- b. Predictors: (Constant), CGI, RAF
- c. Predictors: (Constant), CGI, RAF, GCL
- d. Dependent Variable: CRI

The adjusted R2 value shown in Table 2 indicates that the model developed by the study accounts for 83.8 percent of

variance in the consumer responsiveness. Hence, a highly significant model has been emerged.

**Table 3: ANOVA<sup>d</sup>**

	Model	Sum of squares	df	Mean Square	F	Sig.
1	Regression	30762.960	1	30762.960	623.826	.000a
	Residual	7298.373	148	49.313		
	Total	38061.333	149			
2	Regression	31841.475	2	15920.738	376.270	.000b
	Residual	6219.858	147	42.312		
	Total	38061.333	149	10668.762		
3	Regression	32006.287	3	257.246		.000c
	Residual	6055.046	146	41.473		
	Total	38061.333	149			

Table 3, which reports on ANOVA, assesses the overall significance of the model. Since  $p < 0.05$  the model is significant.

**Table 4: Coefficients<sup>a</sup>**

	Model	B	Std. Error	Beta	t	Sig.
1	(Constant)	-7.760	1.816		-4.274	.000
	CGI	.906	.036	.899	24.977	.000
2	(Constant)	-14.262	2.118	.875	-6.733	.000
	CGI	.882	.034	.170	25.991	.000
	RAF	3.332	.660		5.049	.000
3	(Constant)	-8.096	3.737	.839	-2.167	.032
	CGI	.845	.038	.166	22.023	.000
	RAF	3.252	.655	-.076	4.967	.000
	GCL	-2.546	1.277		-1.993	.048

At the final step of the model formulation only three independent variables have been accepted for the model. The standardized Beta Coefficients shown in Table 4 indicates a measure of contribution of each variable to the model. It shows that a unit change in CGI (consumer knowledge on global warming) has the largest effect on CRI (consumer response on global warming messages). The largest t value which is equal to 22.023 and  $p = .000$  value for CGI also indicate that this predictor variable is having the largest impact on CRI. However, the next contributory variable to the model, RAF, shows a big gap when compared to CGI. The remaining significant variable of the model is GCL (gender of consumption decision leader). This variable shows a negative relationship with the predictor variable whereas the other two predictor variables had a positive

relationship. Gender of the decision leader was valued as 1 for female and 2 for male, giving the higher value for male. Therefore, this negative relationship means that when the opinion leadership of a family or spending unit changes from female to male, responsiveness to messages declines. It suggests that female leadership in consumption decisions are more environmental friendly. The results satisfy the critical assumptions of the linear regression model.

**6. Conclusions and Recommendations**

**6.1. Conclusions**

The following conclusions can be made based on the results of the study:

- People in slums and shanties cannot be effectively encouraged for an environmentally friendly

consumption behavior unless they are settled in a better environment. Even the response of the economically low level people live in better residential areas, they are also reluctant to messages on environmental protection.

2. The strongest variable that determines the consumer response is the consumption related global warming knowledge. If the people are well-educated on the problem, it is the most effective way of directing them for an environmentally friendly consumption. However, the global warming knowledge of people seems to have a significant interaction with education level of people and the socio-economic well-being (This possible to suggest since there was a multi-correlation between CGI, MIS, SOH and ELC).
3. Female leadership in consumption decision making shows to be more environmental friendly.

### 6.2. Recommendations for environmental policy

The following recommendations can be made based on the results and the conclusions of the study:

1. People in slumps and shanties should be resettled in a better environment if an environmental friendly behavior is expected from them. Parallel programs should be implemented in order to improve the income levels of the lowest income groups.
2. Since the people who are living in better residential areas with no very low income can be effectively diverted for an environmental friendly consumption, steps should be taken to educate them for that purpose.
3. Since the responsiveness of females to global warming messages is high compared to men, they should be equipped with necessary knowledge and involved in consumption related environmental protection programs.

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