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The Role of Regulation on Adoption of Environmental Management Practices: A Discriminant Analysis

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ABSTRACT

The purpose of this study was to examine empirically the extent to which the legal system on environment have an impact on Sri Lankan agri-food firms' private action on the adoption of solid waste management practices recommended by the Ministry of Environment, where the perceptual and behavioral changes occurred in the system over time were of special interest. The data collected from a cross section of firms (n=146) through a structured questionnaire during January to April 2013 (Stage II) were taken up with the corresponding data collected about three years earlier (Stage I) from the same set of firms to formulate an Environment Regulation Responsiveness Index (ERRI). The ERRI reflects the relative strength of a firms' perception on the environmental regulation (i.e. 0 the least to 1 the most responsive). Disciminant analysis was carried out to assess the relative importance of regulatory incentives of: (1) Existing Regulation; (2) Anticipated Regulation, and (3) Liability Laws in differentiating "adopter" from "non-adopters". The results suggest that there is no significant change in firms' perceptions over time, which is also evident by the low magnitude of ERRI (i.e. less than 0.5). It also highlights that Anticipated Regulation was the most important incentive motivating adoption, while Liability Laws was the least important. The outcome of analysis calls for more localized, monitored, and futuristic regulatory strategies to govern environmental compliance.

KEYWORDS: Adoption, Agri-food processing sector, Discriminant analysis, Regulation

INTRODUCTION

Improper management of solid waste in firms is one of the biggest and key environmental problems in Sri Lanka. Lack of systematic waste collection systems, waste transport systems and suitable waste disposal systems have been contributing to aggravate the solid waste problem in Sri Lanka. Recent analysis of data pertaining to waste accumulation from these industries reveals that the real problem is not the increase rate of generation of waste, but unlike in the past, today firms involve with various activities in the supply chain from production to marketing of goods and services calming to be pursuing corporate environment practices and strategies by engaging in self-regulated environmental management.

Regulation has thus become a major element of the environment in which firms operate that can constraint the strategic behavior of firms (Porter and Van Linde, 1995) and the food industry is one example of this. In regulating businesses by way of public legislation, according to Stigler (1971) government force them to operate within certain constraints when the social of private market activities are considered great and government action is needed to mitigate market defects. Capture theory suggests that firms may attempt to co-option the regulatory process in an attempt to gain strategic advantage and this can occur at the level of the individual firm or the industry through, for example, interest groups (Peltzman, 1976).

When faced with a new regulation, according to Henson and Heasman (1998), firm's compliance does not involve a simple question as to whether to comply or not, because it is closely related to decisions regarding 'how to comply', since a continuum of responses is available with it, ranging from 'full compliance' to 'non-compliance.'

Khanna *et al.*, (2007) examine the motivations for firms to participate in voluntary environmental programs and to adopt environmental management practices using data gathered from a survey of six industrial sectors in Oregon. They find that larger facilities were more likely to participate in more voluntary environmental programs, but were likely to adopt more EMPs only if environmental issues were of significant concern.

Ministry of Environmental and Natural Resources (MENR) in Sri Lanka, designs policies to encourage the firms to adopt sustainable solid waste management disposal in an environmentally sound manner. A part of these regulations is to emerge as mandatory regulatory regimes and can act voluntarily. However, in a recent attempt to investigate this phenomenon in the context of Sri Lanka, using the special case of Sri Lankan agri-food processing firms' compliance to Ministrys' recommended 9 different solid waste management practices (SWMPs), Jayasinghe-

Mudalige and Udugama (2010) concluded that agri-food processing firms in Sri Lanka, in general, do not take into account the potential role the government regulation.

With the assumption that a decision maker's perception change over time, this study incorporates time dimension in to the study by Jayasinghe-Mudalige and Udugama (2010) with the aim of identifying the impact of regulatory incentives and firm level characteristics on the adoption of recommended SWMPs by the firms in the agri-food processing sector with a special focus on the changes occurred in the system over time.

METHODOLOGY

Study Area and Data

The data pertaining to Stage I was obtained from South Asian Network for Development and Environmental Economics (SANDEE) Database used in Jayasinghe-Mudalige and Udugama (2010) that includes the primary data on numerous aspects related to a firm's performance on environmental quality management of 325 agri-food processing firms in Sri Lanka belonging to five different sub-sectors. The data collected from a cross section of firms representative to the industry structure (n=146) through a structured questionnaire administered with environmental managers/owners during January to April 2013 (Stage II) were matched with corresponding data collected three years earlier (Stage I) from the same set of firms (i.e. panel data). The sample include firms from four districts (Central, North-Western, Southern and Western provinces) covering five product categories: (a) coconut products (COP); (b) essential oils (ESO); (c) non-alcoholic beverages (NAB); (d) other processed products (OPP), and (e) processed fruit and vegetables (PFV) which were then categorized as "large" firms (LRG) and "small" firms (SML) based on the annual returns.

Development of an Index to Reflect Firm's Perception on Regulation

As an initial step towards assessing the managerial perception on environmental regulation, three attitudinal statements included in the questionnaire reflecting different facets of environmental regulations i.e. the Existing Government Regulations (EGR), Anticipated Government Regulation (AGR) and Liability Laws (LBL) were used to derive an index-herein referred to as "Environment Regulation Responsive Index" (ERRI).The value of ERRI signals the extent to which a manager of a firm perceived various aspects pertaining to the firm's response to regulation. The managers ranked the statements and scored on a five point likert scale ranging from 1 to 5.

In Principle, the ERRI was specified to meet the characteristics of a Weighted Additive Index (Powers and Xie, 1999) in the form of:

$$ERRI_i = \sum^{n}_{i=1} W_s [a(R_s)_i]/[a(R_s)]$$

Where, the term a $(R_s)_i$ denotes the score given by a respondent (i) to a statements (R_s) [s=number of statements] on the likert-scale. To derive ERRI for a given firm, the summation of scores of all the statement (s=3) was divided by the maximum potential score [a (R_s)] to normalize the value of the index.

For this particular analysis, the value of $[a(R_s)]$ was 15 (i.e. maximum score of +5 on the likert-scale ×3 statements]. With the normalization, the values of ERRI for a given firm, range from 0 to 1, where 1 reflects the "perfect perceptions of the decision maker towards compliance to regulation". And 0 on the other extreme reflects his/her "perfect perception towards non-compliance to regulation" Indexes were prepared for both stage I and II. Data were analyzed by using a t-test to identify the impact of regulation on SWMPs in firms over time.

This empirical analysis aims to capture the extent to which managers perceived the effect of each attitudinal statement on their decision to adopt SWMPs in the firm.

Multiple Discriminant Analysis (MDA)

Perceptions being a directly unobservable phenomenon, the scores provided by respondents were scrutinized with MDA using the Statistical Package for Social Sciences (SPSS) [version 17]. The primary objective of this was to identify the group to which an object belongs, and it estimate the relationship between a single nonmetric (categorical) depended variable and a set of metric independent variables.

Discriminant analysis is used to investigate the factors that influence adoptability to the three most popular SWMPs; (1) sorting of waste based on 3R system; (2) composting and (3) good manufacturing practices (GMP). The independent variables are as follows: EGR, AGR and LBL. The dependent variable is Adoption of the SWMPS. The null hypothesis was developed to check the importance of each regulation towards Adoptability of SWMPs in the firm.

H_0 - EGR do not influence ADP of SWMPs
H_0- AGR do not influence ADP of SWMPs
H_0- LBL do not influence ADP of SWMPs

The reduced variable set, typically is almost good than the complete set of variables (Hair *et al.*, 1998). The Wilks's Lamda and univariate ANOVA were used to assess the significance between mean index values of each incentive for the two groups. The 0.05 significant levels with the lowest Wilks' Lambda value were used to enter the variables into the discriminant function and 0.1 was the removing significant level. Discriminant Loadings (DL) which assess the relative contribution of each regulation incentives to the discrimimant function were considered the most appropriate measure of discriminatory power, but the discriminant weights also considered. Variables that exhibit a loading of ±0.04 or higher are considered substantives (Hair *et al.*, 1998).

RESULTS AND DISCUSSION

Descriptive Statistics of the Sample

The total sample was categorized into three categories according to the annual revenue as small (< 50millions), medium (50-100 millions) and large (>100 millions). The sample comprised 28%, 37%, 35% of large, medium and small firms respectively, and also 30 (20%), 29 (19.8%), 41 (28%), 21(14.5%), 25(17.2%) of COP, NAB, ESO, OPP and PFV firms respectively.

With regard to the type of SWMPs adopted by firms, it was observed that "Good Manufacturing Practices", "Composting" and "3R system" were the most popular amongst the firms, while only a small percentage of firms adopted the rest of the recommended practices. It is of interest to examine the changes took place between stage I and stage II with regard to the degree of adoption of SWMPs and the motives behind. In stages I, GMP was the most popular practice among the firms with an adoption rate of 36% followed by 28% and 26% of firms adopting GMP, Composting and a 3R system, respectively. These percentages were seen to have increased considerably in stage II with 61%, 33% and 46% of firms, respectively, adopting GMP, Composting and 3R system (Figure 1).

A considerable increase to the total number of practices adopted by a firm was also detected from stage I to stage II. About 46% of the firms did not possess any of the 9 recommended practices in stage I. However, this percentage dropped to 14% in Stage II.

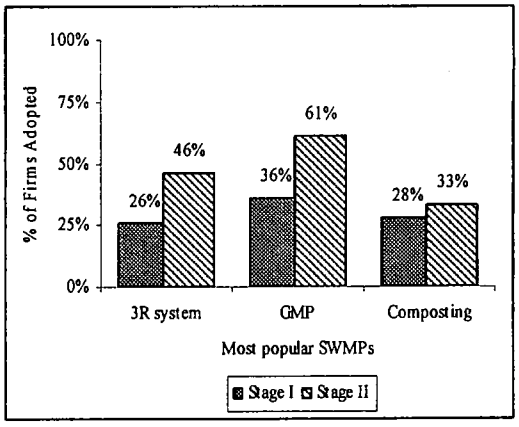

Figure 1. Level of adoption of the most popular SWMPs

Derivation of ERRI

The scores given to the regulation incentives were used to derive the ERRI in large, medium and small firms and also according to the firm type at Stage I and II (Figure 2).

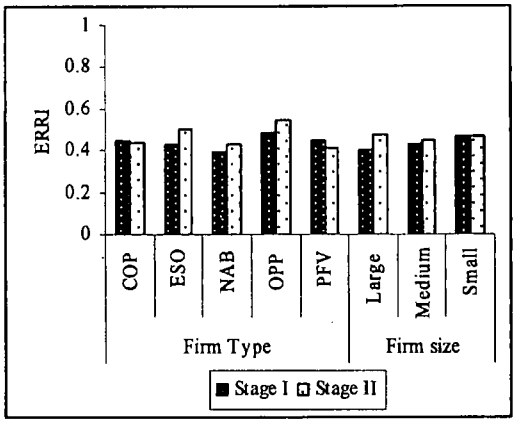

Figure 2. Mean IRRI values for both Stage I and II

The outcome of the analysis shows that the magnitude of ERRI of a majority of the firms was relatively low (i.e. in between 0.4 to 0.5). This is much clear in the context of firm size, where the value of which of the small scale firms were relatively high indicating that these firms' did not consider the government regulation as a promising factor governing their action on environment.

The large firms, though with relatively low values, showed a positive relationship to the environment regulations due to the likelihood to undertake actions impacts if made mandatory by the regulatory framework.

Mean value of scores obtained from each regulation statements in both stages I and II were used to run a paired t-test to test the variation in perception over time. The results suggest that there was no significant change in the decision maker's perception over time ($P = 0.08 > 0.05$).

Outcome of the MDA

The outcome of the analysis for 3R system, GMP and composting is summarized below:

3 R System

In Stage I the MDA for 3R system, the univariate ANOVA indicated that rank indexes of three regulation incentives as EGR showed a significant difference while, AGR and LBL showed an insignificant difference between group means (Table 1). Therefore, AGR and LBL cannot be use to differentiate the ADP from the NAD, in other words we cannot predict the level of adoption to 3 R system of the firm, by using the ranks they have given to the above mentioned non significant incentives, and also EGR having DL that exceed ±0.04 threshold. So it is the most important regulation in differentiating the ADP from the NAD. In Stage II the MDA for 3R system, EGR, AGR and LBL were showed insignificant difference Therefore, these three incentives cannot be use to differentiate the ADP from the NAD, in other words, we cannot predict the level of adoption to 3 R system of the firm, by using the ranks they have given to the above mentioned non significant incentives.

Good Manufacturing Practices

EGR showed a significant difference in stage I and AGR showed a significant difference in stage II. With highest F value and the lowest Wilks's Lambda value EGR and AGR were only variables that entered into the each Stage's discriminant function. In Stage II EGR and LBL did not contribute enough uniquely to enter into the discriminant function.

Composting Unit

In the MDA for composting system univariate ANOVA indicates that rank indexes of AGR and EGR are significantly different between two groups in stage I while there was no significant difference between group rank indexes of LBL. So it cannot be used to differentiate the ADP of composting from the NAD. Thus, we cannot predict the level of adoption to composting a GMP of firms, by using the rank they have given to the above mentioned insignificant incentives. EGR showed the highest F value, the lowest Wilks' Lamda and had the strongest effect in order to distinguish the ADP from NAD. But in Stage II, AGR was the only factor that enters into the discriminant function, because it showed the highest F value and lowest Wilks's Lamda value, DL of AGR also exceeded ±0.4 threshold. Therefore it was the most important incentive in differentiating the ADP from NAD. LBL was not significant in any Stages. Therefore, LBL cannot be use to differentiate the ADP from the NAD, in other words we cannot predict the level of adoption to any SWMPs of the firms, by using the rank they have given to the LBL regulation incentive.

Summary of the Discriminant Loadings

The relationship between the regulation incentives and the level of adoption to each control can be identified through the summary of DL (Figure 3). Incentives with a positive DL indicate the positive relationship with the level of adoption and negative sign indicate the negative relationship. Therefore, the firms implemented their SWMPs considered, EGR was the important in Stage I, but it became AGR as important factor in stage II.

Table 1. Outcome of the Multiple Discriminant Analysis

SWMPs	RI	Stage I				Stage II			
		WL	FV	Sig.	DL	WL	FV	Sig.	DL
3R	EGR	0.807	16.25	0.000	0.615	0.991	1.370	0.244	0.746
	AGR	0.986	0.98	0.325	-0.243	0.999	0.087	0.769	0.441
	LBL	0.924	5.56	0.021	-0.176	0.997	0.479	0.490	-0.187
GMP	EGR	0.819	15.08	0.000	0.455	0.999	0.096	0.757	-0.012
	AGR	0.993	0.50	0.481	-0.147	0.196	589.9	0.000	0.903
	LBL	0.951	3.52	0.065	-0.285	0.975	3.621	0.059	-0.071
Composting	EGR	0.919	5.99	0.017	-0.380	0.988	1.790	0.183	0.042
	AGR	0.925	5.51	0.022	-0.312	0.144	859.4	0.000	0.921
	LBL	0.984	1.03	0.291	-0.220	0.984	2.317	0.130	0.048

Note: RI-Regulation incentives; WL-Wilk's Lambda value; FV-F value; Sig.-Significant level DL- Discriminant Loading; GMP-Good Manufacturing practices; SWMPs-Solid Waste Management Practices;
**significance at 5%*

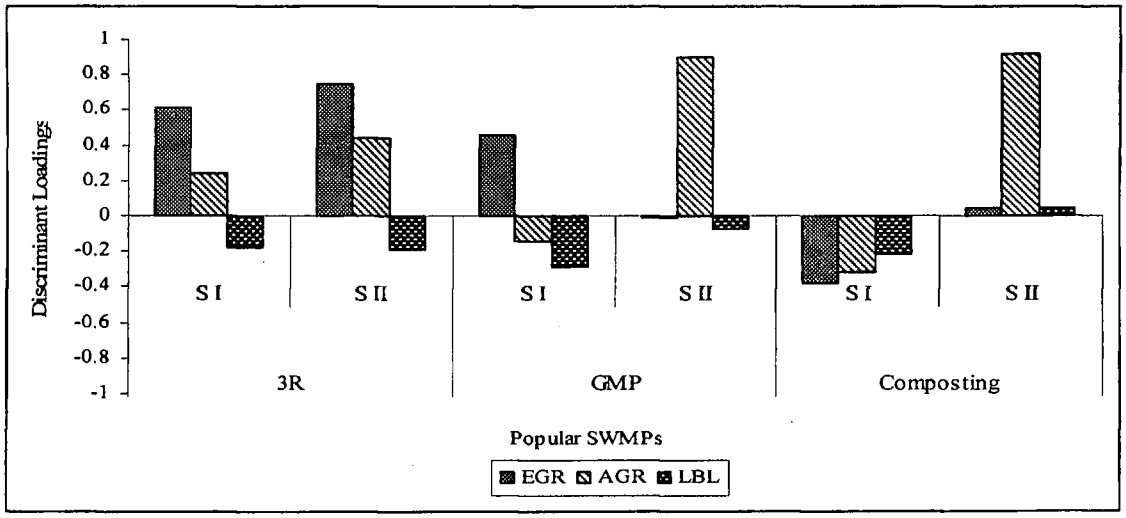

Figure 3. Summary of the DL values
Note: S I-Stage I; S II-Stage II

CONCLUSIONS

The outcome of the analysis shows that the magnitude of ERRI of a majority of the firms was relatively low (i.e. in between 0 to 0.5). This is clear in the context of firm size, where the value of which of the small firms were relatively high indexes indicating that these firms' did not consider the government regulation as a promising factor governing their action on environment. However, the large firms, through with relatively low values, showed a positive response towards environmental regulations due to many reasons such as likelihood to undertake actions to reduce their environmental impacts if made mandatory by the regulatory framework.

The results suggest that there was no significant change in the decision maker's perception on regulation over time on the adoption of SWMPS in firms. Anticipated regulation was the most important incentive motivating adoption, while Liability Laws was the least important. The outcome of analysis calls for more localized, monitored, and futuristic regulatory strategies to govern environmental compliance.

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