IMPACT OF ENVIRONMENTAL ALTRUISM ON ADOPTION OF SOLID WASTE MANAGEMENT PRACTICES IN THE FIRM: CASE OF AGRI-FOOD PROCESSING SECTOR IN SRI LANKA

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ABSTRACT

This study examines empirically the potential relationship between the environmental altruism of a firm's decision maker on environmental quality and the level of adoption of enhanced environmental controls by the firm using the special case of adoption of solid waste management practices (SWMPs) recommended by the Ministry of Environment of Sri Lanka to the agri-food processing firms in Sri Lanka. The data collected from 275 firms by means of an in-depth interview with the environmental manager/owner were used to formulate a Weighted Environmental Altruism Index (WEAI) to estimate the degree of altruism of the manager. The Count Data Model was specified to assess the relationship between altruism and levels of adoption of SWMPs. The results suggest that the degree of environmental altruism of these mangers was relatively low (i.e. 0.25, on an average, of the WEAI ranges from -1 to 1) and the level of adoption of SWMPs was very unsatisfactory (i.e. Mean 1.2 with 47% of non-adopters) showing no significant relationship between these two factors. This implies the importance of augmenting the perspective of a firm's management beyond the profits through a collaborative action of the firm and other social institutions to make sure that the businesses will not be liable for the environment it operates.

KEYWORDS: *Agri-food processing sector, Altruism, Environmental controls, Waste management*

INTRODUCTION

The literature on environmental economics and management points out two broad ways to maintain environmental quality: (1) the legal framework provided by the government and judiciary [public], and (2) the voluntary environmental protection, which is to be carried out by a firm on its own willingness [private] (Hettige *et al*., 1996). A large number of conceptual frameworks developed (see, for example Kolstad *et* al., 1990; Rugman and Verbeke, 1998; Segerson and Miceli, 1998; Viscusi, 1989; Weersink *et al*., 1998) and empirical analysis carried out (Henriques and Sadorsky, 1996; Khanna 2001; Nakamura *et al*., 2001) with respect to perspectives of both the developed and developing countries show the effect of the actions of both these institutions (i.e. public and private) in the past two decades. The outcomes of many of these studies generally place too much emphasis on the shortcomings of the market to address the issues related to environment, and at the same time, have tended to over-estimate the advantages that come from government regulation.

Though the effect of government regulatory framework and the market forces for a firm operates in a particular market, especially for a food processing firm which is subjected to a relatively high consumer concerns and sensitivity towards

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food and environmental quality related issues is more or less the same at a given point of time (Segerson, 1999; 1986), there exist significant differences with regard to private action by individual firms on environmental quality or the interplant variations in responses towards the adoption of enhanced environmental management controls at the firm level. From the social sciences point of view, the economists and psychologists insist that this may mainly be associated with the degree of "altruism" of decision makers of the firm. Altruism can be defined broadly as the unselfish concerns for the welfare of others, or in other words, as an action that increases the welfare of others without regard for one's self interest. This shows that altruism is likely to play a particularly important role in people's attitudes and behaviour when the issue of concern is a matter of collective interest, and environmental issues can be considered as prime examples in this domain. Altruistic behavior of a firm can have a crucial impact on its private action towards maintenance of the quality of its products and on the environment. Environmental altruism is, thus, defined as making decisions and taking actions by the management of a firm with respect to environment that will ultimately augment the environment quality and its status (Kolm and Ythier, 2006).

Under these circumstances it is of paramount importance to examine extent to which the environmental altruism of the management of a firm has an impact on management of environmental quality as that knowledge can be used extensively to formulate appropriate end-user friendly environmental policies or to strengthen the existing regulatory frameworks by minimizing their vagueness. For the purpose of this study, we use the special case of adoption of enhanced environmental controls, which was formulated by the Ministry of Environment (and Natural Resources then) [MENR], by the firms operate in the agri-food processing sector in Sri Lanka.

Being the largest manufacturing sector in Sri Lanka with more than 80 percent of firms operate in the provinces of very high population density, for example more than 500 people per km^2, the generation and unhygienic accumulation of waste through these agri-food processing firms has become a growing problem in Sri Lanka. As a solution to this problem, the MENR has already formulated the "*National Strategy for Solid Waste Management*" and a number of specific procedures that firms in the food processing sector should adopt in order to manage the solid waste generated in a firm are introduced. These include: (1) "*Sorting of waste based on 3R System*" – establishment of necessary infrastructure facilities in appropriate places and allocating labor for the purpose; (2) "*Composting*" – the conversion of solid waste materials into composts, in which the heavy metal composition should be maintained below the recommended standards; (3) "*Biogas technology*" – establishing units in accordance with the guidelines provided by the MENR; (4) "*Biodegradable packaging materials*" – using material such as paper, glass, cloth, etc. instead of polyethylene and other non-biodegradable plastics; (5) "*Sanitary land filling*" – the maintenance of a site for which the firm should obtain clearance based on the guidelines provided by the Central Environmental Authority (CEA) in Sri Lanka; (6) a set of "*Good Manufacturing Practices*" (GMP); (7) Regular "*Waste Auditing*" system; and (8) *ISO 14000 Environmental Management System*. An individual business can select either one or a combination of these practices or any other appropriate mechanism that they deem to be effective in rectifying the problems associated with the generation of waste in their premises.

The specific objective of this study was, therefore, to examine empirically the potential relationship between the degree

of environmental altruism and the level of adoption of those solid waste management practices (SWMPs) by the firms operate in the agri-food processing sector in Sri Lanka and to assess how firms' altruistic behavior varies according to the type and the scale of operation. In turn, we hypothesize that a firm's response to environmental quality, which is reflected by the number of SWMPs adopted by a firm, has a positive relationship with the degree of environmental altruism of decision maker of the firm and the characteristics of the firm (i.e. type and size of the firm).

MATERIALS AND METHODS

Derivation of Index to Reflect Environmental Altruism

The first step towards empirical analysis was to assess the degree of environmental altruism of firm's decision maker on environmental quality. Altruism is, however, a behavioral concept that is directly unobservable, and in consequently, an analysis on quantifying its effect on a phenomenon such as environmental quality management is needed to be constructed as an indirect measurement that has an ability to approximate the true behavior of environmental altruism at the level of firm. Following Jayasinghe-Mudalige and Henson (2006), we have resolved to derive an index for this purpose, which reflects the degree of altruism of the firm's decision maker on environmental quality. To derive this particular index – herein referred to as "*Environmental Altruism Index*" (EAI), a series of attitudinal statements (n=12) were specified to reflect diverse facets of environmental altruism cited in literature (Table 1).

Table 01: Attitudinal Statements reflecting altruism

	Attitudinal Statement
U_1	Many top managers in my firm are personally and actively involved in developing environment protection policies and monitoring their implementation.
U_2	My Company has a written environmental policy that states goals for improving our environmental performances.
U_3	Clear and strong signal has been sent from our top managers that better environmental management is a requirement in our firm, not a choice.
U_4	My firm has a long term plan to lower our pollution control costs in order to be more competitive in the market.
U_5	Environmental protection is an integral part of my company's culture.
U_6	Ideas on pollution management are shared freely among lower, middle, and upper levels within my firm.
U_7	Humans have the right to modify the natural environment to suit their needs.
U_8	Advances in technology will eventually solve the problem of environmental degradation.
U_9	My firm's contribution to environmental pollution is small and hardly makes a difference.
U_{10}	Polluters should pay fully for the damage they cause, and be responsible for cleaning up their pollution.
U_{11}	A certain amount of environmental damage is tolerated if there is to be economic growth.
U_{12}	I feel it is my personal responsibility to ensure that my organization improves its environmental performance.

Following the good practices of developing attitudinal statements to obtain objective responses from respondents by preventing response bias (Henson and Trail, 2000), the meaning of some of the statements were set to reflect techno-centrism of a respondent purposely. A multi-point likert-scale of which the points range from -5 from one end to +5 on the other (i.e. -5 to 0 if the respondent "disagree" with the underline phenomenon of the statement and 0 to 5 if "agree" to it) was constructed to obtain scores for each statement.

Having formulated the set of statements, we need to make sure whether all statements were condensed into a single factor by eliminating the empirical issues associated with quantifying attitudes and perceptions of people, including the endogeneity, mutual exclusivity, subjectivity and unobservability through the testing for their unidimensionality (Buchanan, 1969; Hair *et al*., 2006; Nakamura *et al.*, 2001). The Principal Component Analysis (PCA), which is an interdependence technique stated under the Multivariate Data Analysis techniques that is used commonly to define the underlying structure among a set of variables of an analysis objectively, was employed to test this condition (Hair *et al*., 2006). The PCA technique helps particularly to find a way to condense the information contained in these 12 statements (i.e. original variables) into "single variate (factor)" or if not into a "smaller set of new composite dimensions or variates" with a minimum loss of information by taking into account of the total variance amongst the original variables (De Vellis, 1991).

In principle, the EAI was specified to meet the characteristics of an Additive Index (Powers and Xie, 1999) in the form of equation (1) below:

$$EAI_i = \sum_{i=1}^{n} \left[a(U_S)\right]_i$$

The term $a(U_s)_i$ in equation (1) denotes the score given by a respondent (*i*) to a statement (U_s) [s = number of statements] on the likert-scale. To derive EAI for a given firm, the summation of scores of all the statements (s=12) was divided by the Maximum Potential Score [a (U_s)] to normalize the value of the index. For this particular analysis, the value of [a (U_s)] was 60 (i.e. maximum score of +5 on the likert-scale x 12 statements]. With the normalization, the values of EAI for a given firm, thus, ranges from -1 to 1, where -1 reflects the "perfect non-altruism" of the decision maker on environment quality, and 1 on the other extreme reflects the "perfect altruism".

Extent to which a manager is perceived the effect of each attitudinal statement on her decision to adopt SWMPs in the firm was of interest in the empirical analysis. Logically, even under the circumstances where the 12 attitudinal statements stated originally were confined to a single variate (i.e. unidimensionality), all the respondents in the sample may not value the underline phenomenon explained in a given statement as equally important, for them to be altruistic towards the environment. If so, it is imperative to incorporate this variation into the analysis. To fulfill this condition the original EAI was extended to a "weighted" EAI – herein referred to as WEAI, as expressed in equation (2) below:

$$WEAI_i = \sum_{i=1}^{n} W_s \left[a(U_S)\right]_i$$

where, all parameters are equal to those given in the EIA equation expressed earlier and W represents the weight assigned to each statement to characterize the variation of responses of respondents.

Given that the condition of unidimensionality was satisfied in this study (see below), the following method

was employed to derive the weights. First, the Summation of Scores (SS_a) provided by all respondents in the sample to a given statement was taken and the weight to be assigned to each statement was decided upon the size of SS_a accordingly. As a result, a relatively large weight was assigned to any statement that obtained a large SS_a (see, Table 3). Inclusion of weights into the EAI, thus, helps to identify the statements reflecting altruism that the respondents "most valued" in terms of their private action on environmental quality, and in turn, to assign them with high weights, which is not the condition for unweighted index (EAI) as it assigns equal weights to all statements.

Count Data Models to Specify Environmental Responsiveness

The MENR does not suggest any recommended order in which to adopt the above mentioned eight SWMPs in a food processing firm. Further, none of these practices is endowed with a higher value over the others. In other words, each practice has its own merits. For the purpose of this analysis, we have presumed that the number of SWMPs adopted by a firm reflects its degree of responsiveness towards environmental quality. Under these circumstances, there is a possibility that certain firms may decide to adopt a single or a few (i.e., two or three) practices at a time, whereas others may even go beyond (i.e., four or five) depending on the gains to the firm by doing so. On the other hand, there may be firms that do not adopt a single practice out of the eight recommended. In such case, an analyst may come up with a series of zeros as he/she works on a scale of: *Adoption* = 1; *Non-adoption* = 0 to report the status of adoption of these practices in the firm on an individual basis. At times, he/she may therefore experience excess zeros. In light of this, we use the total number of technologies/practices adopted by a firm as a measure of its 'intensity of adoption', which has been a common practice in literature on economics, where Count Data Regression models were employed for estimation purposes (Cameron and Trivedi, 1998).

Econometric Specification

The following econometric model was specified to examine the relationship between the levels of environmental controls adopted by a firm and its environmental altruism and firm characteristics:

$$SWMP_i = \sigma_0 + \beta_1 * EIA_i + \gamma_1 * FT_i + \gamma_2 * FS_i + \varepsilon_I \qquad (3)$$

where: $SWMP_i$ denotes the dependent variable (i.e. no. of SWMPs adopted by a firm). The right-hand side variables include: σ_0 = intercept, β_1 = coefficients of EAI, and γ_k = coefficients of characteristics of a firm such that *FT* is the firm type (on the different sub sector to which the agri-food processing firm belongs i.e. Coconut products) and *FS* is the firm size (based on annual returns i.e. very large to very small).

Study Area and the Data

The food processing firms belonging to five sub-sectors based on the type of product, including: (a) processed fruits and vegetables (PFV)]; (b) coconut products (COP); (c) essential oils (ESO); (d) non-alcoholic beverages (NAB), and (e) other processed products (OPP), located in four provinces [i.e., Western (WP), North Western (NW), Central (CP) and Southern (SP)] were taken for the collection of data. The final sample consists of 275 firms, which was selected randomly from a mailing lists of food processors that operate at various locations by contacting reputed institutions such as the Department of Census & Statistics of Sri Lanka, the main and regional offices of the Export Development Board of Sri Lanka, the Federation and Regional Chambers of Industry and Commerce, Coconut

Research Institute of Sri Lanka, Fruit and Vegetable Processors Association of Sri Lanka, and Sri Lanka Standards Institution, etc. Further, the firms were classified into two groups to reflect its size by taking into account of its value of annual sales, namely: (a) "Small" (Rs. 100,000 – 500,000), and (b) "Large" (>Rs. 500,000).

A face-to-face interview supported by the structured questionnaire was conducted with the top-most executive who possess executive powers to make decisions with respect to environmental quality related aspects of the firm (in certain cases, especially in the small firms, it was the owner) to collect data from April to September 2009 followed by an inspection of the site for the cases where permission was granted. With regard to the statements explaining altruism, each respondent was asked, in particular, first to rate his/her perception on each statement in relation to the current performance of his/her firm on a two-point Likert scale, i.e., (1) *agree* ("yes"), or (2) disagree ("no"). Afterwards, he/she was instructed to rate the same statement on a five-point Likert-scale by taking into account of the extent to which he/she agrees (if they say "yes" in the 1st rating) or disagrees (if they say "no" in the 1st rating) with this particular statement (Oppenheim, 1992).

Having coded the data appropriately and performed the standard tests for the missing data in certain cases, the "Statistical Package for Social Sciences" (SPSS) [*Version 13*] was used to obtain the results of the PCA and the STATA [*Version 8*] was used to obtain the outputs of the Count Data models.

RESULTS AND DISCUSSION

Descriptive Statistics of the Sample

The 275 firms in the sample comprised of 77 (28%) PFV, 64 (23%) NAB, 52 (19%) ESO, 21 (8%) COP and 61 (22%) of OPP in terms of type of the firm and 150 (55%) Small and 125 (45%) Large, in terms of the size of the firm. With regard to the types of SWMPs adopted by firms, it was observed that "Composting" (24%), "3R system" (31%) and "Good Manufacturing Practices" (23%) were popular amongst the firms and only a small percentage of firms adopt other recommended practices (Figure 1).

Interestingly, almost 50 percent of firms in the sample, i.e. 135 firms, did not adopt a single SWMP suggested by the MENR. Another 70 (25%), 24 (9%) and 18 (7%) firms have adopted only 1, 2 or 3 out of the 8 practices respectively (Figure 2). The number of SWMPs adopted by a firm varied to a great extent vis-à-vis the type of the firm and its size. Firms that produced non-alcoholic beverages (NAB) and processed fruits and vegetables (PFV) tend to adopt a higher number of SWMPs in comparison with those that processed essential oils (ESO) and coconut products (COP). With regard to firm size, large firms, not surprisingly, tended to adopt a higher number of SWMPs. For example, nearly 20 percent of large firms adopted more than 4 such practices in the firm compared to 67 percent of small firms who did not adopt a single practice.

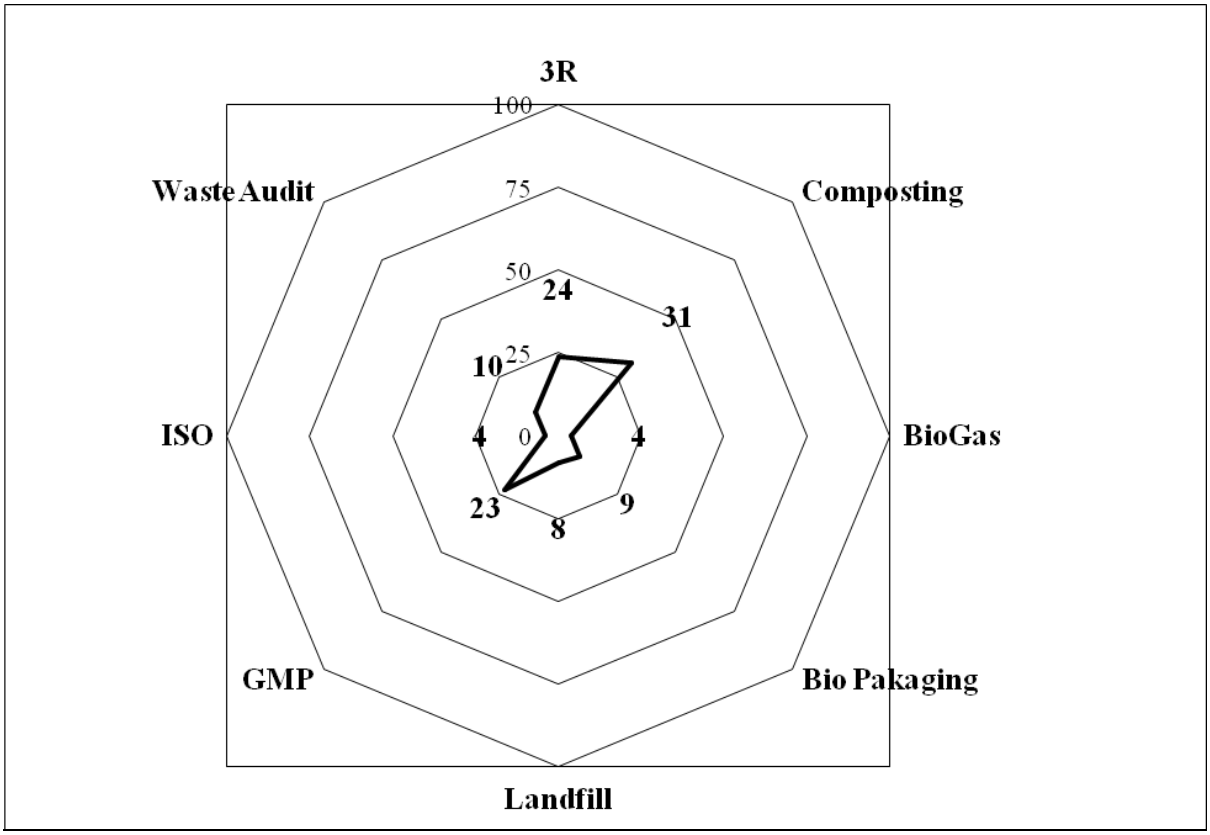

Figure 01: Percentage of adoption of different SWMPs by the firms

Mean Value of the Attitudinal Statements

To evaluate the extent to which the decision maker of the firm perceived the effect of individual statements explaining environmental altruism, the Mean of the scores provided by respondents on each statement on the likert scale was calculated for the sub samples representing both firm type (5 categories) and firm size (2 categories). The values reported in Table 2 clearly show that these values varied substantially within these sub samples.

The highest Mean value was reported for the statement U_{11} for all sub samples, which tells us that all firms judge that a certain amount of environmental damage is tolerated if there is to be economic growth. Given that Mean of the statement U_{12} was relatively high and positive in all sub samples, we can state that all managers recognize that it is their responsibility to ensure that his/her organization must work on its environmental performance. However, as can be seen in Table 2, the means of the majority of statements in almost all sub samples for other statements were rather low and in many times they were negative indicating that the environmental altruism of managers in the food processing sector is not satisfactory.

Outcome of the Component Factor Analysis

While there is no rigorous criterion specified to assess when factor loadings are significant, Spector (1992) suggests that a minimum value of around 0.30 – 0.35 indicates that an Indicator loads onto a factor, thus unidimensionality condition is satisfied. The outcome of PCA clearly shows that all the statements used to assess environmental altruism in this analysis were condensed into a one factor (Table 3).

Table 02: Mean values of the attitudinal statements

AS	Firm Type					Firm Size	
	COP	**ESO**	**NAB**	**OPP**	**PFV**	**SML**	**LRG**
U_1	0.95	-1.12	0.89	-1.28	1.13	-1.32	1.81
U_2	0.00	-1.37	0.77	-1.44	0.83	-1.56	1.50
U_3	2.00	-0.35	1.83	-0.31	1.80	-0.33	2.48
U_4	2.29	0.87	2.22	0.78	2.16	0.75	2.69
U_5	1.09	0.21	1.81	0.09	1.75	0.01	2.31
U_6	0.90	-1.06	1.61	-0.26	1.48	-0.44	1.85
U_7	0.00	-1.69	-0.31	-1.54	-0.15	-1.71	-0.34
U_8	0.19	-0.02	1.71	0.09	0.97	0.01	1.46
U_9	-1.61	-3.5	-2.19	-3.75	-2.67	-4.03	-1.88
U_{10}	-1.47	-2.07	-1.34	-1.65	-1.48	-2.18	-0.90
U_{11}	3.04	2.77	3.05	3.05	2.99	2.79	3.25
U_{12}	2.81	2.21	2.24	2.24	2.71	2.03	3.29

Table 03: Rotated factor loading matrix

Altruism Statement	Varimax-Rotated Factor Loadings	COM	Estimated Weight (W)
U_1	0.873	0.763	0.019
U_2	0.892	0.796	-0.032
U_3	0.847	0.718	0.185
U_4	0.837	0.701	0.319
U_5	0.864	0.746	0.206
U_6	0.812	0.659	0.117
U_7	0.780	0.608	-0.151
U_8	0.579	0.336	0.113
U_9	0.753	0.567	-0.561
U_{10}	0.436	0.190	-0.311
U_{11}	0.444	0.197	0.586
U_{12}	0.749	0.561	0.508

Note: COM – Communalities

Derivation of EAI and WEAI

The values of both unweighted and weighted index EAI and WEIA were obtained for each and every firm in the sample and Mean of EAI and WEIA are illustrated in Figure 3 for sub samples representing the firm types and the firm size.

The results highlight that degree of environmental altruism is comparatively low as the values of both EAI and WEAI are below 0.2 when food processing firms taken as a whole. However, we can infer that the degree of environmental altruism of managers has a positive correlation with firm size, because Mean EAI and WEAI of the large firms is positive and greater than any other sub sample and that of small firms is negative suggesting that the larger firms posses a higher tenacity to adopt SWMPs in compared to their counterpart. However, the type of firm does not show any significant difference with regard to the degree of environmental altruism. The non-alcoholic beverage (NAB) processing firms possess the highest positive value for both EAI and WEAI followed by those fruits and vegetables (PFV) and coconut product (COP) processing firms, while the mean values of other two types of firms (i.e. ESO and OPP) were negative indicating that the management of those firms, on an average, did not show altruistic behavior towards the environmental quality.

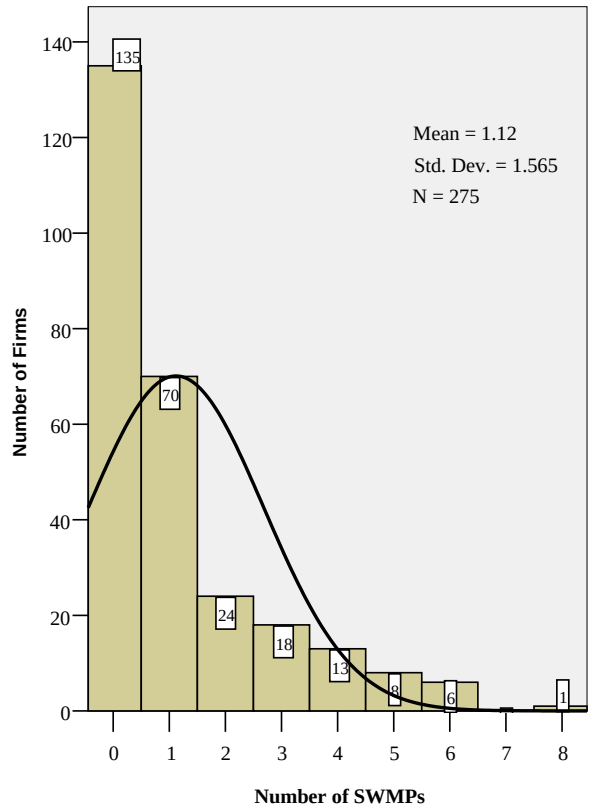

Figure 02: Number of SWMPs adopted by the firms

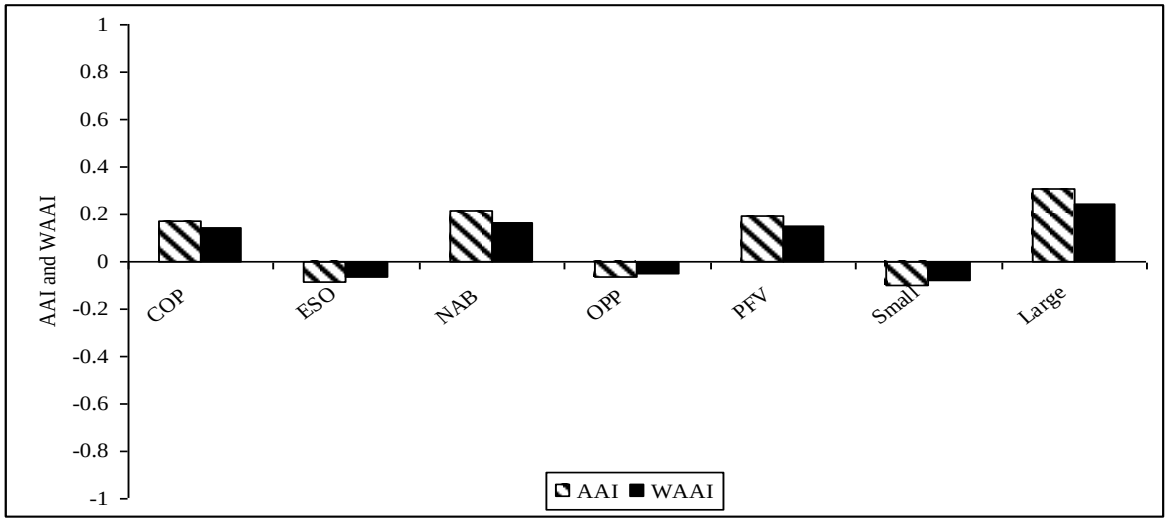

Figure 03: Mean values of EAI and WEAI for different sub samples

Results Pertaining to the Count Data Analysis

As can be seen from Figure 1, the number of SWMPs adopted by firms in the sample differs considerably. As a result, the dependent variable would be in the form a non negative integer-valued count and the appropriate statistical model could be the Poisson Regression model. However, in most economic applications, the integer-valued count data encompasses over-dispersion meaning that the Conditional Variance exceeds the Conditional Mean. In such cases, Poisson model cannot be used. In addition, a relatively higher frequency of zero observations on the dependent variable is another frequently encountered issue in empirical studies. Thus, with a large proportion of zero observations and the potential presence of over-dispersion, the Poisson Model is not appropriate (Cameron and Trivedi, 1998). Given that 135 out of 275 firms (49.1%) in the sample did not adopt even a single SWMP (i.e. non-adopters), the Zero-Inflated Poisson (ZIP) and Zero-Inflated Negative Binomial (ZNIB) models were selected for the analysis.

The ZIP regression was performed initially. The Vuong test of ZIP versus standard Poisson (probability value = 0.000) proved that ZIP model is preferable to the parent Poisson distribution. Next, the ZINB regression analysis was performed and insignificant dispersion parameter alpha (α) with the probability of 0.862 proved that there is no unobservable heterogeneity. As a result, the outcome ZIP model was selected as the best fitted model to explain the relationship specified in the econometric model (Table 4).

Table 04: Estimates of coefficients of ZIP model

Variable	Estimate of Coefficient	Probability
WAAI	3.271	0.981
ESO	1.937	0.998
NAB	2.412	0.995
OPP	1.321	1.000
PFV	1.832	0.999
LRG	2.489	0.981
Constant	2.347	0.996

** Significant at 5% level*
Voung test of ZIP vs. standard Poisson: p = 0.000
Note: COF – Coefficient; PRO – Probability

The outcome of analysis shows that there is no significant relationship between the firms' decision to adopt SWMPs with the degree of environmental altruism of the decision maker. Interestingly, none of the other variables were significantly associated with the adoption decision either indicating that firm type or size does not act as a significant factor in this respect. It is evident that both the levels of adoption of SWMPs at the firms and degree of altruism of managers in this sector were not up to considerable level to impact the adoption; for example the Mean level of adoption is almost 1.2 with a large majority of non-adopters in the sector and the value of environmental altruism index is below 0.2 showing very low positive altruism of managers.

CONCLUSIONS

The outcome of analysis proves that the low levels of environmental responsiveness of agri-food processing firms, which is reflected by the small number of SWMPs adopted by the firms, is associated with relatively low degree of environmental altruism of decision maker of the firm. Therefore, it could be assumed that the perceptions of managers who make decisions with regard to environmental quality in this particular sector may be triggered by the perspectives of diminish profit and/or increased costs and other financial implications associated with the adoption of such controls rather than their unselfish thoughts on the private and social benefits of it in the long run.

The results, overall, suggest that the lack of formalized environmental structures and/or empowerment in the firm appear to have established a context of moral frustration for environmentally interested managers who may feel obliged to suppress their altruistic behavior and prioritize economic interest of the firm. Or it could also be due to the fact that external institutional pressure to adopt these environmental management controls in the developing country context has submerged the altruistic behavior of the managers. We may infer that firms' voluntary action on responding to the market-based incentives such as reputation, minimizing commercial pressure and increasing efficiency in technology and human resources may also not become a reality as the decision makers lack propensity to act voluntarily on such action.

In its process to respond to the current regulation on environment, a firm has several roles to play and out of which augmentation of environmental altruism of

managers is not second to any. The outcome of analysis insists that the government, together with the other sectors in the market (such as industry and trade organizations) should assist the firms to develop appropriate environmental quality management programs coupled with extensive training to enhanced their awareness on the environment. Trade and other industry organizations, as an integral part of the market can play an extensive role in this connection to make use of a firm's resource base most effectively in this respect, and for that purpose, it is needed to reward the self-motivated managers regularly for their altruistic behavior on environmental quality.

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