ADOPTION OF HACCP FOOD SAFETY METASYSTEM BY AGRI-FOOD PROCESSING ENTERPRISES IN SRI LANKA: AN EMPIRICAL ASSESSMENT ON INCENTIVES FOR FIRMS TO ACT

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ABSTRACT

The effect of market-based, regulatory and liability incentives for Sri Lankan tea and dairy processing firms to adopt HACCP food safety metasystem is explored. The highly export-oriented tea processing firms are more likely to adopt HACCP voluntarily in response to the market-based incentives they face such as enhanced reputation, increased sales and commercial pressure, while the dairy firms that serve largely to the domestic markets show non-compliance. The importance of developing an appropriate mechanism to inject market-based incentives and strengthening food safety regulation aiming food and agribusiness sector of Sri Lanka is emphasized.

Keywords: Adoption, Economic incentives, Food processing sector, Food safety, HACCP

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EXECUTIVE SUMMARY

The impact of individual market-based, regulatory and liability incentives on food safety responsive behaviour of firms is assessed using the Sri Lankan tea and dairy processing firms‟ motivation to adopt HACCP food safety metasystem as the case. A series of face-to-face interviews were conducted with the manager responsible for food quality assurance in the firm, supported by a validated structured questionnaire and a site inspection, between April and September 2010 to collect data from tea (n=32) and dairy (n=34) processing firms operate in six provinces. A comprehensive Structural Equation Model was developed using the "*Analysis of Moment Structures*" statistical package to elicit the effect of nine individual incentives on firms‟ decision to adopt HACCP and to derive an Incentive-Related Index reflecting the strength of each incentive. The outcome of analysis suggests that "Reputation" has the greatest impact on a firm's food safety behaviour followed by "Sales and Revenue" for tea and "Liability Laws" for the dairy processing sectors. It also implies that larger firms have a greater tenacity to adopt HACCP than smaller firms and tea sector is more likely to adopt this metasystem voluntarily than the dairy sector. This creates the need for policy makers to recognize the importance of market-based incentives and the close interplay and interactions of which with regulatory incentives, and in turn, importance of development of a properly functioning regulatory and liability system and a steadfast system to inject market-based motivators such as brand equity to promote adoption of HACCP among firms.

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1. INTRODUCTION

Throughout the world, there is an on-going process of reforms to the food safety controls. In part, this is in response to the emerging regulations and standards on food safety and quality and the demands of the food markets at the local, regional to international level. In fact, the governments as well as respective food processing industries, both in the developed and developing countries, are currently intensifying their efforts to improve the levels of food safety in response to an increasing number of food safety problems and rising consumer concerns. Parallel to the reform of food safety regulation, private enterprises are themselves implementing new forms of food safety controls to act in accordance with the demands of the local and international markets and/or internal management pressures. One example is adoption of Hazard Analysis & Critical Control Point (HACCP) food safety metasystem (Caswell *et al*, 1998; Mortimore and Wallace, 1998).

Like many other developing and developed countries, the agri-food processing sectors in Sri Lanka face an array of challenges and opportunities related to the management of food safety; with regulatory requirements in a "state of flux", laying down increasingly strict requirements on the end-product quality and the production process, and their customers, locally and globally, demanding ever more strict food safety standards. Also, food safety controls can impose a significant economic burden on agri-food businesses that can threaten national and international competitiveness. All of these factors highlight the need for food safety controls to be effective and cost efficient. Thus, it requires a clear understanding of the underlying economic forces that induce and control food safety in the agricultural and food processing sectors (Henson, 2007, Henson and Jaffee, 2008).

There is an ongoing debate involving economists and policy-makers regarding the most effective and desirable mechanisms to achieve an appropriate level of food safety. A review of the food economics literature identifies a number of incentives and provides evidence of the potential roles played by these incentives. They have begun to recognize that food suppliers face a broad array of incentives to implement enhanced food safety controls (Bukenya and Nettles, 2007, Henson and Holt, 2000, Ollinger and Moore, 2008). According to Segerson (1999), a system of economic incentives operates broadly at two levels, i.e. market-driven versus regulatory inducements or liability legislation. Buzby *et al.* (2001) suggest three elements that create incentives for a food business to have enhanced food safety controls in its place, including: (1) market forces; (2) food safety laws and regulation, and (3) product liability laws.

Jayasinghe-Mudalige and Henson (2007) subdivided these three elements of a system of economic incentives further into ten hypothetical distinct incentives and suggest that the relative importance of each of these incentives to adopt enhanced food safety controls differs across different sectors in an economy and regions within a country. The literature also suggests that in many circumstances, these incentives are both inter-related and operate simultaneously (Henson and Hooker, 2001) and the controls implemented by individual businesses can, in turn, reflect the interplay between them (Henson and Northen, 1998).

Consequently, it is required that these economic incentives are managed in such a way that food safety controls, and more specifically metasystems like HACCP, are implemented in the most efficient and cost effective manner, both from the perspective of private enterprises and government. Nevertheless, to date, there is little systematic evidence available that reports the effectiveness of incentive-based market-oriented mechanisms to ensure food safety, and the findings from empirical studies based on the performance of food industries in the developing world in this respect are scarce. In light of this, the specific objective of this study was to examine empirically extent to which the individual economic incentives comprised of market and non-market forces (i.e. regulatory / legal) motivate firms operate in the agri-food processing sectors in Sri Lanka to adopt the HACCP metasystem and to assess the impact of firm and market-specific characteristics on the strength of prevailing these incentives at the levels of firm to augment adoption of HACCP.

The empirical analysis was based on the firms operate in two prominent food processing industries in Sri Lanka, namely the: (1) Tea, and (2) Dairy processing firms. The selection of which for this study was on the justification that, amongst the others, they: (a) represent, respectively, the "crop" and "livestock" based industries; (b) cater into two different markets such that more than ninety percent of processed tea is exported to the international markets, where the "food safety concerns matter for them today" more than ever, and as a result, the exports are subject to both globally and locally oriented food safety standards and regulations in various forms, and, on the other hand, a large share of dairy products are consumed domestically, and due to highly sensitive nature of the products, they are subject inherently to the food safety related issues, and (c) these firms are scattered all over the country and play a substantial role in Sri Lankan economy in terms of their contribution to domestic production, markets, value-addition and employment etc.

Here we present the results of first phase of a multi-stage program of research carried out on this issue. This is the first time a comprehensive empirical research that is enriched by panel data is carried out to examine this important economic problem in the context of agri-food processing sector in Sri Lanka.

2. METHODOLOGY

A systematic procedure was used to assess the effect of individual economic incentives on firms' decision to adopt HACCP empirically. From one hand, we need to understand the firm's level of adoption of HACCP and the effect of individual economic incentives that can have an impact on this decision must be evaluated, on the other. The steps used to identify the individual incentives of interest and to quantify which using the Structural Equation Modelling (SEM) techniques are explored next which ultimately led to development of an index reflecting the relative strength of an each incentive at the level.

2.1 Firm's Level of Adoption of HACCP

At a given point of time, a firm can be classified into one of the four categories based on the actions taken by its management with respect to the adoption of the HACCP food safety metasystem, such that the firm: (1) has "*no plan*" to implement it; (2) "*has a written plan*" to implement it; (3) "*is in the process*" of implementing it, and (4) "*has already adopted*" it. A careful investigation into the process and records through site inspection is needed to determine the state of adoption.

2.2 Identifying the Individual Economic Incentives

We hypothesized that the managerial decisions on the adoption of HACCP was coupled with a system of economic incentives a firm faces, which is comprised of the market (private), regulatory (public) and liability (judiciary) incentives and is characterized by the direct and indirect "expected benefits" and "costs" to the firm arising from that decision. The nine individual incentives identified in Jayasinghe-Mudalige and Henson (2007) using a qualitative approach based on *N-Vivo* statistical package and a quantitative assessment based on index-based Logistic Ordered Regression was chosen to serve as the base of the theoretical formulation of the model. It classifies these 9 incentives under three main types of economic incentives, including: *market-based incentives* such as (1) financial implications/cost (CST); (2) efficiency in human resources (HRE); (3) efficiency in technical procedures (TCE); (4) sales and revenue (SLR); (5) reputation (REP), and (6) commercial pressure (CPR); *regulatory incentives* such as (7) existing government regulation (EGR) and (8) anticipated government regulation (AGR), and *Liability incentives* such as (9) liability laws (LBL).

2.3 Quantification of Effect of Economic Incentives

2.3.1 Use of Structural Equation Modeling

Unlike the level of adoption of HACCP, which can be decided upon a careful investigation into the respective records and through an on-site inspection, an analyst works on quantifying the real impact of an individual incentive on a behavior of firm faces several challenges, including: (a) "*Mutual Exclusivity*" and "*Endogeneity*" of incentives, i.e. prevalence of an individual incentive as an element of a system (Nakamura *et al.*, 2001, Shavell, 1987); (b) "*Subjectivit*y", i.e. the management of firm perceives these incentives in terms of potential benefits and costs to the firm (Buchanan, 1969), and (c) "*Unobservability*", i.e. the management cannot directly observe the nature of incentives prevailing at the firm level (Hair *et al*., 1998).

To minimize such effects, and in turn, to come up with an objective assessment of individual incentives, moving beyond the methodology adopted by Jayasinghe-Mudalige and Henson (2006; 2007), this study has resolved to use the Structural Equation Modelling (SEM) with the aid of *Analysis of Moment Structures* (AMOS) [*version 16*] statistical package to quantify the effect of these incentives. SEM is a family of statistical models that seek to explain the relationships among multiple variables, which combines *Measurement Model* [commonly referred to as Confirmatory Factor Analysis (CFA)] and *Structural Model* into a simultaneous statistical test. It has the ability to incorporate latent variables (i.e. a hypothesized and unobserved concept such as "incentives" considered in this analysis) that can only be approximated by observable or measured variables or indicators into the analysis (Hair *et al*., 1998; Hoe, 2008).

2.3.2 Specification of Measurement Model

The Measurement Model of SEM developed for the purpose of this analysis to quantify the individual economics listed above is illustrated in Figure 1, where the nine incentives were served as the "Constructs" in the model with each loading on to five "Indicators", and as will be explained later, a series of attitudinal statements can be used to represent the Indicators of the model (Hair *et al*., 1998).

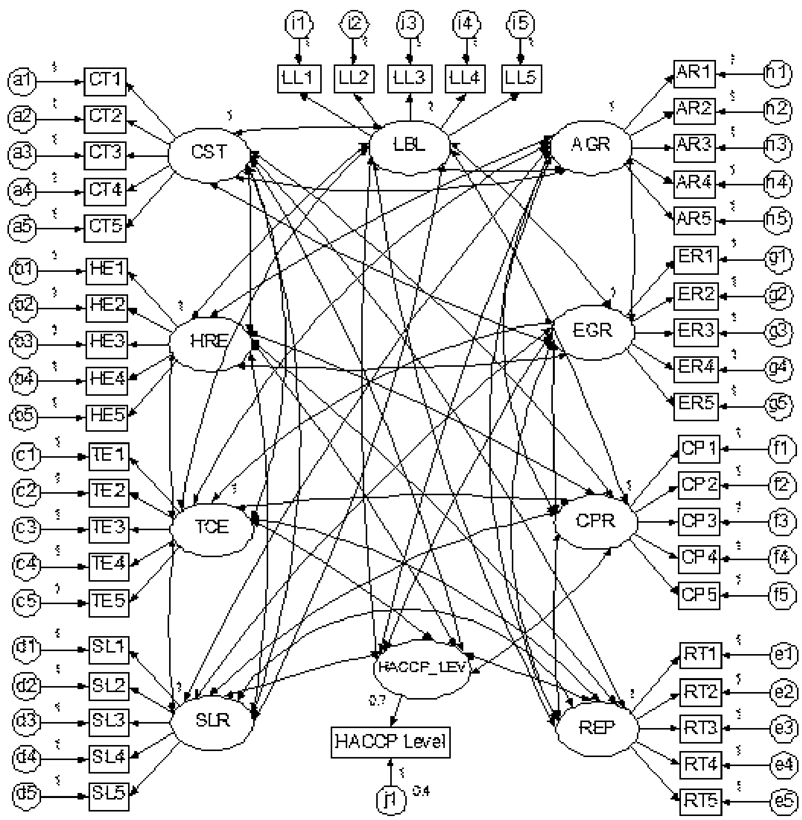

Figure 1. Measurement Theory Model for Confirmatory Factor Analysis

Using the standard notations given in the Jöreskog and Sörbom (1996) and Hair *et al*. (1998), the Measurement Model can be expressed as follows by means of a series of equations such that for any single Indicator associated with an exogenous latent construct:

$$x_1 = \lambda_{x1,1}\,\xi_1 + \delta_1 \qquad (1)$$

where, $\lambda_{x1,1}$ represents the relationship between the latent factor ξ_1 and the measured variable, x_1, it explains; because it does not explain it perfectly, δ_1 represents the error. The recommendations of Hair *et al*., (1998) were considered to assess the validity of Measurement Model for its "Model Fit" and the "Construct Validity". The former was determined using Multiple Fit Indices. A number of other measures were employed to assess the Construct Validity, including: (a) "*Face Validity*" (content and meaning of the attitudinal statements representing Indicators in relation to their associated incentives); (b) "*Convergent Validity*" (indicators of a specific incentive should converge or share a high proportion of variance in common); (c) "*Discriminant Validity*" (extent to which a incentive is truly distinct from other incentives) and, (d) "*Nomological Validity*" (whether the correlations among the incentives in the measurement theory made sense).

In addition, several other measures were estimated for the same purpose, including: (a) Factor Loadings (given as Regression Weights in the AMOS); (b) Reliability, and (c) Average Variance Extracted (AVE). With regard to Factor Loadings, Hair *et al.* (1998) recommend that Standardised Regression Weights obtained through the AMOS should be 0.5 or higher, ideally 0.7 or higher and at a minimum statistically significant. To test for Reliability, we have resolved to estimate the Construct Reliability (CR) using the Equation (2), as it is recommended to be used in conjunction with the SEM for this purpose (Garver and Mentzer, 1999):

$$CR = (\Sigma\lambda_j)^2 / (\Sigma\lambda_j)^2 + \Sigma(1-\lambda_j^2) \qquad (2)$$

Where, λ denotes the Standardized Factor Loading and *n* shows the number of Indicators used in the model. The rule of thumb for CR is that it should be 0.6 or higher, and ideally 0.7 or higher to mean that reliability is good with internal consistency (Fornell and Bookstein, 1982). Based on the same notations, AVE can be estimated using the expression $\Sigma\lambda_i^2/$ n (Hair *et al*., 1998), and a value of 0.5 or higher to which suggests adequate convergence and that the scale has higher distinct validity (Fornell and Larker, 1981).

2.3.3 Specification of Structural Model

Once the Measurement Model was established, the next step was to explore the Structural Model. Using the standard notations in Jöreskog & Sörbom (1996) and Hughes *et al*. (1986), it can, theoretically, be expressed as in equation (3) below:

$$\eta = \Gamma\, \xi + \zeta \qquad (4)$$

where, η represents the endogenous construct in the model, Γ is the corresponding matrix of parameter coefficients linking the exogenous constructs, ξ, with η and ζ represents the error in the prediction of η. In AMOS, the nine individual incentives identified above were specified as exogenous constructs and the level of adoption of HACCP (HACCP_LEV) as the endogenous construct for this purpose (Figure 2).

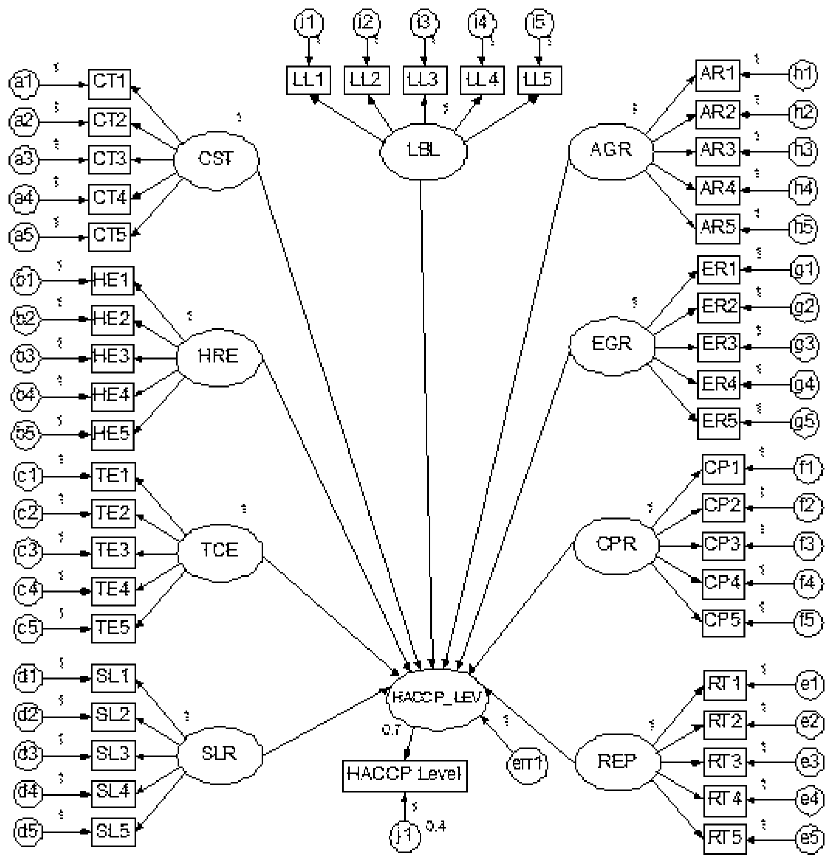

Figure 2. Structural Model for Estimated Structural Theory

Following Hair *et al*. (1998), the level of adoption of HACCP by a firm was treated as a single-item measure, and in turn, the best possible value for the Reliability was estimated (Est_R). The relationship between the "actual level of HACCP adoption" variable (HACCP LEVEL) and the "latent construct" (HACCP_LEV) was then fixed to the square root of the estimated reliability and the corresponding error term was in consequently set to = 1 – Est_R. Empirically, the single indicator of this construct consisted of binary response, i.e. whether the firm had an HACCP system at present or not. The outcome of this model was herein utilized to choose the set of indicators that most accurately reflect variation in the incentive they stand for. The management of firm can, in turn, evaluate the performance of her firm with regard to the phenomenon explained by each Indicator, which, evidently, represents an important characteristics of a given incentive (Henson and Traill, 2000; Jayasinghe-Mudalige and Henson, 2007).

2.4 Derivation of an Incentive Related Index

Once the most valid and reliable Indicators for the respective Constructs (i.e. attitudinal statements for incentives) were chosen, the next step was characterized by derivation of an index to reflect the relative effect of each incentive at the level of firm towards its action on adoption of HACCP, which is herein referred to as "Incentive Related Index" (IRI). This can be computed for each of the nine incentives using the scores given by respondents to each indicator. The IRI was, in particular, developed in the following manner:

$$IRI_{ik} = \frac{\left(\sum X_{ij} \big/ N_k \right)}{M}$$

Where,

IRI_{ik}	= Incentive related index of k^{th} incentive for the i^{th} respondent
X_{ij}	= Scores given by i^{th} respondent to j^{th} statement (of k^{th} incentive)
N_k	= Number of statements per k^{th} incentive
M	= Maximum Potential Score for all statements of k^{th} incentive

The value of IRI, therefore, ranges from -1 to +1 depends on the scores provided by respondents to respective statements of an incentive on a multi-point likert-scale (see below).

2.5 Study Area and Data

A *face-to-face* interview with the manager responsible for food safety and quality assurance/owner of the firm of tea (n = 32) and dairy (n = 34) processing firms from six provinces in Sri Lanka (Western, North Western, Central, North Central, Sabaragamuwa and Southern) were carried out between March and August 2009 with the support of a pre-tested (n = 8) structured questionnaire to collect data followed by a site inspection and a search for records to verify the status of adoption of HACCP. Any firm was considered for being included in the sample on the condition that it is willing to participate to the second stage of study too to facilitate the panel data analysis in future. Though this led to “non-participation” of some of the firms into the study in the first place, and as a result, the sample size became relatively small, we can generalize the outcome of analysis as the firms responded to the study embodied the general characteristics of the firms in these two industries.

To develop the Measurement Model, following Henson and Traill (2000) and Jayasinghe-Mudalige and Henson (2007), the responses to a set of attitudinal statements (m = 45) in the questionnaire were defined as Indicators to reflect the observable characteristics of the nine incentives of interest. The statements were a modification to the existing five-point likert scale, by including a “Yes” (Agree) and “No” (Disagree) field; resulting in a 1 to 5 range of ‘agree a bit’ to ‘strongly agree’ and ‘disagree a bit’ to ‘strongly disagree’. This enabled the possibility of obtaining numerical scores that ranged from -5 to +5 to a statement on which the respondents were asked to score on based on its conceptual meaning and the underlying or corresponding phenomenon. Certain statement were inverted purposely in the questionnaire, so that respondents cannot guess the potential incentive, and in turn, provide answers invariably and hastily, thus preventing ‘agreement bias’.

To assess the impact of firm characteristics on its behavior on food safety and quality assurance, the tea and dairy firms in the sample were categorized into four based on their size as follows: (1) Tea-Small (TS); (2) Tea-Large (TL); (3) Dairy-Small (DS), and (4) Dairy-Large (DL). Given empirical issues, we have resolved to use two different criteria to distinguish small firms from large firms in tea and dairy processing industries, where any tea processing firm of which green leaf intake per day was less (more) than 10,000kg was considered a Tea-Small (Tea-Large) firm. For dairy, we cannot obtain a reliable measure on production applicable to all in the sample, given the lack of maintenance of proper records and/or due to the issues related to "confidentially", thus, any dairy processing firm which possesses less (more) than 50 workers was considered a Dairy-Small (Dairy-large) firm. In addition, a further categorization similar to above was done on the level of HACCP adoption. Firms that already possess a system of HACCP were named as "HACCP Adopters" (HA) and the rest into "HACCP Non-adopters" (NA) to make the statistical analysis uncomplicated and to harmonize with small sample size.

3. RESULTS AND DISCUSSION

3.1 Firms' Level of Adoption of HACCP

The descriptive statistics of sample, which comprised of 32 and 34 tea and dairy processing firms, respectively, are reported in Table 1.

Table 1: Characteristics of firms in the sample

Sector	Scale of Operation		Total
	Small	Large	
Tea	*<10,000 kg*[a]	*>10,000 kg*[a]	
	18 (27%)	14 (21%)	32 (48%)
Dairy	*<50 emp*[b]	*>50 emp*[b]	
	16 (24%)	18 (27%)	34 (52%)
Total	34 (58%)	32 (48%)	66 (100%)

Note: [a] green leaf intake per day; [b] emp – no. of employees

Nearly 31.3% of tea processing firms already possess a system of HACCP in the firm compared to just 20.6% of dairy processing firms. Also, we found that that only 9.4% of tea processing firms have no plan to implement HACCP compared to 64.7% of dairy processing firms in the sample. When this is considered with regard to the size-based categories, as shown in Figure 3, almost all of the small diary (DS) firms have no plan to implement HACCP, while 22.2% of small tea (TS) firms, on the other hand, already have implemented HACCP with only 16.7% with no plan to implement. Even among the large-sized firms, differences fairly lesser were obvious, with 38.8% of large dairy (DL) firms with no plan, compared with none in the large tea (TL) firms. These results are symptomatic that tea processing firms than the dairy processing firms and large firms than the small firms have greater propensity to adopt HACCP.

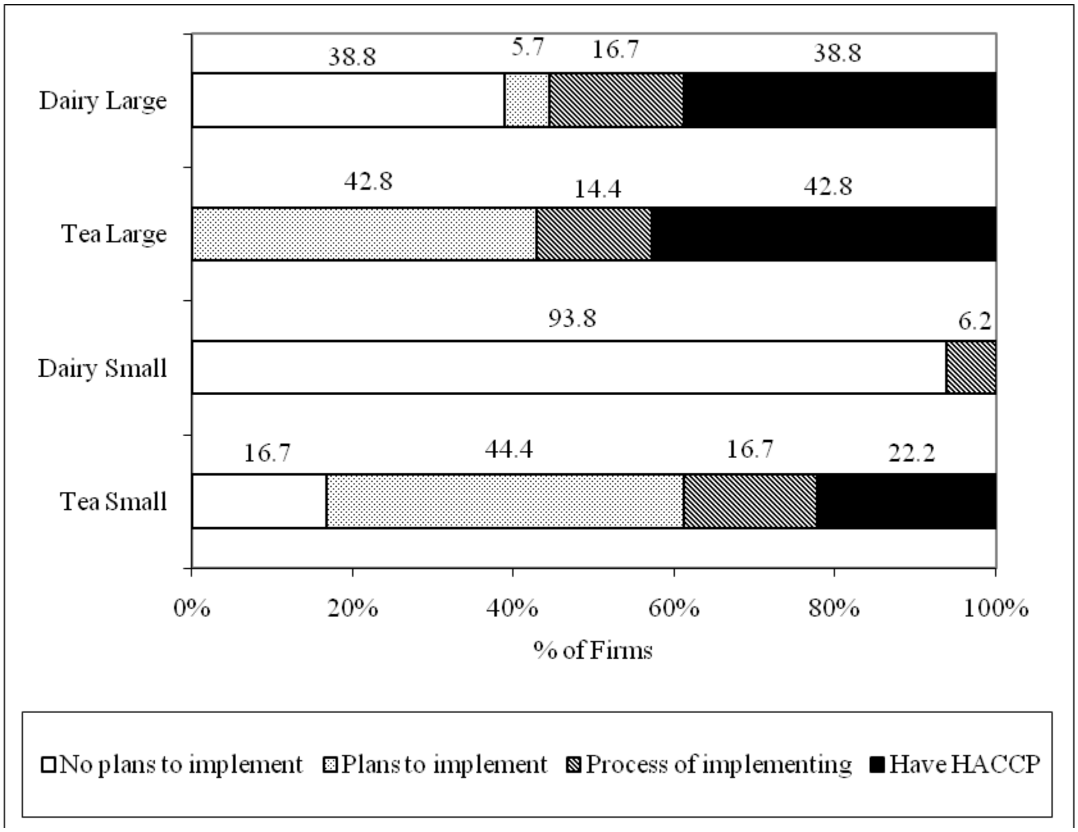

Figure 3. Level of adoption of HACCP by tea and dairy firms

3.2 Outcome of Estimates from the AMOS

As the first step towards quantification of incentives using the AMOS, the Measurement Model Fit was assessed by means of Multiple Fit Indices commonly use this statistical package, namely Chi-square, CFI, TLI, and RMSEA (Hair *et al.*, 1998; Hoe, 2008). However, the outcome of analysis at this point of time, which uses 45 statements as Indicators, indicated that the model fit was insufficient to proceed with the same set of indicators; thus, it needs to "prune" the superfluous Indicators.

To do so, the Regression Weights (i.e. Factor Loadings) of each of the indicators were taken into account, and they were checked for the cut-off point of 0.5 or higher. We found that 13 out of the 45 statements had Standardized Regression Weights below the 0.5 cut-off point and 10 out of these were insignificant (at p=0.10). As a result, the model was pruned by removing these 10 insignificant statements; however the remaining 3 statements were retained despite their low factor loadings because of their conceptual importance to their respective constructs, or in other words, to explain the specific facet of the corresponding incentive. Having removed the insignificant Indicators, the revised model was estimated again and the outcome of which is reported in Table 2.

Table 2: Measurement and Structural Model Fit Indices

Goodness-of-Fit Measures	Measurement Model Estimates	Structural Model Estimates	Cut-off Values Based on Model Characteristics
Chi-square (X^2)	1226.59	1579.49	
Degrees of Freedom (df)	550	587	
Probability Level	0.000	0.000	Significant p-values can be expected
X^2/df Ratio	2.230	2.691	< 3
CFI	0.894	0.872	> 0.92
TLI	0.822	0.815	> 0.92
RMSEA	0.061	0.073	< 0.08 with CFI of 0.92 or higher

The values of Measurement Model Fit Indices of the modified model indicated a reasonable model fit given the nature of the study in assessing a complex model through a relatively smaller sample size (Hair *et al.*, 1998) and utilizing a 'total disaggregation' approach (Hoe, 2008). The Standardised Regression Weights indicated that all loadings were significant (at p=0.05) and, except the 3 retained indicators, had the loadings exceeding 0.5 with more than half of the statements having the loadings above 0.7. The Construct Reliability (CR) and Average Variance Extracted (AVE) measures were estimated next for the modified version of model with 35 Indicators (Table 3).

Table 3: Construct Reliability and Average Variance Extracted Estimates

Construct (Individual Incentive)	Construct Reliability (CR)	Average Variance Extract (AVE)	Final No. of Indicators
CST	0.807	0.506	5
HRE	0.762	0.527	3
TCE	0.627	0.535	3
SLR	0.589	0.464	4
REP	0.867	0.592	5
CPR	0.726	0.508	4
EGR	0.715	0.509	3
AGR	0.891	0.632	5
LBL	0.592	0.635	3

The CR values of all, except three constructs (TCE, SLR and LBL), were above 0.7 with two constructs lower than 0.6. The CR estimates of SLR and LBL were only marginally below 0.6, thus signifying that all constructs have adequate reliability. The AVE of only one construct fell below 0.5 (SLR) with all others having estimates above 0.5. For all nine constructs as a whole, the indicators were sufficient in terms of Measurement Model specification. Satisfaction of conditions for all three estimates, i.e. Regression Weights, CR and AVE, thus, supported the Convergent Validity of the measurement model.

An examination of the Construct Correlation Matrix showed that none of the correlations exceeded 0.7 supporting adequate Discriminant Validity and all, except HRE, had a positive relationship with other constructs. Although the behaviour of the other constructs showed sufficient Nomological Validity, the correlation values of HRE was unexpected. The estimates of AVE of all constructs (i.e. nine incentives) exceeded their corresponding Inter-construct Squared Correlation estimates. Overall, these measures supported the Discriminant Validity of the Measurement Model. In abstract, the Confirmatory Factor Analysis techniques applied to the Measurement Model proved its validity by means of sufficient model fit and adequate Construct Validity.

The modified Measurement Model was then re-specified and the Structural Model (as illustrated in Figure 2, but without the pruned scales) was estimated as before. The model fit indices for the Structural Model signified a reasonable model fit (see, Table 2). An examination of the loadings of the indicators showed that there was no substantial change in the values from the Measurement Model. The Standardised Regression Weights of the hypothesised structural paths, or in other words, Standardised Path Coefficients, are illustrated in Table 4.

Chin (1998) recommends that standardised paths of a Structural Model should be at least 0.20, and ideally above 0.30, in order to be considered meaningful for discussion. Also, the estimates need to be statistically significant and in the predicted direction. Out of the nine hypothesised structural paths, only two were neither significant nor in the expected direction (i.e. HRE→HACCP_LEV and EGR→HACCP_LEV). However, it was interesting to note that, given an insignificant path linking EGR and Level of HACCP Adoption, the hypothesised relationship between AGR and HACCP adoption was both significant and carried a high path coefficient estimate.

Table 4 – Standardized regression weights for the structural paths

Hypothesized Relationships			Estimate
HACCP_LEV	<---	SLR	0.138*
HACCP_LEV	<---	TCE	0.149*
HACCP_LEV	<---	HRE	-0.103
HACCP_LEV	<---	CST	0.333***
HACCP_LEV	<---	LBL	0.137*
HACCP_LEV	<---	AGR	0.540***
HACCP_LEV	<---	EGR	-0.232
HACCP_LEV	<---	CPR	0.379***
HACCP_LEV	<---	REP	0.560***

Note: * $p<0.05$, * * $p<0.01$, * * * $p<0.001$

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HRE→HACCP_LEV and EGR→HACCP_LEV). However, it was interesting to note that, given an insignificant path linking EGR and Level of HACCP Adoption, the hypothesised relationship between AGR and HACCP adoption was both significant and carried a high path coefficient estimate. Among the nine incentives, REP, AGR, CPR and CST were the most important determinants and motivators of firm behaviour in relation to food safety and adoption of HACCP. Although SLR, LBL, and TCE had a positive and significant relationship with HACCP adoption, the low path coefficients, adds minimal value to the understanding of the relationships between these incentives and the adoption decision (Hoe, 2008). Also, the substantial support for the hypothesized relationship between CST and HACCP adoption was surprising, given the prior expectation of CST being a deterrent for firms to implement food safety practices.

3.3 Values of the Incentive Related Index

The scores provided by respondents to each Indicator of an incentive on the five-point likert scale were, then, used to derive the IRI for each firm. Figure 4 illustrates the distribution of Mean IRI value (i.e. aggregate of the values of IRI / number of firms) for the firms that already have HACCP in the firm (HA), which, in particularly, belong to the sub-categories of "Small-Tea" (HA-TS), "Large-Tea" (HA-TL), and "Large-Dairy" (HA-DL).

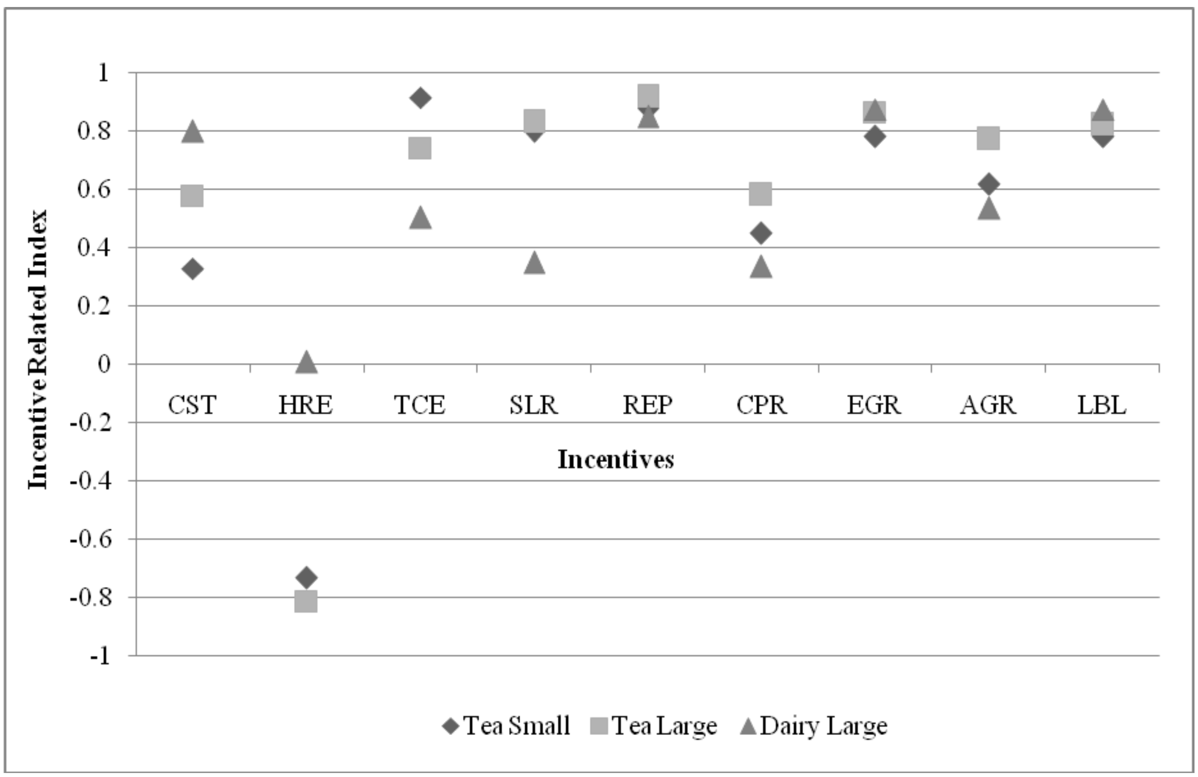

Figure 4. Mean Index Values for the adopters of HACCP

Irrespective of the firm size and type, among the adopters of a system of HACCP, one of the most important incentives was Reputation (REP). This result was in-line with the supported relationship in the SEM phase. This suggests, perhaps that firms are more likely to implement enhanced food safety practices if they are more concerned with brand equity, perceive HACCP certification as an element of their corporate reputation, and believe that this improves the image of the enterprise in the market. Existing government regulation (EGR) followed Reputation as an important motivator for HACCP adoption. However, the lack of support from the SEM phase pushes to doubt the IRI indication.

Both large scale tea (HA-TL) and dairy (HA-DL) firms indicated that the effect of legal system and judiciary has pressurized them to behave food safety responsibly and the IRI pertaining to the Liability laws (LBL) was highest in the large scale dairy firms (HA-DL). The insinuated role of liability laws is reasonable; both tea and dairy processing firms perceive HACCP as a hedge, which reduces their liability should a consumer suffer food product related poisoning. This is clearly important for dairy processing plants, given that milk is a highly perishable commodity and a good microbial support media. In addition, larger firms more sensitive to liability issues than smaller firms and perhaps are more aware of the negative impacts of liability cases against the company.

The Mean IRI of small and large scale tea firms (HA-TS and HA-TL) demonstrated Sales and revenue (SLR) as one of the predominant drivers of HACCP adoption in the firm. Tea processing firms are conceivably more concerned with issues such as revenue and market share since they predominantly trade in the export markets. The relatively lower Mean IRI for the individual incentives of Commercial pressure (CPR) and anticipated government regulation (AGR) came in stark contrast to priori expectations, given the strong support for the hypothesised relationship in the Structural Model. For both these incentives, both small and large scale tea processing firms (HA-TS and HA-TL) had larger values than large scale dairy (HA-DL). This is acceptable, considering that tea processing firms consider adoption of HACCP since it is a requirement of their international customers, while most of the dairy processing firms including HACCP adopters believed that a majority of their customers do not have any idea about HACCP.

In the dynamic global marketplace, tea processing plants, perhaps, consider the need to prepare for changing regulatory systems and possible HACCP certification requirements in markets other than the European Union. Dairy firms on the other hand, and small firms in particular, who predominantly serve the local customer base do not anticipate any government regulation mandating HACCP adoption in the near future.

For all firms that have adopted HACCP, Cost/financial implications (CST) were a considerable incentive. The relative impact of this increased with increasing firm size. Firms that have implemented HACCP in their plants perceive it as cost efficient, with larger firms in a better position in both resources and capabilities to support enhanced food safety practices. The negative index values for Human resource efficiency (HRE) for almost all categories, together with the insignificant relationship in the structural model, imply that firms do not perceive HACCP adoption enhances efficiency of their human resources and thus is not a significant motivating factor.

4. CONCLUSIONS AND POLICY IMPLICATIONS

The role and impact of firm level incentives comprised of an elements of a system of market-based, regulatory and liability incentives to adopt HACCP food safety metasystem in the agri-food processing sector of Sri Lanka was assessed in this study with special reference to its tea and dairy processing firms. Overall, the results suggest that reputation is the most important propeller behind food safety responsive behaviour of firms, followed by sales and revenue as being more important for tea plants and liability laws having high impact on dairy firms. Other coercive elements responsible were commercial pressure and anticipated government regulation.

The outcome of analysis, overall, calls for better recognition of market-based incentives from policy makers and demand for an approach in the form of "Carrot (to comply) and Stick" (for non-compliance), as suggested by Segerson (1999), to augment the levels of food safety maintained by the firms, since both market and regulatory incentives operate side-by-side in a complex and close association; not only rely on one form of incentives, but utilize both to enhance the food safety aspects of the agri-food processing sector. Support programmes to improve brand equity, assistance to branding exercises and quality/safety certification, subsidised communication and promotional channels/options, properly functioning liability system, publicity for liability cases or food product-related trials, increasing public awareness about safety and quality issues, and step-wise directives on food safety metasystems, are some of the areas that could be addressed by policies and action programmes to augment firms responsiveness towards food safety, in turn.

The results also highlight the importance of workings of the private (market) and public (non-market) institutions to enhance the levels of food safety maintained by firms on a more "dynamic" perspective, i.e. by taking into account of changes to the incentive-base of a firm over time, to make sure such efforts are sustainable and cost-effective, as the firms responsiveness to food safety depend largely on concurrent changes in the business environments, both locally and globally. The implications of this study is, therefore, such that it provide justification for designing a system that guarantee the consumers of a safe food supply while avoiding draconian measures that hamper the competitiveness of food businesses by curtailing the incentives for producers with little marginal benefit from improved safety controls, or in abstract, there is room for development of an incentive-based regulatory framework for agri-food processing sector in Sri Lanka to augment food safety at the level of firm.

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