

Incentives and Constraints for Bottled Drinking Water Manufacturing Firms in Sri Lanka to Adopt HACCP Food Safety and Quality Metasystem: A Discriminant Analysis

N.D.K. WEERASEKARA¹, U.K. JAYASINGHE-MUDALIGE¹, S.M.M. IKRAM²,
J.M.M. UDUGAMA¹, H.M.T.K. HERATH¹, J.C. EDIRISINGHE¹ and H.M.L.K. HERATH¹

¹*Department of Agribusiness Management, Faculty of Agriculture and Plantation Management, Wayamba University of Sri Lanka, Makandura, Gonawila (NWP)*

²*Nielsen Lanka Company (Pvt) Ltd, Colombo 08*

ABSTRACT

The specific objective of this study was to analyze the economic incentives that motivate and the barriers that impede the adoption of the Hazard Analysis and Critical Control Point (HACCP) food safety metasystem by the bottled drinking water manufacturing firms in Sri Lanka. A structured questionnaire was developed utilizing the information gathered through a series of discussions held with quality assurance (QA) managers of the firms and inspection of manufacturing facilities. Both personal interviews with the QA managers and a postal survey were used to collect data of which the sampling framework consists of all registered firms with the Ministry of Health. Discriminant Analysis was carried out (n=30) to assess the factors that best discriminate between the "HACCP Embracers" and "HACCP Deferrers". The results suggest that large firms were more likely to adopt the metasystem and sales and revenue was the major incentive for a firm to adopt HACCP. Major barriers faced by the firms include lack of finance and negative attitudes of the employees. Further, the low demand for food safety and quality standards and lack of customer awareness about the HACCP played a significant role as the reason for slow uptake of adoption of HACCP by the industry.

KEYWORDS: Adoption, Bottled drinking water industry, Discriminant analysis, Food safety and quality, HACCP

INTRODUCTION

All would agree that there is nothing more satisfying than a cool and refreshing "bottle of water" to beat the heat of the day, wherever you may be. But the fact remains that many of the vast number of consumers who consume what is available in the market under different brand names, as bottled (packaged) drinking water may not be aware how safe it is as a food product. According to unofficial sources there are over 100 brands of bottled drinking water, marketed by various manufacturers available in the open market throughout the island.

However, since the enforcement of the regulations published, under the Food Act No. 26 of 1980, per Gazette No. 1420/4 of 21st November 2005 (i.e.) from around mid-May, 2006, "no person is allowed to:- a) bottle or package natural mineral water or drinking water or, b) import and distribute bottled or packaged natural mineral water or drinking water," without obtaining a certificate of registration from the Chief Food Authority of the Ministry of Health Care and Nutrition. This process of registration of "bottled drinking water", with the Health Ministry is a mandatory requirement for the sale of imported as well as locally manufactured

bottled water in the local market.

The issue of the product certification mark which is known as the "SLS Mark" by the Sri Lanka Standard Institution (SLSI) is a voluntary process, independent of the above registration procedure. This voluntary scheme for obtaining the "SLS Mark" for any product has been in operation since 1980, and is conducted by the SLSI, based on the primary requirement that the particular product complies with the relevant Sri Lanka standard specifications for the product. The relevant Sri Lanka standard specifications with regard to the bottled drinking water are :- (1) SLS 894:2003 - specification for bottled (packaged) drinking water and (2) SLS 1038:2003 - specification for natural mineral water (Wijesekara, 2007).

Considering these facts, it is neither surprising nor unexpected that consumers and many national/ regional supermarket chains and food service operators now consider the SLS certification mark as the "symbol of quality" in respect of all products carrying this mark. It is not unusual now, that though this certification scheme is a voluntary one, most manufacturers desire to obtain the SLS certification and the latter, certification (HACCP) of an independent third party (which

is a government body and the member body of the International Organization for Standardization (ISO) in Sri Lanka) for re-assurance of the product (Wijesekara, 2007).

On the other end, firms that realize the failure in these institutions may reluctant to compliance with the basic recommended levels of food safety controls. Alternatively, based on its position in the market, such a firm could act strategically to avoid such regulation (Henson and Heasman, 1998).

These emphasize the importance of investigating empirically the firm level incentives and constraints for bottled drinking water manufacturing firms to adopt enhanced food safety controls in this "imperfect world", since that information can effectively be used to design appropriate regulation to minimize such failures (Jayasinghe-Mudalige and Henson, 2006).

The objective of this study was to examine the relative importance of economic incentives, constraints and firm characteristics in differentiating HACCP embracers from the deferrers in the Bottled Drinking Water firms in Sri Lanka.

METHODOLOGY

Conceptual Framework

The basis for the conceptual framework was, the level of adoption to HACCP depends on incentives, constraints and firm characteristics. The HACCP adoption level divides firms into two categories, as *Embracers* (EMB) or *Deferrers* (DEF).

Base on the qualitative analysis on incentives by Jayasinghe-Mudalige and Henson (2006), nine individual incentives prevailed at the firm level, were selected for the study. (1) Cost/financial implications (CST); (2) Efficiency of human resources (HRE); (3) Efficiency in technical procedures (TCH); (4) Sales and revenue (SLR); (5) Reputation (REP); (6) Commercial pressure (CPR); (7) Existing government regulation (EGR); (8) Anticipated government regulations (AGR); and (9) Liability laws (LBL).

According to previous studies seven constraints that firms face when implementing HACCP were identified (Herath and Henson, 2010). (1) To retain the staff in new practices; (2) Negative attitudes; (3) Inflexibilities associated with the production process; (4) To renovate the plant with new equipment; (5) Lack of reliable information about food safety/quality controls; (6) Lack of financial support from external sources; and (7) Lack of space to accommodate new practices.

Further hypothesized that the following

firm characteristics were likely to influence in differentiating HACCP embracers from deferrers: (1) Vintage; (2) Firm size; (3) Water source; (4) Major markets; (5) Sales strategy (Herath *et al.*, 2007).

Other than screening firm characteristics, incentives and constraints to differentiate EMB and DEF of HACCP, seven negative perceptions made by managers in bottled water manufacturing firms regard to HACCP were considered to see the relative importance of each of them towards HACCP adoption.

Data Collection and Analysis

According to the list revised on 01st February 2013 by the food control administration unit in Sri Lanka, 61 bottled drinking water manufacturing firms representing 77 brands with valid registrations were selected for the study. A structured questionnaire was developed utilizing the information gathered through a series of discussions held with quality assurance (QA) managers of the firms and inspection of manufacturing facilities. Both personal interviews with the QA managers and a postal survey were used to collect data, during January to March 2013. A total of 30 usable questionnaires were returned, yielding a response rate of 49 per cent. The QA managers were asked to respond each of the incentive and constraint according to a five-point likert scale ranging from very important (5) to very unimportant (1) and each of the statements under negative perceptions according to a five point likert scale ranging from "very true" (5) to not at all true" (1).

Discriminant Analysis

A Discriminant Analysis (DA) was done using Statistical Package for Social Sciences (SPSS) version 20, to differentiate HACCP embracers and deferrers based on firm characteristics, economic incentives, and constraints.

DA is an appropriate technique when the dependent variable is categorical (non-metric) and the explanatory variables are metric. It is used for testing the hypothesis whether the group means of a set of explanatory variables for two (or more) groups are equal (Hair *et al.*, 1998). The percentage of variance accounted for, by each discriminant function was shown in Eigen values table and the significance of Wilk's Lambda test (0.05 significant level) was used to interpret the statistical significance of the discriminatory power of the discriminant function. The Wilks' Lambda and Univariate ANOVA were used to assess the significance between means of each predictor variable for

the two groups. The 0.05 significant level with the lowest Wilks' Lambda value was used to enter variables into the discriminant function. Discriminant Loadings (DL) which assess the relative contribution of each predictor variable to the discriminant function were considered the most appropriate measure of discriminatory power, but the discriminant weights also considered. Variables exhibit a loading of ± 0.40 or higher were considered substantive. Cross validation approach was used to see the validity of the discriminant results as the original sample is too small to divide into analysis and holdout samples (Hair *et al.*, 1998).

RESULTS AND DISCUSSION

Descriptive Statistics of the Sample

Table 1 summarizes details about the sample. 67 per cent of the respondents in the sample were small scale and majority were represented the domestic market only.

Table 1. Characteristics of firms in sample

Firm character	Description	% of firms
Vintage	< 10 years	53%
	> 10 years	47%
Employees	< 30 (small)	67%
	> 30 (large)	33%
Water source	Public water supply	0%
	Dug well	27%
	Tube well	53%
	Spring	20%
Major markets	Domestic only	80%
	Domestic + Export	20%
Sales strategy	Own brand	77%
	Own brand + Customer brands	23%

Current Level of HACCP Adoption

Two different levels of HACCP adoption were identified: (1) HACCP embracers and (2) HACCP deferrers (Figure 1). Only 30 per cent firms were HACCP embracers and other 70 per cent firms were HACCP deferrers by the time of interviewing.

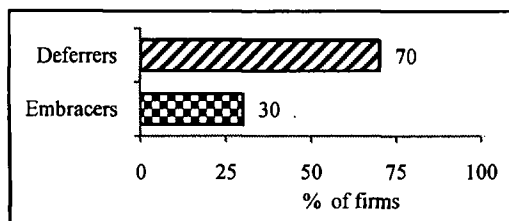


Figure 1. Current level of HACCP adoption

Economic Incentives and Constraints

The mean values for each statement are given in table 2.

Table 2. Mean values of economic incentives and constraints

Factor Item	Mean
Incentives	
I1: Cost/financial implications	4.1
I2: Efficiency of human resources	4.4
I3: Efficiency in technical procedures	4.0
I4: Sales and revenue	4.2
I5: Reputation	4.0
I6: Commercial pressure	4.1
I7: Existing government regulation	4.6
I8: Anticipated government regulations	4.6
I9: Liability laws	4.1
Constraints	
C1: To retain the staff in new practices	3.9
C2: Negative attitudes	3.7
C3: Inflexibilities associated with the production process	4.0
C4: To renovate the plant with new equipment	3.6
C5: Lack of reliable information about food safety/ quality controls	4.3
C6: Lack of financial support from external sources	4.3
C7: Lack of space to accommodate new practices.	3.6

Negative Perceptions

Top two box reporting was used to see the relative importance of negative perceptions made by managers in bottled water manufacturing firms about HACCP. The top two box scores are the two most favorable response options on a scale that has been used by respondents to indicate their answers (*Very true and Somewhat true*). The percentage of respondents who have given top two box scores for each statement were calculated (Figure 2).

Statements namely: High cost of maintaining certification; For us SLS standard is very much enough; Certification does not have an impact on profitability; Certification having low value among customers; had high levels of top two box scores and HACCP deferrers were the majority who have given highest top two box scores for all attitudinal statements.

Outcome of the Discriminant Analysis

Firm Characteristics

In the DA for firm characteristics the Canonical Correlation of 0.67 indicates that $(0.67)^2 = 0.45$ or 45% of variance in the dependent variable can be explained by the independent variables. The Wilk's Lambda test was also significant with p-value 0.000 proves that there is a statistical significance of the discriminatory power of the discriminant function. Univariate ANOVA indicated that rank mean of firm size have a significant difference between group means while vintage, water source, Major markets, and Sales strategy showed an insignificant difference (Table 3). Therefore Vintage, Water source,

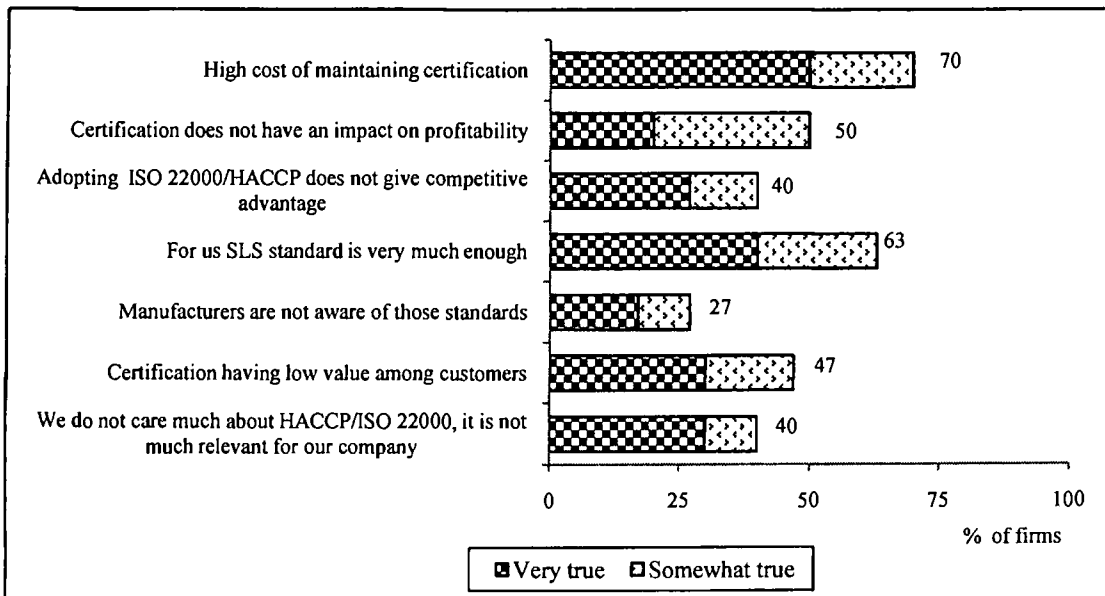


Figure 2. Top two box scores for negative perceptions about HACCP

Major markets and Sales strategy cannot be used to differentiate among EMB and DEF.

The DL for the firm size exceeded ± 0.40 threshold. Therefore firm size can be used in discriminant function. It says firm size can be used to discriminate among EMB and DEF of HACCP. According to the discriminant coefficient for firm size there was a positive relationship between firm size and the level of HACCP adoption (large firms were more likely to embrace HACCP).

Economic Incentives

In the DA for nine incentives the Canonical Correlation of 0.66 indicates that $(0.66)^2 = 0.43$ or 43% of variance in the dependent variable can be explained by the independent variables. The Wilk's Lambda test

was also significant with p-value 0.000 proves that there is a statistical significance of the discriminatory power of the discriminant function. Univariate ANOVA indicated that rank mean of SLR have a significant difference between group means (Table 4). Since CST, HRE, TCH, REP, CPR, EGR, AGR and LBL showed an insignificant difference between two groups. Therefore they cannot be used to differentiate EMB from DEF for HACCP. Since DL for the SLR exceeded ± 0.04 threshold it was the most important incentive that differentiates EMB of HACCP and DEF. According to the discriminant coefficient for SLR there was a positive relationship between SLR and the level of HACCP adoption (major motivation factor to embrace HACCP was increase in sales and revenue).

Table 3. Summary of interpretive measures of DA for firm characteristics

Firm Characteristics	Wilks' Lambda Value	Univariate F Ratio		Discriminant Coefficients		Discriminant Loadings (DL)
		F value	Sig.	Unstandardised	Standardised	
Vintage	0.969	0.884	0.355	NI	NI	-0.270
Firm size	0.786	7.636	0.010	2.237	0.968	0.792
Water source	0.971	0.845	0.366	NI	NI	0.264
Major markets	0.952	1.400	0.247	NI	NI	0.339
Sales strategy	0.976	0.687	0.414	NI	NI	0.238

NI = Not included in estimated discriminant function

Table 4. Summary of interpretive measures of DA for economic incentives

Economic Incentives	Wilks' Lambda Value	Univariate F Ratio		Discriminant Coefficients		Discriminant Loadings (DL)
		F value	Sig.	Unstandardised	Standardised	
CST	0.938	1.843	0.185	NI	NI	0.503
REP	0.940	1.792	0.191	NI	NI	0.496
TCE	0.890	3.470	0.073	NI	NI	0.691
SLR	0.859	4.586	0.041	0.545	0.466	0.794
HRE	0.897	3.211	0.084	NI	NI	0.665
CPR	0.955	1.312	0.262	NI	NI	0.425
EGR	0.958	1.222	0.278	NI	NI	-0.410
AGR	0.958	1.222	0.278	NI	NI	-0.410
LBL	0.971	0.847	0.365	NI	NI	0.341

NI = Not included in estimated discriminant function

Table 5. Summary of interpretive measures of DA for constraints

Constraints	Wilks'	Univariate F Ratio		Discriminant Coefficients		DL
	Lambda Value	F value	Sig.	Unstandardised	Standardised	
To retain staff	0.987	0.362	0.552	NI	NI	-0.100
Negative attitudes	0.788	7.553	0.010	-1.272	-1.420	-0.456
Inflexibilities with process	0.998	0.062	0.805	NI	NI	-0.041
To renovate plant	0.942	1.721	0.200	NI	NI	-0.218
Lack of information	0.997	0.083	0.775	NI	NI	0.048
Lack of financial support	0.804	6.830	0.014	-1.387	-0.909	-0.434
Lack of space	0.999	0.015	0.904	NI	NI	-0.020

NI = Not included in estimated discriminant function

Constraints

In the DA for identified seven constraints the Canonical Correlation of 0.75 indicates that $(0.75)^2 = 0.56$ or 56% of variance in the dependent variable can be explained by the independent variables. The Wilk's Lambda test was also significant with p-value 0.005 proves that there is a statistical significance of the discriminatory power of the discriminant function. Univariate ANOVA indicated that rank mean for Negative attitudes and Lack of financial support have a significant difference between group means (Table 5). Since other five constraints showed an insignificant difference between two groups they cannot be used to differentiate EMB from DEF for HACCP. Since DL for the Negative attitudes and Lack of financial support exceeded ± 0.04 threshold they were the most important constraints that differentiate EMB of HACCP and DEF. According to the discriminant coefficients Negative attitudes and Lack of financial support have a negative relationship with the level of HACCP adoption (the reason behind slow uptake of HACCP was negative attitudes and lack of financial support).

CONCLUSIONS

The results suggest that large firms were more likely to adopt the metasystem and sales and revenue was the major incentive for a firm to adopt HACCP. Major barriers faced by the firms include lack of finance and negative attitudes of the employees. Further, the low demand for food safety standards and lack of customer awareness about the HACCP played a significant role as the reason for slow uptake of adoption of HACCP by the industry.

The implementation of HACCP might be facilitated and enhanced through cooperation and coordination between policy makers and industry organizations. First, there is a fundamental need to raise awareness of the weakness of established food safety controls. Here, information dissemination and training can play a key role. Second, finance is obviously a critical issue. Many firms and especially small and medium-sized enterprises, have difficulty accessing the required capital to

fund investments. This failure of existing sources of finance may require action on the part of government. Finally, there is clearly a need to make the process of HACCP implementation and the firm-level impacts visible to firms that are contemplating implementation. This could take the form of firm-level case studies or demonstration plants.

ACKNOWLEDGEMENT

Authors express their gratitude to the National Science Foundation of Sri Lanka, for its financial support under the Competitive Research Grant RG/2011/AG/01 and to Mr. T. G. G. Dharmawardana (SLSI) - Director/ Systems Certification Division for his continuous assistance to carry out this study.

REFERENCES

- Hair, J.F., Anderson, R.E., Thatham, R.L. and Black, W.C. (1998). *Multivariate Data Analysis*. 5th ed. New Jersey, Prentice-Hall.
- Henson, S.J. and Heasman, M. (1998). Food Safety Regulation: An Overview of Contemporary Issues. *Food policy*, 23, 9-23.
- Herath, D. and Henson, S. (2010). Barriers to HACCP implementation: Evidence from the food processing sector in Ontario, Canada. *Agribusiness*, 26 (2), 265-279.
- Herath, D., Hassan, Z. and Henson, S. (2007). Adoption of food safety and quality controls: Do firm characteristics matter? Evidence from the Canadian food processing sector. *Canadian journal of Agricultural Economics*, 55, 299-314.
- Jayasinghe-Mudalige, U.K. and Henson, S. (2006). Economic Incentives for Firms to Implement Enhanced Food Safety Controls: Case of the Canadian Red Meat and Poultry Processing Sector. *Review of Agricultural Economics*, 28 (4), 494-514.
- Wijsekara, A.R.L. (2007). Bottled drinking water-facts the consumer should know. Available from: <http://www.dailynews.lk/2007/02/26/fea05.asp>. (Accessed 28 March 2013).