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DETERMINANTS OF WILLINGNESS-TO-PAY A PREMIUM PRICE FOR INTEGRATED PEST MANAGEMENT PRODUCED FRUITS AND VEGETABLES IN TRINIDAD

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ABSTRACT
Overuse of pesticide in crop production poses enormous challenges to the health of farm families, consumers, and the environment. Integrated Pest Management (IPM) is an ecosystem approach to crop production that combines different management strategies and practices to grow healthy crops and minimize the use of pesticides. As a result of increasing awareness, education and per capita income, there is an increasing concern for food safety and demand for safe products among consumers of high-income countries. Consequently, this study was conducted among 266 randomly surveyed consumers of an affluent Caribbean country, Trinidad to ascertain the factors influencing consumers' Willingness-To-Pay (WTP) a premium price for IPM grown-fruits and vegetables. The consumers' responses for the dichotomous question, "Would you be Willing to Pay an additional cost of 10% for the IPM produces from the current market prices?" were analysed using Binary logit regression model. Results indicated that females ageing over 26 years and having children, those with higher annual income and higher level of education were all most likely to pay a premium to obtain IPM grown fruits and vegetables. Willingness-to-purchase IPM produce was found to increase with income, education and age. The findings of this study are promising to those developing marketing strategies, besides enabling the producers to understand that producing fruits and vegetables through IPM would fetch them premium.

Keywords: Fruits, Logit Regression, Organic Agriculture, Vegetables, Willingness To Pay

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INTRODUCTION

Development scholars and practitioners have been emphasizing sustainable agricultural practices over the last decades. Recent reflections of the decades of progress indicate that policy makers should no longer consider agricultural sector in terms of production maximization (Alston, 2018). Rather it is necessary to consider sustainability of agriculture along a more complex interlocking of issues such as, production, environment, equitable benefits for smallholders, and cooperation and collective actions of relevant stakeholders, and more recently sustainable consumption. We have started witnessing this reflection in policy-making.

Of several components of sustainable agriculture, Integrated Pest Management (IPM) is considered as widely adopted cum vital approach in agricultural production. It is a pest management strategy to keep the pest population below an economic threshold level with minimum use of pesticides. The approach emphasizes the successful application of different physical and biological methods without relying on a schedule use of chemical pesticides. The chemicals are allowed as a last resort only when other methods fail to control pests at an economically threshold level (Vijay et al., 2010; Hashemi & Damalas, 2011; Chowdhury et al., 2015). IPM systems may also deliver an array of ecosystem goods and services beyond pest control, increasing general resilience at farm and landscape scales (Pretty & Bharucha, 2015).

Overuse of pesticide in crop production poses enormous challenges to the health of farm families, consumers, and the environment (Akter et al., 2018; Bonner & Alavanja, 2017; Popp et al., 2013). Pesticide exposure is linked to various short-term and chronic health hazards including cancer (Kim et al., 2017). An early study indicates that despite several efforts to introduce IPM in Cabbage and Tomato production in Trinidad and Tobago, farmers used pesticide 40% and 100% respectively above the recommended rates. The current policy and IPM research (Wynn et al., 2014) focused on technology and extension approach for promoting IPM practices. The National Food Production Action Plan of Trinidad and Tobago also accentuates on safe food grown locally (MFPLMA, 2011).

There is an extensive literature on IPM and FFS which mainly focus on agronomic practices, behavioural changes, and later on decision making processes, and economics of pest control (e.g. Hashemi & Damalas, 2011; Mengistie et al., 2014; Jørs et al., 2017; Larochelle et al., 2017; Ganpat et al., 2018). A second

type literature focused on learning and institutional development of IPM. This literature argued that successful application of IPM and FFS is related to facilitation of learning among multiple actors who usually belong to different domains of knowledge and authority (e.g. Toleubayev et al., 2011; Harris et al., 2013; Chowdhury et al., 2015; Tuz, 2018). A third literature type has recommended that IPM approach should go beyond production and input supply domains and include variables from consumption domains. The key insights of this literature substantiate that farmer's decision to use IPM and related practices are influenced by other off-farm factors such as negotiations with retailer, contractor, regulatory agencies and most importantly preference of consumer (Savary et al., 2012). This is in line with the suggestion that innovation traditions in IPM research should move beyond from development, transfer, adoption and diffusion of crop protection technologies to the holistic approach encouraging interaction among different stakeholders of the agricultural systems (Schut et al., 2014).

In this context, the current study was carried out in high income Caribbean island, Trinidad and Tobago (i) to understand the consumers' potential motivation to purchase IPM grown fruits and vegetables (ii) to evaluate their Willingness To Pay (WTP) a premium price for IPM grown fruits and vegetables.

Further, it is envisioned that the study will provide important insights into potentials of expanding IPM based agricultural production and consumption in the country. Ultimately, findings of the paper could serve as a policy suggestion for including consumption domain in a holistic approach, aimed at supporting sustainable agricultural development in the Caribbean region.

METHODS

Survey

The questionnaire was developed primarily to determine the willingness to pay for IPM grown fruits and vegetables compared to conventional method of production. The pre-tested and perfected questionnaire consisted of the socio-demographic attributes such as age, gender, income, education level, size of household and number of children under 14 years old. During pre-testing, the consumers were asked, 'how much percentage they would be willing to pay over market prices for the IPM grown fruits and vegetables' and thus an average WTP of 10% was included in the final survey. The survey questionnaire was also designed to assess perception and attitudinal variables of participants. The study was conducted during January-

February 2019. Survey was done with a questionnaire in Trinidad. An attempt was undertaken to approach every third shopper from randomly chosen four grocery stores in eastern part of Trinidad with goal to have a random representation of respondents. In total, 266 individuals were surveyed.

Data analysis

The data collected were subjected to conventional descriptive and binary logit regression analyses. Lancaster's theory of consumer's choice was used to analyse the determinants of demand for IPM produces, as traditional theories of consumer behaviour do not take into account the dynamic adjustment of the market (Kiruthika & Selvaraj, 2013). Lancaster's attribute theory of consumer behaviour assumes that consumer obtains utility not from the IPM produces but from the attributes of the IPM produces. Consumer gets utility from the attributes of the IPM grown fruits and vegetables although they consume directly them. Thus, all consumers plan to allocate their income among various IPM produces so as to attain highest possible attribute combination. IPM produces have some distinct characteristics that make them different from the fruits and vegetables produced traditionally. More specifically, the credence characters of IPM food products distinguish them from the conventional ones. Consequently, those consumers who apparently recognised these characteristics of IPM products would be willing to pay more with the purpose of securing them. Therefore, the Lancaster consumer theory, which assumes product characteristics in-lieu of product itself as a determinant of consumer's utility, is more appropriate to examine the demand for IPM produce (Caroline, 2012). In order to analyse the consumers' WTP for IPM produces, random utility discrete choice models are appropriate (Kiruthika & Selvaraj, 2013; Obayelu et al., 2014)). Further, binary logit model that has the asymptotic characteristic constrains on the predicted probabilities, was chosen to analyse the factors predisposing the consumers' WTP of an additional cost of 10% for the IPM produces from the current market prices. The Logit technique vis-à-vis Probit is a better technique for its capturing the magnitude of the effects of independent qualitative variables (Puduri et al., 2011; Priyadharsini et al., 2017).

The empirical model assumes that the probability (P_i) of Willingness To Pay a premium price for IPM produces depends on the vector of independent variables (X_{ij}) related to the i^{th} consumer and the j^{th} variable and an unknown parameter vector, β. The likelihood of

observing the dependent variable is tested as a function of set of independent variables. In other words, That is, $P_i = F(Z_i) = F(\alpha + \beta X_i) = 1/[1 + \exp(-Z_i)$. $F(Z_i)$ represents the value of the standard normal density function associated with each possible value of the underlying index Z_i and P_i is the probability of observing a specific outcome of the dependent variable for a set of independent variables, X_is. Z_i is the underlying index number and βX_i is the linear combination of independent variables, given by:

$$Z_i = \log [P_i/(1-P_i)] = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots\ldots\ldots + \beta_n X_n + \varepsilon$$

Where i is 1,2,…n are observations, Z_i is the log odds of choice for the i^{th} observation, β is the parameters to be estimated, ε is the error term. The regressand, Z_i in the above equation is the logarithm of the probability that consumers are willing to pay or not premium prices for IPM produces. The probability change that $Y_i = 1$ (P_i) due to a change in X_{ij} is,

$$(\partial P_i/\partial X_{ij}) = P_i(Y_i.X_{ij}=1) - P_i(Y_i.X_{ij}=0)$$

A binary logit regression model of the following form was fitted to evaluate the determinants of consumers paying premium prices for IPM produces from the current market prices, using the variables as described in Table 1.

$$Y = \beta_0 + \beta_1 \text{ Male} + \beta_2 \text{ Age\_26-50} + \beta_3 \text{ Age\_>50} + \beta_4 \text{ Ethn\_Indo-Trini} + \beta_5 \text{ Ethn\_mixed} + \beta_6 \text{ Ethnic\_others} + \beta_7 \text{ Fam\_children} + \beta_8 \text{ Hsize} \geq 4 + \beta_9 \text{ Inc\_low} + \beta_{10} \text{ Inc\_lmid} + \beta_{11} \text{ Inc\_umid} + \beta_{12} \text{ Edn\_pri} + \beta_{13} \text{ Edn\_sec} + \beta_{14} \text{ Edn\_UG} + \beta_{15} \text{ Buy\_org} + \beta_{16} \text{ Buy\_local} + \beta_{17} \text{ P\_shopper} + \beta_{18} \text{ Watch\_adv} + \beta_{19} \text{ Heard\_IPM} + \beta_{20} \text{ Age\_Edn} + \beta_{21} \text{ Inc\_Edn}$$

The binary logit regression model was fitted to evaluate the determinants of consumers' WTP of an additional cost of 10% for the IPM produces from the current market prices, using the variables as described in Table 1.

RESULTS AND DISCUSSION

Fruits and vegetables are major agricultural products in Trinidad. Simultaneously, the occurrence of pests and diseases are serious concerns in fruits and vegetable production which warrants IPM strategy for successful production of safe food (Pollard 1991; Saravanakumar et al. 2016). A recent study indicates that farmers in Trinidad considered economic viability of the IPM production system (Wynn et al. 2014). To assess the economic viability of IPM, consumer preference will play important roles in determining economics of crop produced by IPM. Therefore, the study current study was conducted to understand the consumer preferences about fruits and vegetable produced by IPM techniques.

The results of the descriptive statistics on survey questions

Table 1: Explanatory variables used in the binary logit regression

Variables	Levels	Measurement Scale	Variable ID
Gender[a]	Male, Female	1 - if male; 0 - otherwise	X_1
Age[b]	≤ 25 years, 26–50 years, >50 years	1 - if 26–50 years; 0 - otherwise	X_2
		1 - if >50 years; 0 - otherwise	X_3
Ethnicity: Indo-Trini[c]	Afro-Trini, Indo-Trini, Mixed, Others	1 - if Indo-Trini; 0 - otherwise	X_4
		1 - if Mixed; 0 - otherwise	X_5
		1 - if Others; 0 - otherwise	X_6
Family having children	Yes, No	1 - if Yes; 0 - otherwise	X_7
Household with 4 or more members	Yes, No	1 - if Yes; 0 - otherwise	X_8
Monthly income[d]	TT$ 9999 or less, TT$ 10000 to17999, TT$ 18000 to 23999, TT$ 24000 and more	1 - if TT$ 9999 or less; 0 - otherwise	X_9
		1 - if TT$ 10000 to17999; 0 - otherwise	X_{10}
		1 - if TT$ 18000 to 23999; 0 - otherwise	X_{11}
Education[e]	Primary, Secondary, UG Degree, PG Degree	1 - if Primary level; 0 - otherwise	X_{12}
		1 - if Secondary level; 0 - otherwise	X_{13}
		1 - if UG Degree; 0 - otherwise	X_{14}
Usually buy organic fruits and vegetables	Yes, No	1 - if Yes; 0 - otherwise	X_{15}
Buy from local fruits and vegetable markets too	Yes, No	1 - if Yes; 0 - otherwise	X_{16}
Primary household grocery shopper	Yes, No	1 - if Yes; 0 - otherwise	X_{17}
Usually watch food advertisements	Yes, No	1 - if Yes; 0 - otherwise	X_{18}
Heard of IPM	Yes, No	1 - if Yes; 0 - otherwise	X_{19}
Age x Education		1 - if the individual was old aged had PG degree; 0 - otherwise	X_{20}
Income x Education		1 - if the individual had high income and PG degree; 0 - otherwise	X_{21}

Reference categories: a - Male; b - Less than 26 years; c - Afro-Trini; d - TT$ 24000 and more; e - Masters and Doctoral degree.

determining consumer preference of IPM are summarized in Table 2. The findings indicate that more than two-third (62%) consumers were aware about pesticide related health hazards. About two-third of the consumers believed that traditionally grown produce was safer to consumer. Most of them (89%) agreed that synthetic/ chemical pesticides had adverse effect on the environment. Almost two-third (61%) of the consumer agreed that

vegetables and fruits produced through IPM would cost more to farmer. Majority of the consumer (66%) mentioned that they would buy fruits and vegetables in the supermarket if these were labelled for IPM.

The findings about respondents' demographic variable are presented in Table 3. About half of the consumers were middle-aged (48%) female (62%) having a child (56%) living in the households. Furthermore, majority of the respondents (62%) indicate that they are the primary household grocery shopper (Table 2). This is an important segment of consumer who usually has an influence decision about food consumption of a typical Trinidadian family. Most consumers (53%) had a small family size (less than 4 members) while about 47% had medium or large size family (4 or more members). More than half of the consumers (61%) had household income less than 20000 TTD while one-fourth (26%) of the respondents had more than 25000 TTD. This indicates that a variability of respondent's purchasing ability. More than two-third respondents had a university degree. Although one-fourth of the respondents indicated about purchasing of organic produce almost all of them (92%) visited local fruits and vegetable markets. About two-third of the respondents (59%) did not consider advertisement while purchasing the

Table 2: Consumers' perceptions on the chemically grown fruits and vegetables

Questions	Response types	Frequency	Per cent
How hazardous do you believe chemical pesticide residues are to human health?	A serious hazard	210	78.95
	Somewhat hazardous	50	18.80
	Not hazardous	6	2.26
Do you believe that traditionally grown produce is generally safer to consumer?	Agreed	166	62.41
	Disagreed	40	15.04
	Not Sure	60	22.56
There is a significant difference in the safety between IPM and non-IPM produces. Do you agree?	Agreed	178	66.92
	Disagreed	16	6.02
	Not Sure	72	27.07
Synthetic/ Chemical pesticides are damaging to the environment. Do you agree?	Agreed	236	88.72
	Disagreed	8	3.01
	Not Sure	22	8.27
Do you agree that production of fruits and vegetables following IPM practices would cost more to farmers?	Yes	162	60.90
	No	52	19.55
	Not Sure	72	27.07
If IPM produce was labelled as such in your supermarket, do you think that you…	Would buy	176	66.17
	Would not buy	8	3.01
	Are not sure to buy	82	30.83

Table 3: Descriptives of explanatory variables

Variables	Response types	Frequency	%	Mean	SE
Gender	Male	102	38.35	0.38	0.030
	Female	164	61.65	0.62	0.030
Age	Less than 25 years of age	74	27.82	0.28	0.028
	26–50 years of age	128	48.12	0.48	0.031
	Over 50 years of age	64	24.06	0.24	0.026
Ethnicity	Afro-Trini	84	31.58	0.32	0.029
	Indo-Trini	114	42.86	0.43	0.030
	Mixed	62	23.31	0.23	0.026
	Others	6	2.26	0.02	0.009
Are there children residing in the household? (Kids)	Yes	150	56.39	0.56	0.030
	No	116	43.61	0.44	0.030
Household size	Four or more individuals	124	46.62	0.47	0.031
	Less than four individuals	142	53.38	0.53	0.031
Monthly household (family) income in TT$	9,999 or less	68	25.56	0.26	0.027
	10,000 to 17,999	94	35.34	0.35	0.029
	18,000 to 23,999	36	13.53	0.14	0.021
	24,000 or more	68	25.56	0.25	0.022
State your highest education level	Primary level	6	2.26	0.02	0.009
	Secondary level	42	15.79	0.16	0.022
	UG Degree	116	43.61	0.44	0.030
	PG Degree	102	38.35	0.38	0.030
Do you usually purchase organic fruits and vegetables?	Yes	70	26.32	0.26	0.027
	No	196	73.68	0.74	0.027
Have you ever visited local fruits and vegetable markets?	Yes	244	91.73	0.92	0.017
	No	22	8.27	0.08	0.017
Are you the primary household grocery shopper?	Yes	166	62.41	0.62	0.030
	No	100	37.59	0.38	0.030
Do you usually make use of food advertisements?	Yes	110	41.35	0.41	0.030
	No	156	58.65	0.59	0.030
Do you believe that pests pose a very serious problem in crop production?	Yes	228	85.71	0.86	0.021
	No	38	14.29	0.14	0.021
Have you ever heard of IPM?	Yes	156	58.65	0.59	0.030
	No	110	41.35	0.41	0.030
Do you agree that production of fruits and vegetables following IPM practices would cost more to farmers?	Yes	162	60.90	0.61	0.030
	No/ Not sure	104	39.10	0.39	0.026
Would you be Willing To Pay an additional cost of 10% for the IPM produces from the current market prices?	Yes	153	57.50	0.58	0.030
	No	113	42.50	0.42	0.030

food. The findings in indicate that more than half of the respondents (59%) heard about fruits and vegetable produced by IPM and were willing to pay an extra 10% premium while purchasing the produce.

Determinants of WTP

Factors influencing the consumers' WTP of an additional cost of 10% for the IPM produces from the current market prices were evaluated through a binary logit regression model. The results of logit regression analysis showed that 88.5 per cent of 'no' and 92.50 per cent of 'yes' responses were correctly classified with an overall rate of 90.60 per cent. The good fit of the model could be understood from the high Cox & Snell and Nagelkerke R^2 values. The analysis also exhibited that, of the 21 explanatory variables included the model fitted, 14 were found to be significantly influencing the consumers' decision of WTP a premium for IPM produces (Table 4).

In contrary to the findings of Kiruthika and Selvaraj (2013) in India, the results of this study indicated that the males, compared to females, are significantly less likely to pay more for IPM grown fruits and vegetables. Literacy rate and consumers' awareness could be reasons for the differences elicited among nations. Consumers' age is identified to be the major determinant of WTP a premium price for IPM produces. Although both middle and old aged consumers were likely to exhibit WTP, the older aged consumers had relatively high tendency, as compare to middle aged consumer, to exhibit WTP. Although Trinidadian ethnicity of population of (afro-trini, indo-trini and mixed) do not significantly influence the WTP, the other ethnicity living in Trinidad is willing to pay more for IPM produces. Consumers with children in their family were willing to pay significantly more than counterparts, while the consumers with large families didn't exhibit any significance. Considering the average household size of 3.3 in Trinidad, the results implied that the household size of four or less with one or two children has been health conscious and supporting for a premium price. In addition, the families with more children may not be willing to pay a premium price due to their pressing household expenditure. The analysis showed the income was to be one of the significant factors in the consumers' decision for WTP a premium price for IPM produces. The lower income groups, as compare to higher income group were less likely to pay more for IPM produces. Similarly, the educational level of the consumers was one of significant factors determining the WTP for IPM produce. Compared to

those who are with higher qualifications with post-graduate degrees, others were less inclined to pay more for IPM produces. More specifically, post-graduates with high income were more inclined to pay for IPM grown fruits and vegetables. Notably, those who had prior knowledge of IPM were willing to pay a premium price for IPM produces.

CONCLUSION AND SUGGESTION

This study, since it documented the significant linkages between many socio demographic variables and consumers' WTP for IPM grown produces, would provide a better insight into the consumers' buying behaviour that are relevant to IPM adopters and marketing agents. Gender, age, ethnicity, having children at home, monthly

Table 4: Results of Binary Logit Regression

Variable ID	Variable Name	B	S.E.	Sig.	Exp(B)
X_1	Gender (male)[a]	-3.653***	0.806	.000	0.026
X_2	Age: 26–50 years[b]	1.673**	0.592	.005	5.329
X_3	Age: Over 50 years[b]	5.468***	1.178	.000	237.018
X_4	Ethnicity: Indo-Trini[c]	0.750	0.606	.215	2.117
X_5	Ethnicity: Mixed[c]	0.078	0.718	.914	1.081
X_6	Ethnicity: Others[c]	4.052*	1.801	.024	57.528
X_7	Family having children	4.603***	0.844	.000	99.750
X_8	Household with 4 or more members	0.038*	0.580	.947	1.039
X_9	Monthly income: TT$ 9999 or less[d]	-5.181***	1.109	.000	0.006
X_{10}	Monthly income: TT$ 10000 to17999[d]	-5.692***	1.197	.000	0.003
X_{11}	Monthly income: TT$ 18000 to 23999[d]	-4.681***	1.171	.000	0.009
X_{12}	Education: Primary level[e]	-10.548***	2.160	.000	0.000
X_{13}	Education: Secondary level[e]	-6.597***	1.302	.000	0.001
X_{14}	Education: UG Degree[e]	-4.426***	0.970	.000	0.012
X_{15}	Usually buy organic fruits and vegetables	-0.948	0.653	.147	0.388
X_{16}	Buy from local fruits and vegetable markets too	-2.013	1.098	.067	0.134
X_{17}	Primary household grocery shopper	-1.154	0.615	.061	0.315
X_{18}	Usually watch food advertisements	-0.258	0.606	.671	0.773
X_{19}	Heard of IPM	1.041*	0.517	.050	2.831
X_{20}	Age x Education	1.206	1.646	.464	0.299
X_{21}	Income x Education	3.672**	1.297	.005	0.025
	Constant	7.246	2.105	.001	1402.698
	-2 Log likelihood	123.684			
	Cox & Snell R Square	.593			
	Nagelkerke R Square	.797			
	N	266			

Reference categories: a - Male; b - Less than 26 years; c - Afro-Trini; d - TT$ 24000 and more; e - PG degree.

income, education and knowledge on IPM were the major factors deciding the consumers' WTP a premium price for IPM produces. Well educated mothers ageing more than 25 years with monthly household income of TT$ 24000 or more and knowledge on IPM are the potential buyers. The findings of this study are promising to those developing marketing strategies, besides enabling the producers to understand that producing fruits and vegetables through IPM would fetch them premium.

This study reflects an initial exploration of IPM agricultural production as well as potential perspectives for its introduction and development in the Caribbean region. Increasing public awareness of IPM produces together with sound public policy would allow the farmers of this region to specialize and revive traditional, IPM based agricultural production. Alternatively, the consumers of this region will be greatly benefited as they will be offered healthier and tastier products having the reduced level or even no negative influence on environment.

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