Assessing farmer's preference for sustainable agricultural practices in Kurunegala area by using choice experiments

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1. Introduction

Sustainable agriculture is a combination of practices which mitigate damage to the environment. (Flora, 2008). According to FAO 2011, Sustainable Agricultural Practices (SAP) are the practices that can sustain the health of the agricultural lands, soil, water and biodiversity. Those practices include approaches like farming system management, soil conservation, pest, and environmental conservation (INRA, 2016). Adopting SAP is a win-win strategy for developing countries because of their potential to enhance food security and mitigate environmental issues (Zeweld et al., 2017). The emergence of green agricultural innovations includes many SAP practices like precision farming, enhanced nutrient management and irrigation systems (Adnan, et al., 2017). Due to enhanced yields, easy application, and the government subsidy, the usage of synthetic fertilizer introduced with the green technology has been increased dramatically and created negative effects on the environment and human health. With a proper training and support, farmers are considered as the agents to introduce SAP. Hence, assessing their preference towards SAP is an indispensable preliminary step to promote sustainability (Füsun Tatlıdil et al., 2009). Most of the empirical studies followed the traditional ranking methods to investigate farmer perception on SAP but dearth of studies following the random utility theory in Sri Lankan context. Given this gap, major objectives of this study are (a). to explore the farmer's level of importance for selected SAP practices and, (b). how socio-economic factors affect their attitudes towards SAP using random utility theory (choice experiments). The results of this study are judicious and help policymakers to formulate policies to promote SAP and initiate necessary extension programs.

2. Materials and Methods

This study uses Choice Experiments (CE) to explore farmer preference for selected sustainable practices. CE are a derivative of conjoint analysis which is used to estimate the structure of an individual's preferences by developing the relative importance of attributes (Wattage et al., 2005). In here, selected sustainable practices are considered as key attributes and their attached levels. These attributes and levels produce a total of 56 different combinations using the main effects design. By employing an orthogonal design 56 combinations were reduced to 9 choice cards. Respondents are allowed to select their most preferred profile. The choice cards were displayed in the second section of the questionnaire and used a Conditional Logit Model (CLM) to estimate the parameters explained under each attribute. According to Wattage, et al., (2011) CLM gives the probability that individual i selects alternative j as a function of the attributes that differ for the alternatives and unknown parameters. Xij is used as a vector of attributes site j and individual i, with the probability that individual i selects alternative j considered as:

$$\mathrm{P}\, r_i\,(j) = \frac{e^{Xij\beta}}{\sum_{K=1}^{J} e^{Xik\beta}}$$

The questionnaire includes several socio-economic and farming-related questions important for the analysis and validation of the choice results. Descriptive statistics were used to interpret the results.

Primary data was gathered by using a questionnaire completed by 100 farmers who engage in paddy farming in four Grama Niladari divisions of Polgahawela DS division in Kurunegala district based on location, population density, and paddy farming potential. Simple random sampling was adapted as the sampling technique.

Table 01. Attributes and accompanied objective levels

Attributes	Level 1	Level 2	Level 3
Usage of fertilizer	Chemical	Organic fertilizer	Biofertilizer
Method of pest control	Chemical	Integrated pest management (IPM)	Traditional
Type of farming	Smart farming (Using machinery with ICT technology)	Conventional (Without ICT technology)	-
Willingness to pay (WTP) (The amount people would like to pay for the benefits they are receiving through sustainability)	40000	30000	20000

3. Results and Discussion

3.1 Choice Model on assessing the preference for SAP.

The model has chi-square values for all the tests 45.633, 50.366 and 50.366 respectively. They are significant at 1%, showing a strong relationship between attributes and the levels.

"Fertilizer": The organic and chemical fertilizer are preferred over biofertilizer which is the status quo. Organic fertilizer (1.299) is preferred at 1% over chemical fertilizer (0.601) at $\alpha = 0.1$ level. Therefore, organic fertilizer is mostly preferred by the farmers. The negative impacts which create to the environment and for human health due to higher usage of chemical fertilizer is the major reason for this. (Widyanti et al., 2014).

"Pest control": Chemical pesticides and IPM methods were tested against traditional methods of controlling pests which is the status quo. Chemical pesticide (1.255) was preferred over the IPM method (1.027). Both parameters tested under this proved highly significant at $\alpha = 0.01$ level.

"Farming method": The Smart farming parameter is not significant even at the $\alpha = 0.1$ level. Therefore, it makes no sense for the model. The reasons could be inappropriateness of the sampling method, respondent's mindset at the time of data collection, and lack of

understanding (Wattage et al., 2011). Therefore, the farming method was not a significant determinant of farmer preference. Further research should be conducted to explore exact reasons for the insignificance.

"Willingness to pay (WTP)": The parameter 40,000.00 LKR (0.649) was significant at the α = 0.05 level. However, 30,000.00 LKR is not having any effect on the model because it's insignificant. Therefore, the results can be concluded as farmers would like to pay more for the benefits that they are getting through moving towards innovative SAP.

Table 02. Results of conditional logit regression analysis

Parameter variable	Estimate	SE	Wald	df	Sig	Exp(B)
1.Fertilizer application						
Chemical fertilizer	0.601	0.322	3.489	1	0.062	1.824
Organic fertilizer	1.299	0.316	16.930	1	0.000	3.667
Bio fertilizer				0		
2.Pest control						
Chemical pesticides	1.255	0.369	11.568	1	0.001	3.509
IPM	1.027	0.372	7.601	1	0.006	2.792
Traditional methods				0		
3. Farming method						
Smart farming	0.334	0.294	1.284	1	0.257	1.396
Conventional farming				0		
4. Willingness To Pay (WTP)						
40000LKR	0.649	0.286	5.153	1	0.023	1.914
30000LKR	-0.373	0.309	1.452	1	0.228	0.689
20000LKR				0		

3.2. Relationship between preference towards SAP and socio-economic characters of Sri Lankan Paddy farmers.

Land ownership, preference for SAP, and ability to practice SAP were identified as the most significant socio-economic characters. Majority are male farmers accounting 76 percent. among the respondents, 45 percent had primary education and (42%) had secondary education. Only (6%) is having a university education. Therefore, majority of the respondents don't have a sound formal education. And 82 percent were their own land holders and a similar percent prefer SAP. This reveals that every farmer who owns their land has a higher perception of practicing SAP than those who do not possess a own land. This is also supported by a study done by (Füsun et al., 2009). Most of the respondents in this area engaged in paddy farming mainly for their own household consumption as they own additional income sources with mean worth of 25,830.00 LKR. Therefore, respondents mostly think about health and land sustainability, and choose to apply organic fertilizer as their first preference and they prefer IPM as the second preference to eradicate pests. However, some farmers prefer chemical fertilizer and pesticides as they possess poor educational background (45%), and lack of awareness (25%), and comparative difficulty in engaging in SAP (37%) and leading to ignore in adapting sustainable farming practices (18%). This could be a reason to select synthetic pesticides over IPM.

4. Conclusions

This study was done to assess farmer perception towards adopting SAP and the relationship between socio-economic factors. According to the results, application of organic fertilizer, chemical pesticides, and prefer to pay Rs. 40000 to value the benefits they are receiving through adopting SAP, are the most preferred combination of alternatives in CE. Majority, of the

farmers are willing to practice SAP. Because majority are engaged in paddy farming for household consumption and SAP is beneficial for both human and production. Overall, promoting new trends and techniques for SAP and initiating extension programs to promote organic fertilizer and IPM methods to reduce chemical pesticide usage are recommended.

5. References

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