Economic Valuation of Bio Ecosystem Services from Organic Farming in Valikamam Jaffna Sri Lanka.

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Introduction

Ecosystem can provide a wide range of services and benefits to the society (Costanza et al., 2014), however the expansion and intensification of agriculture ismajor threaten to the ecosystem functioning. Nowadays Jaffna district is facing many burning problems from over usage of agrochemical in agricultural production. Farmers apply excess of synthetic fertilizer, harmful pesticides and chemicals to achieve profit within short period. These are dramatically affect the environment. These cause leaching of high nitrate level in ground water, declining of soil fertility, loss of biodiversity, Soil erosion, environmental degradation, declining crop productivity and depletion of natural resources. Ecosystem plays a major role in agriculture market and support directly to the economic output from agriculture. Therefore, a growing human population and associated increasing food demands make the challenge to maintain and enhance ecosystem services in agriculture greater than in other ecosystems (Takatsuka, Y., 2005).There is no price and no markets for ecosystem services and there is an absence of property rights for ecosystem services. So accurate measure the value of non-marketed ecosystem services associated with organic farming is very important. In our study we consider the choice modeling technique to estimate the values of selected ecosystem services provided on Valikamam farming land. This paper estimates the welfare values associated with three key ecosystem services: water regulation, soil retention, bio diversity associated with organic farming lands and Valikamam resident's willingness to pay for improvements on those ecosystem services through establishes different discrete levels for those attributes.

Materials and Methodology

The survey was done during the month of May to July in 2017. Survey was conducted from 300 farming household across all Valikamam area. By using pretested questionnaire information was gathered from direct interviews withrandomly selectedfarmers from the each Valikamam DS divisions.

Attributes of selected ecosystem services provided by organic farming in Valikamam area were briefly introduced to all respondents at the beginning of survey. Three ecological attributes and one cost attribute were used for this purpose. Ecological attributes discussed were nitrate leaching, soil retention and biodiversity of cropping farms. Each attribute was presented to respondents as several discrete levels. (See Table 1). Discrete

range of cost alternatives given to respondents was Rs10, 30, 60 and 100. These are annual payment to the regional office for next five years.

The choice modeling question includes multiple choice questions, cost to household (4 levels), nitrate leaching (3 levels), soil quality (2 levels) and biodiversity (2 levels). There are 48 possible orthogonal combinations (4 × 3 × 2 × 2). Only 24 choices were considered, amongthese 24 choices, 3 unrealistic options were excluded, the balance 21 were selected. Each choice set has 3 options (A, B, C) in which option C-"No change" is common for all sets.With the use of JMP software 10 choice sets were formulated. In option Acost to the household was designed higher than option B & C for all choice sets. Levels of the attributes change from one alternative to the other except option C. Each option has different level of intensive organic farming. Respondents were asked to select the most preferred option among the each choice sets.

For the econometric estimation choice modelling and logit model was employed. The theory of thechoice model is Utility function (U) is a function of an observable component (indirect utility function) and an unobservable error component

U=V+ ε

Observable component- V

Unobservable error component- ε

The conditional logit model is used to estimate welfare changes in ecosystem services. Welfare change is estimated by the following equation

$$CV = -\frac{1}{\alpha}\left[\left(\beta_i X_{ki} - \beta_j X_{kj}\right) + \left(\varepsilon_i - \varepsilon_j\right)\right]$$

Where CV is compensating variation, ki X (= {x1, x2, …,xk}) is a vector of k attributes associated with alternative I , β is a coefficient vector ,αis the coefficient vector of income. (Takatsuka et al., 2005)

Results and Discussions

The descriptive results are presented in Table 2.

The result of choice modeling for Valikamam areas are shown under Table 3. Nitrate leaching big reduction and soil quality variables are significant at the 0.05 level for all the valikamam DS divisions. Biodiversity variable is significant at the 0.05 level for Valikamam East, West and South-West.Nitrate leaching small reduction is significant at the 0.05 level in only for Valikamam South area. Coefficient of big reduction in nitrate leaching and soil quality show relatively large magnitudes in all Valikamam areas. In all five Valikamam areas biodiversity shows positive coefficient and relatively lower than for other variables.

Willingness to pay for ecosystem services are shown in the Table 4. In the results Valikamam East and West respondents, they are willing to pay more amount of money for nitrate leaching big reduction than other variables. On the other hand Valikamam South, North and South West respondents' willingness to pay for improve the soil quality is more than other attributes. Only Valikamam South respondents are less likely to pay for

improvement on biodiversity. In almost all the five areas willingness to pay for improvement on biodiversity is less than the other variables.

The total WTP for ecosystem services are estimated and shown in the Table 5. Estimates value nitrate leaching is Rs.2.57 million and in the highest among the other attributes. Values for improve the soil quality and bio diversity for Valikamam area are Rs 2.37 million and Rs 0.97 million respectively. Valikamam farmers willing to pay less amount to improve the bio diversity compared to nitrate leaching reduction and soil quality improvement. Among the all five Valikamam DS division, Valikamam South farmers' willingness to pay is Rs 2.35 million and it is the highest WTP among the other Valikamam DS divisions whereas the lowest Rs 0.17 million per year are from Valikamam South West farmers.

Conclusions and Recommendations

The choice modeling study allows us to estimate values non-marketed ecosystem services. Mean WTP for Big Reduction in Nitrate Leaching, soil quality improvement and enhancement of biodiversity per household per year around Rs 61, Rs 56, and Rs 25 respectively.Farmers give more importance for reduction of nitrate leaching and improve the soil quality than improvement in biodiversity.Mean welfare values of improvements of all three ecosystem services are around Rs.150 per household per year. Total amount of WTP is around Rs 6.44 million per year and Rs 32 million for five years. Since farmers from Valikamam area are willing to pay improve the ecosystem services by organic farming, Government Authority (Central Environment Authority) can collect totally Rupees 32 million for 5 years as tax payment. This tax revenue can be given as a subsidy to encourage farmers to adopt organic farming.This study will help provincial or central government policy makers to formulate an effective feasible tax rate for agricultural land use or product and find the mechanism for the tax payment to improve the organic farming in this area.Awareness programs about the value of ecosystem services from organic farming should be conducted to the farmers to reduce the environmental pollution and enhance the biodiversity in the Valikamam area.

Keywords: Choice Modeling; Ecosystem Services; Ecosystem Management; Organic Farming; Willingness to Pay

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