

Factors Affecting Farmers' Willingness to Pay for *Jatropha* Biodiesel

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Introduction

Sri Lanka in its principle policy aims to produce at least 20% of energy requirement by renewable energy source by 2020. Still not much attention has been paid on bio fuels. *Jatropha curcas* L. is found to be a potential alternative source of renewable energy since its cultivation and oil extraction contribute to sustainable development, poverty alleviation, combating of desertification, reduction of greenhouse gas emissions and women empowerment in developing countries (Pushpakumara et al, 2008, and Francis et al, 2005). *Jatropha* has various socio-economic benefits which makes it more economical when cultivated on commercial scale. Like other vegetable oils, *Jatropha* oil can be used directly in modified diesel engines for automobile applications. Its adaptability to marginal conditions is an advantageous feature, which other oil producing crops do not have (Pushpakumara et al, 2008), thus it has the ability to reclaim problematic lands and restore eroded areas (Francis et al 2005). *Jatropha* originated biodiesel is less expensive to produce than other energy crops such as rapeseed and soybeans. This study looks at the demand for *Jatropha* produced biodiesel. Initially, it is unlikely to be used as a substitute for diesel. *Jatropha* biodiesel or Straight oil can be used at village level to operate farm machinery and for day to day activities at small scale. If there exist a willingness from farmers to use biodiesel at least in short term then *Jatropha* could be used as an additional income source. By-products of *Jatropha* biodiesel can also be sold. Thus this study looks at what factors affect rural farmers' willingness to pay for *Jatropha* biodiesel.

Methodology

Welfare estimation is based on Indirect utility and Minimum expenditure functions. Lancaster's (1971) theoretical model for demand estimation is expanded to include other empirical variables. Contingent Valuation Method (CVM) can be viewed as a direct measure of welfare change. WTP as a function of,

$$WTP = F(Y, P, Z, Q_0, Q_1) \dots\dots\dots (1)$$

where, Y income, P is a price vector, Z is a vector of socioeconomic variables, and Q₀ and Q₁ are the environmental quality at status quo and improved levels respectively.

Since bid is a binary outcome a logit regression was employed assuming binomial distribution.

$$WTP^* = \begin{cases} 1 & \text{if yes for bid} \\ 0 & \text{otherwise} \end{cases}$$

$$WTP^* = X_j' \beta + \varepsilon_j \dots\dots\dots (2)$$

Denoting the willingness to pay determinants as a vector, X , then for each respondent $j=1 \dots N$ in the sample, the latent variable, WTP^* , can be written as in equation above for a single bounded model. β is the vector of parameters estimated. In this model the dependent variable was the level of willingness to pay for *Jatropha* Biodiesel. Numeric value of one was assigned to respondents who were willing to pay for *Jatropha* biodiesel and zero was assigned to the respondents who were not willing to pay for Biodiesel. Socio economics characteristics and attitudes about environment were used as independent variables. A survey was conducted in Hasalaka, Kandy covering 310 farmer households to estimate the WTP for *Jatropha* diesel and the factors affecting their decisions.

Results and Discussion

The below table 1 summarizes the results of the logit regression for WTP for *Jatropha* biodiesel. According to the results, males are 49% less likely to go for *Jatropha* biodiesel than females. People with higher age are less likely to pay for *Jatropha* biodiesel when compared to younger respondents. A one year increase in age decreases the likelihood to select biodiesel by 0.4%. Socioeconomic variables like marital status, total income, and employment did not show any significant relationship. Respondents who have heard about global warming are 11% less likely to pay for biodiesel and people know about global warming are 36% less likely to buy biodiesel than the reference group. They may be educated and knows about global warming. Thus, they might have an idea about other alternative fuels which might affect their answers. It is human nature that when people are presented with information, the uneducated might buy without any scepticism, whereas educated people may be having doubts as they too think about the possibility of making biodiesel once they are informed about this. Proper income earners might not want them into risks. So, they might stick to the conventional diesel given its availability around the country. Some may already get an additional income through other investments in their land.

People who have land to cultivate other crops are 11% less likely to go for *Jatropha* biodiesel. When the energy cost increase by one rupee likelihood of choosing biodiesel increases by 0.011%. It should be reminded that energy cost is a continuous variable and it accounts for the expenditure incurred in fuel plus monthly electricity expenditure. When people spend too much on an item, they will seek for any alternative substitutes at lower price. Rational people with limited resources will buy those resources which are highly demanded even by paying some additional amounts. Households where women participate in household decision making are 18% more likely to choose biodiesel. In Sri Lanka, household chores are governed by females they may be more cautious to reduce their total family expenditure per month. An Rs 1000 increase in energy cost will increase the likelihood to pay for biodiesel by 11%. Households with food insecurity are 22% less likely to choose biodiesel. The intuition here is whenever a

household is at a position where they cannot meet their basic needs with what they are receiving as income then, those household will always tries to maximize their utility for basic needs. An inverse relationship exists between food insecurity and WTP for biodiesel. People who have considerable amount of social capital are 26% more likely to choose biodiesel. Social capital measures the connection a household has with the society. Social capital is an important asset as the individual can use this resource to generate profit by careful delegation.

Table 01: Results of logit regression for factors affecting WTP for Jatropha Biodiesel

DV=WTP(1/0)	Coefficient	P> z	Marginal Effect (dy/dx) %
Gender_Male	-2.5227***	0.001	-0.4965
Age	-0.0376**	0.041	-0.0048
Education_years	-0.0166	0.778	-0.0021
Marital Status	0.3452	0.701	0.0490
Total Income	1.65e-06	0.917	2.11e-07
Employment-Farmer	-1.2206	0.251	-0.1303
Employment -Government	2.5481	0.167	0.0623
Employment -Self employed	-1.5672	0.174	-0.1912
Employment -Private	-1.2201	0.371	-0.1302
Global Warm_heard	-1.3531***	0.002	-0.1145
Global Warm_know	-2.6574***	0.006	-0.3688
Land for crops	-0.9678**	0.011	-0.1175
Energy cost	0.0008**	0.014	0.0001
Women	2.3466***	0.006	0.1816
Food-insecurity	-1.4373 ***	0.001	-0.2227
Economic access	0.2811	0.352	0.0360
Social well being	-0.1111	0.732	-0.0142
Social capital	2.0598**	0.000	0.2639
Constant	3.0221**	0.098	
N = 305 LR chi2(20) = 167.96 Probability > chi2 = 0.0000			
Log likelihood = -118.1111 Pseudo R2 = 0.4156			

***, **, *Significant at 1%, 5% and 10% significance level respectively.

Conclusions

This paper examined the factors affecting willingness to pay for Jaropha biodiesel by farmer households. Older male and respondents knowledgeable on global warming, food insecure households are less likely to pay for biodiesel. Higher energy cost, women's role in decision making, higher social capital affect WTP for biodiesel positively. Significant factors are in line with the economic theory and showed expected

signs. One caveat is that when people are given an opportunity to increase their income, farmers might agree even without analyzing the possibility of such a venture given their experiences in farming.

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