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Economic Evaluation of Health Cost of Pesticide Use: Willingness to Pay Method

MUHAMMAD KHAN

1. INTRODUCTION

Pesticides are the most familiar way to control pests. It helps farmers to kill pests that would otherwise reduce the yield obtained from fields. This role of pesticides, on the other hand is accompanied by disutility in the form of health impairment. Due to the high interdependency of farms and farm workers, an impairment of the health status of the farm worker imposes potential negative effect on agricultural production [Ajayi (2000)]. This negative effect may manifest in a lower level of farm production (e.g. through a reduction in the number of farm labour that are available to work at farm). It may also lead to decrease income for the agricultural household (e.g. through a reduction in the output level). Another negative effect is that it may lead to a reduction in the amount of leisure time available for the household (through a reduction in the leisure time available for sick farm household/worker or more stress of work for the healthy members of farm household who have to work more and harder to fill in for sick members).

In addition to short term health effects, there is now increasing evidence of chronic effects of pesticide use which indeed impose potential negative effects on farm production in future. Given that labour is the most important factor in agricultural production particularly in developing countries, the use of pesticides therefore lower potential output not only in short run but also in long run through negative effects on the health of farm workers. With these concerns, it becomes important to examine the health implications of pesticide use. The measurement of health cost of pesticide use helps to inform policy-makers about the productivity reducing effects of pesticide use (due to morbidity effects on labour). The quantification of human health cost of pesticide use will help: first, for effective allocation of resources to necessary health and safety programmes that can safeguard rural communities and second, for formulation of new rules and regulations to protect farmers from pesticide hazard [Atreya (2007)].

However, economic valuation of health costs of pesticide use is constrained by the measurement challenges because of different value components (market components, e.g. cost of illness and non-market component, e.g. cost of pain and discomfort) of human health. Since it is almost impossible to integrate market and non-market elements of health cost, the economic measurement of pesticide associated health cost in most cases have focused on the market components.

Muhammad Khan <mkhan_490@yahoo.com> is PhD Scholar in Federal Urdu University of Arts, Science and Technology, Islamabad.

However, a comprehensive analysis should also include non-market component of health cost. To overcome these limitations, economists developed some modern approaches for assessing changes in value for these goods in the absence of markets. One such technique is Contingent Valuation (CV) which this study applies to measure health cost of pesticide use in two districts of Punjab, Pakistan.

1.1. Economic Evaluation of Health Cost

Like many other environmental goods, economic evaluation of health cost of pesticide use is embarrassed by the practical obstacles because of different value components of human health; market component such as the cost of illness, productivity loss, work days loss (days on which a person is unable to engage in gainful employment/job) and non-market component like cost of discomfort.

Since it is difficult to integrate market and non-market elements of health cost in a health cost model, evaluations of health costs of pesticides so far have focused on the market components, i.e., estimating the costs of illness, work days loss and productivity loss. Different researchers used different approaches include: accounting for farmers' private expenses for the treatment of acute poisoning and the opportunity cost of labour days lost due to illness [Ajayi (2000); Huang, *et al.* (2000)] which obviously a conservative measure of health cost. Others like [Rola (1993)] included effects on the productivity of the family labour and estimates of the cost of chronic illnesses based on clinical studies [Garming (2006)]. Since economic perspective on health focuses on effects that people are aware of and want to avoid, that is, health effects that would decrease their utility. "Much clinical research focuses on effects of questionable significance to individuals, and measures effects that are difficult to relate to individuals perceptions and behaviour" [Freeman (2003)].

Keeping in mind that individual's preferences give better/suitable basis for making decisions about changes in welfare, health cost of pesticide use should be measured according to individual's preferences or willingness to pay. Hence, the Contingent Valuation method (CV)[1] has been proposed in order to obtain a valuation of health based on the individuals' preferences. As pointed by Carson (2000), CV is a useful tool for benefit-cost analysis and offers potentially valid measure to trace out the distribution of willingness to pay[2] for a population of economic agents for a proposed change in a good. Through benefit-cost analysis, welfare economics, attempts to explain possible change in utility resulting from a minor change in an economic variable. Typically, welfare implications are demonstrated in terms of a change in monetary amount which would need to be taken from or given to the agent to keep the agent's overall level of utility constant [Carson (2000)]. Conceptually, the same measure of benefit applies to non-market goods, that is, the maximum amount an individual would pay to avoid losing or gaining access to the good [Lipton (1995)].

[1]In this approach, respondents are offered a hypothetical market, in which they are asked to express the WTP for existing or potential environmental conditions not reflected in any real market. The monetary values obtained in this way are thought to be contingent upon the nature of the constructed market, and the commodity described in the survey scenario [Garming (2006)]. The answers offered a direct way to trace the demand curve for an environmental good that could not otherwise be seen from the market data [Hanemann (1994)].

[2]CV is better measure of health cost of pesticide use since; it also includes non-market value.

2. THEORETICAL BACKGROUND

Microeconomic theory provides necessary elements to model the decision process of an individual's choice of non-market good. In Contingent Valuation Method, the change in the supply of a non-market good is evaluated with respect to a constant utility for the individuals following the concept of Hicks compensated demand functions. The utility of the farm household (U0) can be expressed as the sum of health (H0) and other goods, summarised as income (Y0). If supply with health is improved to H1, keeping income constant, farmers move to a higher utility level (U1). The value of the change in supply is measured as that amount of income that the farmer is willing to pay (WTP) in order to be indifferent about the change in health, i.e., to remain on his initial utility level, conceptually, using an indirect utility framework; the economic valuation construct can then be represented as:

$$U0 = Y0 + H0 = Y0 - C\ (WTP) + H1$$

Where, for a given individual, U0 is a base level of utility, Y0 is current income and H1 is the improved health. WTP is the amount of income a farmer would give up in order to gain improved health, while maintaining a constant level of utility. Also the Willingness to pay is a function of the product attributes, characteristics of the consumer, and other factors thought to influence the choice.

3. RESEARCH METHODOLOGY

3.1. Sampling and Data Collection

Data from the Pakistan agriculture statistics [Agriculture Census (2000)] were collected to find the composition of pesticide use in different crops and geographical areas. Cotton has been identified as the major crop, which accounts more than 80 percent of total pesticide use in Pakistan [Pesticide Use Survey Report (2002)]. Whereas more than 80 percent of cotton is produced in Punjab province and being the centre of cotton crop the cotton zone of the Punjab has been recognised as the most intensive with respect to pesticide use. Over all two districts (Lodhran and Vehari) of the cotton belt in Punjab province are selected for the study.

A well-designed, comprehensive and pre-tested questionnaire was used to collect data from both the districts in 2008. The method of meeting interview was used for filling in the questionnaire and all interviews were conducted face to face. The questionnaire is based on United States Environmental Protection Agency questions and on that used in the similar World Bank studies in Bangladesh and Vietnam.[3] Sampling for this study combined purposive and probabilistic sampling methods.

To study a small subset of a larger population in which many members of the subset could easily be identified. Area sample/cluster sampling was used to collect data economically. Hence as a sampling strategy, after the selection of study districts, all three tehsils were chosen for survey as the representative area. At least three villages (clusters), from every tehsil were selected in each district to get the pesticide-related information from a sample of farmers. In each village, well informed men were hired to make

[3] See, Dasgupta (2005).

farmer's list in their respective villages. Overall 915 farmers from both the districts, 412 from district Vehari and 503 from district Lodhran were enlisted. A random sample of 400 farmers was drawn without replacement using [Random. Org (2008)]. Respondents were selected in order from the numbers drawn until 318 interviews were successfully completed. The overall response rate (i.e. successful interviews completed) was 80 percent, including 85 percent response rate for Lodhran district and 75 percent response rate for Vehari district.

3.2. Validity and Reliability Tests of CVM

Since CVM has been criticised for relying on stated preferences instead of observable behaviour and controversy, to some extent continues to exist between researchers regarding validity and reliability of CVM, it is important to discuss this issue in present context.

Validity refers to the correspondence between what one wished to measure and what was actually measured. Reliability refers to the measurement's replicability [Carson (2000)]. Both terms can be operationalised in a variety of ways. The ideal way of determining validity is by comparing the measurement made to some criterion measurement known to be correct. Unfortunately, such a criterion to which CVM can be compared does not exist. Furthermore, no such criterion exists to which any other consumer surplus estimate can be compared, irrespective of the econometric technique used or whether the good is private or public [Gunatilake (2003)]. In such cases, investigators adopt different approaches to determining validity; two common ones are Construct validity and Convergent validity. Construct validity refers to how well the measurement is predicted by factors that one would expect to be predictive *a priori*. Convergent validity can be taken only when measurements of the phenomena of interest are available using two different techniques. Two types of reliability have interested CV researchers. One is the chronological/temporal stability of the estimate if two different samples of the sample population are interviewed with the same survey instrument at two different points in time. The other is the classic test-retest reliability where an original sample of respondents is later re-interviewed using the same survey tool.

In practice, as described by Garming (2006) that there is consensus among researchers that the reliability of the CV is not an issue of concern; one should stress on the validity of the results for the assessment of the quality of the particular CV studies. However, this study also measures reliability and the statistics of reliability analysis shows a reasonably good reliability value (.70). Hence questionnaire appeared to have good internal consistency. All items appeared to be worthy of retention except health effects. But the change in overall alpha if item is deleted is only.708. Nevertheless this increase is not dramatic and both values reflect reasonable degree of reliability.

For validity of the CV, there are two main types of validity assessments. Content validity refers to the design of the survey instrument. Is the good defined in a way that the correct value can be measured? Are respondents provided with sufficient and plausible information? Is the proposed way of payment acceptable and scenarios plausible? Careful survey design and pre-tests are tools to enhance content validity [Garming (2006)]. The theoretical validity test applies the idea that the preferences for environmental (non-market) goods follow the same rules as the preferences for conventional market goods.

The valuation should be sensitive to the quantity of the good and WTP should vary with income and attitudes towards the good. Attitudes towards the good, e.g. concerns about pesticide poisoning and experience of illness, as well as budget constraints and risk measures like intensity of pesticide use are expected to have an impact on farmers' valuation of pesticide related health effects.

The study followed NOAA guidelines for good practices in CVM obtained by Portney (1994).

The design of the questionnaire therefore was guided by the CV guidelines, data requirements for the WTP analysis and the tests on the validity. Table 1 gives a snapshot of the validity criteria used in implementation of the field survey. The description of health for the valuation scenario was based on the approach used by Garming (2006). Health was represented as an attribute of a pesticide which was offered in a hypothetical purchase situation.

Table 1

Validity Test in the Implementation of the CV

Content Validity		
Definition of the Good	Pesticide without health risks	Response rates Analysis of comments of respondents with zero WTP.
Payment Vehicle	Pesticide price	
Familiarity	Farmers' heavily dependent pesticides	
Acceptance of the Questionnaire	Modifications after pre-tests	
Construct Validity		
Theoretical Validity	Household characteristics Pesticide related health experiences Perception/attitudes	Scope test: larger the scope (benefits) = more WTP? Ordered probit model on WTP.

Source: Adapted with changes from Garming (2006).

In order to increase the farmers' familiarity with the good, for each respondent his most recent used/heavily dependent pesticide was taken as a reference with respect to pest control efficiency. The price premium, he would be willing to pay for a pesticide (IPM) with the same characteristics except the health risks of the product was then established as the WTP for the health attribute. Other possible descriptions of the good "health" could be included e.g. the willingness to invest in IPM. However, discussions with farmers showed, that most of the farmers were not familiar with IPM; this type of description might not reflect true reference and would have reduced the plausibility of this scenario for the farmers. Thus the most practical description remains chemical pesticides which farmers are very familiar with, rendering the "low toxicity pesticide option" as the most feasible option for the CV survey [Garming (2006)].

Following standard practice in CVM analyses, the respondents were asked suppose that you were able to have access to a pesticide that was just as effective as the one(s) you are using now, but it did not have any short- or long-term health effects. Thinking about the health effects you have experienced with your current use of pesticides, how much would you be willing to pay for the use of the safer pesticide? Furthermore, economic theory would suggest that consumer's choices are influenced by their individual tastes and preferences, income, attitudes towards and perceptions of the different types of products, as well as household and demographic characteristics [Garming (2006)]. One could then use the relationship between WTP and factors affecting WTP.

3.3. Empirical Model

In many empirical analyses, including this study, WTP takes the form of a multiple response variable that has intrinsic order. As a result, ordered qualitative response models must be used. In this case, the WTP model can be written using a latent variable as follows:

$$WTP^* = X' \beta + \varepsilon$$

Where WTP^* is the latent (or unobserved) willingness-to-pay, X is a vector of variables thought to influence willingness-to-pay, β is a vector of parameters reflecting the relationship between willingness-to-pay and variables in X and ε is an independently and identically distributed error term with mean zero and variance one. If a farmer's WTP^* falls within a certain range,[4] their WTP is assigned a numerical value that reflects the category in which their unobserved willingness-to-pay lies [Cranfield (2003)].

The probability of a WTP being in one of J finite categories can now be written as:

$$Pr(WTP = j-1) = \Phi(\alpha j - X'\beta) - \Phi(\alpha j - 1 - X'\beta) \forall j \in J$$

Where Φ(.) is a cumulative density function (CDF), which measures the probability of WTP. Two broad choices, the logistic or standard normal density functions, are readily available. An ordered probit model was used. Like all probability models, an ordered probit model allows for calculation of predicted probabilities for each WTP category and marginal effects. When calculated at the means of the data, predicted probabilities indicate the chance of the average farmer being willing-to-pay a premium falling within each of the categorical premium levels. A number of different explanatory variables also included as common practice in the WTP model. These include household socio-economic characteristics, health-related pesticide exposure. Attitude or perception towards health risk is expected to be the most important variables determining WTP. Similarly previous experience with pesticide poisoning, the reporting of sign/symptoms related to pesticide application was also important explanatory variable. Personal characteristics of the respondent like income, age and education were also used in the ordered probit model [Cranfield (2003)].

3.4. Data Analysis and Result

Table 2 shows the willingness-to-pay categories and distribution of responses. Respondents were asked to indicate their WTP either in actual monetary amounts[5] (which

[4]The amount classified into categories, 1= Not willing to pay, 2= willing to pay from 1 percent up to 5 percent premium, 3= willing to pay up to 6 percent to 10 percent premium, 4= willing to pay up to 11 percent to 20 percent premium, 5= willing to pay over and above 20 percent premium.

[5]Which helps to eliminate respondent's need to make mental calculations, and to be reflective of a retail market situation?

Table 2

Distribution of WTP Responses (%)

Willingness to Pay Category	Both Districts	Vehari	Lodhran
Not willing to pay	22.9	17.4	27.8
Willing to pay one to five percent premium	21.6	26.2	17.8
Willing to pay six to ten percent premium	39.8	36.9	42.6
Willing to pay eleven to fifteen percent premium	1.9	2.0	1.8
Willing to pay sixteen to twenty percent premium	13.2	17.4	9.5
Willing to pay more than twenty percent premium	0.3	0.0	0.6
Total	**100**	**100**	**100**

later converted into percentages), or to percentage amounts directly. The table shows that out of 318 respondents 73 (22.9) percent farmers are not willing to pay any premium. Following standard practice in CVM the farmers were asked if this was because they did not value the health improvements, or because they objected to the payment vehicle or some other aspect of the question [Cho (2005)]. The answers were categorised into (a) I have not enough money to pay more , government should provide these pesticides at the same cost (b) I do not believe that pesticide use lead to health effects as claimed. The farmers who answered (b) can be classified as legitimate zero WTP who did not value health improvements. The households who answered (a) can be categorised as who objected to the payments vehicle.

The zero responses are significantly higher in district Lodhran which was expected since farmers in district Vehari are relatively more educated as well as having higher mean income and higher risk perception. This is also evident from the Table 3. The results, therefore, appear logical and consistent with theory and existing literature.

Table 3

District Wise Mean WTP

	Mean WTP (%)	Mean WTP Amount in (Rs)
WTP in Lodhran	7.5	542
WTP in Vehari	8.8	628
Total Sample WTP	8.1	582

The mean willingness to pay appears to be very low, as compared to other studies such as Garming (2006) found that farmers in Nicaragua willing to pay 28 percent more, the total cost of pesticide. Similarly Cuyno (1999) found that Philippines farmers were willing to pay 22 percent of pesticide costs for human health category. This is however not surprising, if taking into account, that the most of the farmers are poor (small-scale farmers), and uneducated.

3.4.1. *Age, Gender and Education of the Farmers*

All the surveyed farmers were male; this is because usually the spraying operations are done by male in Pakistan. Age ranges from 18 to 66 years, with an average age of 33.3 years approximately. Most of the farmers 113 were in age groups 21-30 (35.5 percent) and 101 were in age group of 31-40 (31.8 percent). The Table 4 displays the education attainment of different age groups.

Table 4

Education Attainment of Different Age Groups

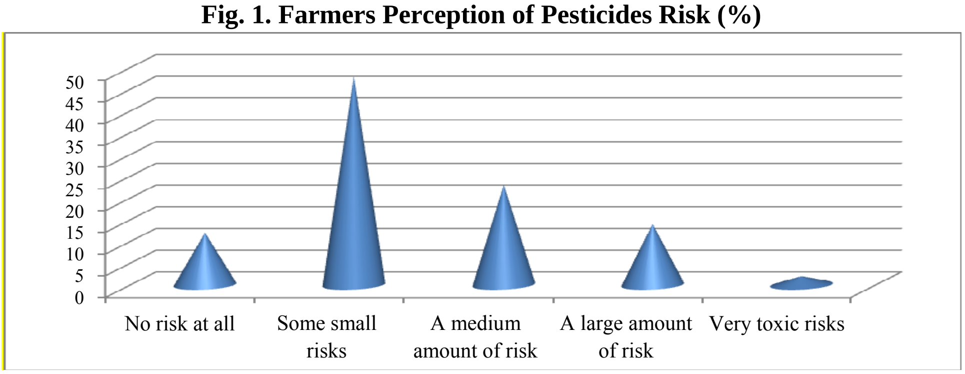
	Education Attainment					
Age Categories	Illiterate	Up to Primary	Middle	Metric	Higher Secondary	Graduation and Above
≤ 20	5	6	2	3	0	2
21-30	32	25	28	15	6	7
31-40	27	33	25	7	3	6
41-50	10	13	18	4	3	2
51-60	9	11	5	8	1	1
61+	1	0	0	0	0	0
Total	84	88	78	37	13	18

3.4.2. *Risk Perception*

Perception of a pesticides' health risk is also of interest as this may influence WTP decision by the farmers. According to the study's results, the majority (88 percent) of farmers believed that they are at health risk while using pesticides. During the interview, farmers were asked to rank the risk. Five categories were presented and scaled as shown in the Figure 1. More than half 52 percent reported some small risk, 23 percent, a medium amount of risk, 10 percent believed that the risk is large and significant, 3 percent said the risk is very toxic, however 12 percent believed that there is no risk at all.

It is important to note that pesticides were regarded as very important for successful production. They also added that they could not grow crops without pesticides. Although many of them believed that spraying pesticide is dangerous but, they said that they have "no other option" at all.

Fig. 1. Farmers Perception of Pesticides Risk (%)

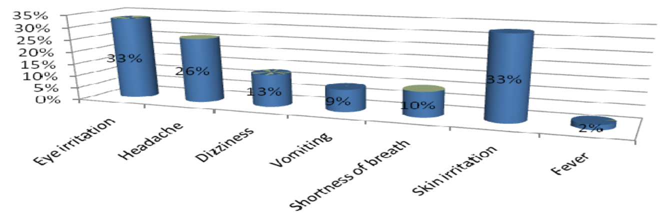


Farmers were also asked if they experienced any health impairment during mixing and spraying pesticides or within 24 hours after the pesticide application is finished.[6] Almost 82 percent of farmers said they experienced health impairment after mixing and spraying pesticides (see Table 5).

[6]It must be noted that most of the pesticide mixture consist of chemicals which have essentially acute effects. Therefore it is expected that the health symptoms of exposure to these chemicals would be visible within 24 hours time period.

Table 5

Main Health Effects Experienced by Farmers (%)



The most common signs[7] and symptom[8] experienced were eye (irritation: 33 percent), neurological (headaches: 26 percent, dizziness: 13 percent), gastrointestinal (vomiting: 9 percent), respiratory (shortness of breath: 10 percent), dermal (skin irritation: 33 percent) and (Fever: 2 percent).[9]

Over 34 percent of the respondents experienced multiple health effects, with an average of 2.6. The maximum numbers of symptom reported were 6. Upon asking sick farmers whether they believed that these symptoms were related to pesticide use, 63 percent believed this to be true. More than 44 percent of them strongly believed that these symptoms were related to pesticide use.

3.4.3. Results of Ordered Probit Model

Since the ordered probit model is non-linear, the estimated coefficients are not marginal effects. Therefore, coefficient estimates and marginal effects are reported individually. The estimated coefficients of the ordered probit model and the corresponding p-values are shown in Table 6. Out of nine explanatory variables, five are significant and have expected signs. Importantly, these variables are theoretically-motivated variables. The Pseudo R2 about (.5167) and the null hypothesis that the estimated coefficients are jointly equal to zero is rejected at the one percent level.

Table 6

Estimated Coefficients of Ordered Probit Model for Positive WTP

Variables	Estimated Coefficients	Z-scores
Education	.2190725***	(4.64)
Perception	1.293249***	(11.46)
Training	–.4451418	(–1.43)
IPM	–.023301	(–0.08)
Farm Size	.1811018*	(1.86)
Age	.0718007	(0.363)
Health Effects	.6933518***	(3.36)
Income	.7846149***	(7.13)
District Dummy(Vehari)	–.027809	(–0.18)

Log likelihood = –206.46517, Pseudo R2 = 0.5167, LR chi2 (12) = 441.41***

* – Significant at the 10 percent level. ** – Significant at the 5 percent level.

[7]Sign: something you can observe or see that requires an examination.

[8]Symptom: something a person feels but you cannot see.

[9]These are the health effects that farmers did not have before they started spraying, but these appeared only during mixing or spraying or within 24 hours after the pesticide spraying has ended.

Regarding personal/household characteristics, it comes as no surprise that income variable approximated by the sum of all the household expenditures, either in cash or in goods is positively related to WTP. Thus, purchasing power of the farmers is highly significant determinant of WTP. Whereas low income farmers cannot decide freely on environmental friendly or quality pesticides for higher prices. Similarly, the coefficient for education is consistently highly significant to a positive WTP. Continuing with personal/household characteristics, the age of the respondent has no impact on WTP. Contrary to Garming, *et al.* (2006) adoption of Integrated Pest Management practices may not always positively associated with WTP. This is supported by the fact that an individual will be least interested to pay for the good which he/she already has; that is, they already practicing IPM successfully. The training variable carry's same arguments, the farmers who already got training of safe handling of pesticide are less likely to pay more for safer pesticide.

Of the health and exposure-related variable, the reporting of an adverse health experience was positively and significantly associated to a positive WTP. Similarly perception of risk is significantly related to positive willingness to pay. More over results showed that the association between the farmers' risk perception and WTP is very strong. Thus risk perception is the most important determinant for positive WTP. The size of the farm is significant to the positive WTP in present analysis which was very much expected since it can be interpreted as an indicator of wealth. With respect to the different regions, WTP is not significantly different in both the districts.

The predicted probabilities for the five willingness to pay categories are reported in Table 7. The reported probabilities indicate the likelihood that on average farmers are willing-to-pay some premium for safe pesticides which possibly improve their health. The table has two panels, the upper panel reports predicted probabilities and the lower indicates the marginal effect for all explanatory variables. Model includes both continuous and binary variables. Starting from top of the table, age of the farmers, nevertheless not significant more likely to pay some premium for safer pesticides since we also assume age as the proxy of farming/pesticide use experience, suggests that farmers who have been using pesticide since long are more likely to perceive higher risk and therefore willing to pay premium for safer pesticides. Differently this can also be explained in terms of income of the farmers. Old farmers are more likely having higher income and more empowered. The "risk perception" variables have negative marginal effects for the first two WTP categories (i.e., the not willing to pay any more and the willing to pay between one and five percent categories), but a positive marginal effect for the other willingness-to-pay categories. Moreover, the marginal effect tends to be very strong for the category "medium amount of risk". Thus the farmers who perceive pesticide a health risk are more likely to be willing to pay premium relative to those who do not perceive pesticides a health hazard.

The pesticide related health effect variable has negative marginal effects for first two categories of WTP but positive marginal effects for other three categories of WTP. These results are analogous to priory expectation since logically, negative health experiences from the pesticides more likely to influence farmer's attitudes to pay higher premium for safe pesticide. The marginal effect of education is negative for the first two categories of WTP; but it is positive for the higher categories of WTP. This suggests that

Table 7

Predicted Probabilities and Marginal Effects from the Estimated Model

	WTP(=0)	WTP (1-5 %)	WTP (6-10%)	WTP (11-20%)	WTP (20 % and above)
Predicted Probabilities	.03946155	.38032781	.57760992	.00260072	7.644e-10
			Marginal Effects		
Age	–.0061195	–.0219439	.0274859	.0005775	3.40e–10
Perception	–.1102229	–.3952452	.4950665	.0104016	6.13e–09
Health Effects	–.0869063	–.1842272	.2676826	.0034509	1.66e–09
IPM	.0020161	.0071064	–.0089395	–.000183	–1.05e–10
Training	.0503218	.1256599	–.1735827	–.002399	–1.05e–09
Farm Size	–.0154352	–.0553487	.0693273	.0014566	8.58e–10
Education	–.0186714	–.0669534	.0838628	.001762	1.04e-09
Income	–.0668723	–.2397955	.3003572	.0063106	3.72e–09
District (Vehari)	.0023701	.008499	–.0106455	–.0002237	–1.32e-10

holding, other things same, there is a higher probability of being in lower WTP categories when farmer's education is low compared relative to when farmer's education is higher. Differently, more educated farmers are more likely to pay higher premium for safe pesticide relative to less educated farmers.

The marginal effects of training and IPM variables for the first two categories (i.e., the not willing to pay any more and the willing to pay between one and five percent categories) are positive, such that the farmers who got training of safe handling of pesticide use and farmers who currently practicing IPM are more likely to pay either no premium or up to five percent premium and very less likely willing to pay higher premium for safe pesticides. The income variable shows a similar pattern. The marginal effect for the first two categories of WTP is negative however these effects are positive for other categories. This is because higher income farmers can afford premium. The farm size variable follows same reasoning. This variable is an indicator of individual's wealth which ultimately expands farmer's budget constraints. Thus more the size of farm, the more likely farmer willing to pay premium for safe pesticides. The result is parallel to priory expectation and consistent to theory.

4. CONCLUSION

This paper highlights the results of Contingent Valuation method to measure health cost of pesticide use from farmer's point of view. Analysis shows that farmers have a positive willingness to pay for avoiding pesticide related health risks. Theoretical validity tests show that relevant indicators such as risk perception, previous experience of pesticide related poisoning, education and income are significant predictors for the positive WTP.

Compared to the other studies in literature [Garming, *et al.* (2006); Cuyno (1999)] mean willingness to pay is relatively small. This is not surprising, since most of the farmers are poor (small-scale farmers), and uneducated and cannot afford premium. From the results it is evident that health effects provided motivation for farmers to pay more for practices like IPM that reduce dependence on pesticide use which in turn a strong motivation for policy-makers to continue research on IPM and its implementation.

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