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Farmers' willingness to pay for less health risks by pesticide use: A case study from the cotton belt of Punjab, Pakistan

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HIGHLIGHTS

- Willingness to pay for less pesticide risks was studied in Pakistani cotton farmers.
- Most farmers showed willingness to pay some fee up to 20% of the pesticide expenditures.
- The mean willingness to pay per farmer was low, reaching 5.8 $US on an annual basis.
- A considerable proportion of the farmers were not willing to pay any premium at all.
- Farmers perceiving major risks appeared willing to pay a premium for safe pesticides.

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ABSTRACT

The amount of pesticides used in crop production in Pakistan has increased rapidly in the last decades, whereas farmers in many areas of the country show little knowledge of safe and efficient use of pesticides. The level of willingness to pay (WTP) for avoiding health risks by pesticides was studied among 318 randomly selected cotton farmers from two districts of the area of Punjab (i.e., Vehari and Lodhran) in Pakistan, using the contingent valuation method. Most farmers felt that pesticide use is a prerequisite for successful cotton production, whereas at the same time they were well aware of pesticide health risks, which they considered minor. The majority of the farmers (77%) showed varying levels of WTP some fee up to 20% of the current pesticide expenditures for avoiding pesticide health risks, but few were willing to pay a fee over 20%. The mean WTP per farmer was low, reaching 5.8 $US on an annual basis. By contrast, a considerable proportion of the farmers (23%) were not willing to pay any fee for avoiding pesticide health risks. These individuals were mostly poor small-scale farmers with limited or no education. High levels of risk perception about pesticides, past experience of pesticide intoxication, high levels of education, and high income were associated with high farmers' WTP for less health risks by pesticides. Farmers who perceived major health risks by pesticides appeared to be highly willing to pay a premium for safe pesticides. Elderly farmers appeared more likely to pay some premium for safe pesticides as a result of higher farming experience and higher income than young farmers. Well-educated farmers were more likely to pay a high premium for safe pesticides. Large farm size was a significant predictor of positive WTP, which was interpreted as an indicator of farmers' wealth.

1. Introduction

Productivity growth in agriculture has been closely related to the increased use of chemical inputs, such as various types of pesticides (Damalas, 2009; Damalas and Eleftherohorinos, 2011). Indeed, the use of synthetic pesticides in agriculture is nowadays a widespread method for pest control and an obvious part of current agricultural production systems. Pesticides help farmers to cope easily and rapidly with common pests that would otherwise reduce yield. As an important side effect, however, chemical inputs in the agricultural production create non-negligible hazards for human health and the quality of the aquatic and terrestrial ecosystems (Van der Werf, 1996; Tilman et al., 2002; Carvalho, 2006; Maroni et al., 2006). Additionally, pesticide residues on edible commodities are ingested by humans with foodstuffs and water (Carvalho, 2006). Thus, human health and environmental risks by the use of such synthetic chemicals have created an ongoing and increasing pressure against their use (Pimentel, 2005; Atreya, 2008; Soares and Porto, 2009; Fantke et al., 2012). Although technical developments in the application equipment have been improved to a great

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extent, enabling more appropriate application of pesticides, professional use has not been transferred satisfactorily to the every-day practice in many developing countries.

An impairment of the health status of farmers or farm workers may impose significant negative effects on the agricultural production (Ajayi, 2000). Negative effects may manifest in the form of lower level of farm production (e.g. through a reduction in the available labor at farm), lower income for the agricultural household (e.g. through a reduction in output), or reduction of the amount of leisure time available for the household (e.g. due to time devotion to the sick worker or through increasing work load for the healthy members of the household who have to work more and harder to cover the work of the sick member). The measurement of health cost of pesticide use helps to inform policy makers about the effects of pesticide use on productivity reduction (e.g. due to morbidity effects on labor). Although the correlation between the severity of health risks and the use of highly toxic pesticides has been previously documented (Kishi et al., 1995), the links between health risks and pesticide exposure are pesticide-dependent and the existing findings often disagree, as there is a lack of data for more reliable results and some methodological issues that could be improved. In any case, reduction of pesticide use is seen by many individuals as a strategy for improving the health status of the rural population.

Economic evaluation of health costs by pesticide use is required to design effective health policies and reduce pesticide poisoning among the rural population. However, the evaluation has to consider both market and non-market value components. Farmers often do not take into account the expenditure incurred in the treatment of illness arising from the direct exposure to pesticides, and they dismiss intangible costs such as discomfort, pain, and suffering as a normal part of their work. Because of the lack of appropriate methodologies and reliable data, the health impacts of pesticide use have traditionally been omitted from the analysis of returns on agricultural research and from the evaluation of specific agricultural policies (Atreya, 2005). Given that no directly observable prices exist for the reduction of pesticide health risk, non-market evaluation techniques to monetize individuals' preferences should be sought. With these techniques, the monetary values are reflected in the individuals' willingness to pay (WTP) for a risk reduction. Thus, given that the individual WTP reflects how much individuals require in compensation for a risk reduction, they reflect individual preferences. So far, the evaluations of health costs by pesticides have focused on the market components, usually evaluating the costs of illness (Ajayi, 2000; Huang et al., 2000). However, a more thorough analysis of the health costs of pesticide use has to consider also the non-market value of human health. For this purpose, the contingent valuation method (CVM) has been suggested, as more suitable in obtaining a valuation of individuals' preferences for health.

Keeping in mind that individuals' preferences give a basis for making decisions about changes in welfare, health costs of pesticide use should be measured according to individual's preferences or WTP. The CVM uses survey questions to elicit individuals' preferences for public goods by finding out what they would be willing to pay for specified improvements in them, i.e., the level of WTP in monetary values (Hanley et al., 1997). Hence, the CVM has been proposed to obtain a valuation of health based on the individuals' preferences. The CVM is a survey-based economic technique for the valuation of non-market resources, such as environmental preservation. While these resources do give people utility, certain aspects of them do not have a market price as they are not directly sold. For example, people receive benefit from a beautiful view of a mountain, but it would be tough to value this benefit using price-based models. Typically, the survey asks how much money people would be willing to pay (or willing to accept) to maintain the existence of (or be compensated for the loss of) an environmental feature, such as, for example, biodiversity. The CVM is a globally appealing valuation technique because of the ease with which it can be applied in different countries and in different contexts in an unbiased fashion. This is due to the fact that the local researchers have full control and autonomy in designing the questionnaire and implementing the survey (Phuong and Gopalakrishnan, 2003).

The need to evaluate pesticide use in rural populations, particularly at the level of small scale farmers in developing countries, is urgent. Perceptions of pesticide risk affect farmers' behavior towards pesticide use (Dasgupta et al., 2005a; Liu and Huang, 2013; Damalas and Hashemi, 2010; Hashemi and Damalas, 2011; Hashemi et al., 2012). Thus, basic information about pesticide handling and safety issues as well as continuous emphasis on the basic safety precautions required when using pesticides is essential for changing wrong habits of farmers that can be hazardous for their health (Damalas et al., 2006a, 2006b). It is also well known that respondents' socio-demographic characteristics are important with respect to risk perception and WTP attitude (Huang, 1993; Sjoberg, 2000). Few studies have applied the CVM to the topic of pesticides and human health. Most of these studies were conducted for integrated pest management (IPM) programs in US agriculture (Mullen et al., 1997; Brethour and Weersink, 2001). Previous studies on farmers' WTP for reduced health costs from pesticide use have been carried out in the Philippines (Cuyno et al., 2001), Nepal (Atreya, 2005), Nicaragua (Garming and Waibel, 2009), and the US (Gallardo and Wang, 2013). Most of similar studies were focused on consumers' WTP for reduced health costs from pesticide use (Cranfield and Magnusson, 2003; Florax et al., 2005; Posri et al., 2006; Combris et al., 2012; Bazoche et al., 2014). The objective of this study was to assess the value of pesticide related health costs from the farmers' point of view. This information can contribute to the targeting of rural health policies and the design of programs aiming to reduce negative effects of pesticides on farmers' health.

2. Materials and methods

2.1. Study area

Data from the official agricultural statistics of Pakistan were used to identify main crops and pesticide use among different geographical areas. Cotton was identified as the major crop in Punjab province. More than 80% of cotton is produced in that area. In fact, this province is the center of cotton production in the country and also is recognized as the area with the most intensive pesticide use, accounting for more than 80% of total pesticide use in Pakistan. Two districts of the cotton belt in Punjab province (Lodhran and Vehari) were selected for the study. Vehari district consists of a plain area, a part of Indus plain, with highly fertile land used for agricultural purposes; the district is subdivided into three tehsils (Burewala, Mailsi and Vehari). Lodhran district is also an agricultural district smaller than Vehari; Lodhran is subdivided also into three tehsils (Lodhran, Kahror Pakka and Dunyapur). These two districts (Lodhran and Vehari) have about 50 years of historical evidence of pesticide use and are well known for cotton production.

2.2. Selection of sample

Cluster sampling with small subsets was used to collect data. Members of the subset could be more easily identified contributing to lower costs of the survey (Green et al., 2006). Hence, as a sampling strategy, after the selection of districts, all three tehsils were chosen for the survey as the representative area. Distribution of sample population by district is illustrated in Table 1. At least three villages (clusters), from every tehsil were selected in each district to get the pesticide-related information from an adequate sample of farmers. In each village, a well-informed person was hired to prepare a list of farmers for the specific village. Overall, 915 farmers from both districts, 412 from Vehari district and 503 from Lodhran district, were enlisted. A random sample of 400 farmers was drawn with replacement using an automatic