



Adverse health effects, risk perception and pesticide use behavior

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ABSTRACT

The use of pesticides on the farm is largely governed by voluntary behavior. It is important to understand what drives farmer's behavior of pesticide use. Health belief models in public health and social psychology argue that persons who have had adverse health experiences are likely to undertake greater preventive behavior which is tested here. A survey of 163 farmers was drawn in Vehari and Lodhran district of southern Punjab. Almost all the farmers were found using pesticides extensively and covering their body partially. Resultantly more than 77% farmers experienced at least one health symptom. The analysis appeared to confirm the hypothesis that farmers who have experienced health problems from pesticide use are having heightened concern about health effects of pesticides than farmers who have not experienced such problems. Farmers who report experiencing such problems are also more likely to report using protective clothing than farmers who do not report having such problems. The study however, does not support the hypothesis that farmers who have had experienced health problems from pesticides are likely to use alternative pest management practices. Finally study concludes that to improve practices of pesticide use, specific and relevant information through training programs should be provided to farmers, focusing health and environmental risks of pesticide use.

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Introduction

All over the world, it has been seen that the use of synthetic pesticides in agriculture is the most familiar way of controlling pests. The extensive use of such pesticides results in substantial health and environmental threats. According to WHO, (1990) "pesticide use causes 3.5 to 5 million acute poisonings a year with roughly 20,000 workers dying from exposure every year" most of them in developing countries.

Latest studies showed that the actual deaths may be around 300 000 [(Gunnell & Eddleston 2003) and (Buckley 2004; Srinivas 2005)]. Residues in air, water and foods, have led to much more concern over the undesirable effects on environment and human health (al-Saleh IA 1994).

The use of pesticide is largely directed by self behavior. In a "political environment in which regulations do not cover how farmers apply pesticides, it is important to know what drives farmer's voluntary behavior of pesticide use" (Lichtenberg & Zimmerman 1999).

The factors that affect whether or not farmers adopt safe behavior of pesticide use are not well understood. Contrary to number of studies in different geographical settings showing pesticide intoxication appear to be due to lack of knowledge and information in developing countries, latest studies such as Kishi (2002) Clarke (1997), McCauley (2004) and Yassin (2002) have shown that personal safety measures were poor and very high risk practices were common, despite high levels of knowledge on the health impact of pesticides. Similarly Damalas (2006) noted that although farmers' knowledge of possible hazards by pesticide use was high, the reported safety measures were poor.

All these studies however do not provide satisfactory answer to the questions that why some farmers, despite high level of knowledge of health risks, do not respond to health promotion. And what factors influence those who exposed to pesticide risk, to transform that risk into self protective behavior? One of the

factors that affect whether or not farmers adopt protective and environmentally sound behavior of pesticide use is whether or not they have experienced a personal health effect" (Lichtenberg & Zimmerman; 1999). This idea is the focus of this study. Basically, concrete knowledge (personal experiences or observations) is more meaningful than abstract knowledge (being listened) to change behaviors regarding health risk.

As health psychology literature says that most of our knowledge in our lives comes from practical experiences, rather than from intellectual exercises. This study aims to explore how farmers respond to information about and perceived experience with the threat of pesticide.

It attempts to evaluate whether or not farmers' experience with adverse health effects from pesticides would influence: Their beliefs or attitudes about the seriousness and importance of health and their willingness to adopt measures to reduce the incidence of those problems.

At the end of this section research questions of the paper are given. In section II trend of pesticide use in Pakistan is discussed. This follows theoretical framework in section III and information on research methodology is briefly touched in section IV.

The survey findings and analytical model are discussed in section V and VI respectively. Conclusion and policy implications are placed in section VII.

Research questions

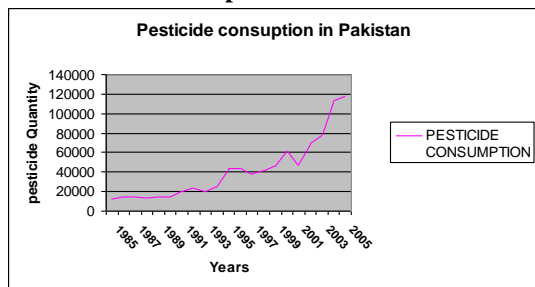
The main research questions of the study are:

1. Whether or not farmers who believe they have had adverse health experiences from pesticides are likely to have heightened concerns about pesticides hazard?
2. Whether or not farmers, experiencing adverse health effects from pesticides take more protective measures?
3. Whether or not farmers, experiencing adverse health effects from pesticides adopt alternative pest management practices.

Overview of Pesticide Use in Pakistan

Use of pesticides has increased considerably in recent years, reaching 117513 metric tons in 2005 which was only 12530 metric tons in 1985. (See Figure 1 below)

Figure1: Pesticide consumption between 1985 to 2005 in Pakistan



Source: Department of plant protection Karachi 2007

Pesticides are intensively used on cotton in Pakistan followed by paddy, fruits and vegetables. Cotton alone accounts for about 80 percent of the total consumption of active ingredient of pesticides (NFDC, 2002). Given the Pakistan's agriculture settings and cash crops security situation, it can be expected that current crop protection trend will likely continue to be the main practice in the country. The trust on pesticides for plant protection is expected to lead to more dependence on (Huang, et al., 2003) and to rising use of pesticides due to rapid development of resistance among pests.

Conceptual Framework

Role of information and awareness in decision making behavior

The pesticide use decision is highly influenced by the level of awareness and information that agricultural households have about the health hazards associated with pesticide use. If information gap exists on the health effects of pesticide use, health costs of pesticide use are most likely not to be included into farm production costs and decision-making which may result in sub-optimal production decisions. If a farm worker is aware of the health consequences of pesticide use on production and overall household welfare, he/she would choose to use more protective clothing or look for alternative technologies (e.g. IPM). Thus, the accuracy of information, level of awareness and knowledge of farmers are key issues in pesticide use decision making behavior. The awareness may include the knowledge about health costs, the perception and the importance that farmers attach to health issues.

Referencing health behavior theory of social psychology this study investigates the role of information in pesticide use decision. The following sections discuss how individuals incorporate information into understanding of environmental health threats to promote solutions at both environmental and personal levels.

Health Belief Model

Social cognitive models provide a theoretical framework for the study of health or illness behavior and motivation to self-protective techniques. One of such theories is health belief model. This study applies health belief model to explain relationships between information, risk perceptions and protective behavior.

Health-belief model postulates that persons who have had adverse health experiences will likely to adopt protective behavior; If he/she (1) believe that a negative health problem can be avoided (2) has a positive anticipation that by taking a suggested action, he/she will avoid a negative health problem and (3) sure that he/she can effectively take a suggested health action. Basically "Health Belief Model" encourages a person to adopt positive health actions using the desire to avoid a negative

health outcome as the key inspiration. For example, pesticide exposure has negative health effect, and the desire to avoid direct exposure from pesticide can be used to motivate farmers to undertake safety measures. Broadly "Health Belief Model" is based on six key concepts which are explained in the context of present study.

Perceived Susceptibility: Farmer's own examination or view of the risk of receiving a health problem from pesticides or their self-confidence or self-belief of the chances of contracting a health condition from pesticides. "The susceptibility component is most closely analogous to the health experiences" (Lichtenberg and Zimmerman 1999).

Perceived Severity: Farmer's personal belief of how severe a health condition and its cost (health and economic) is? Or their beliefs regarding the impact of the illness on overall quality of life or how it may affect functional capacity of farmers (e.g. an illness/health effects prevents farmers doing certain things).

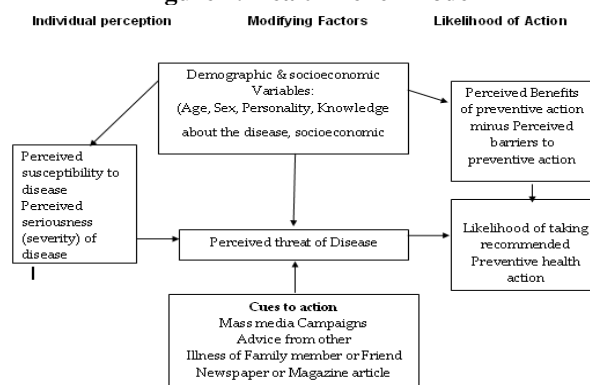
Perceived Benefits: Farmer's belief and confidence of the effectiveness of strategy/plan proposed to decrease pesticide exposure and promotion of health.

Perceived Barriers: The possible hindrance or negative consequences that may result from adopting certain health actions, such as physical, psychological, and economic stress.

Cues to Action: Events, either physical symptoms of a health condition (personal health effects) or environmental incidents (e.g. death of fish, frog and birds/animal) from pesticide use that stimulate farmers to take action/adopt protective measures.

Self-Efficacy: The farmer's belief in being able to effectively and successfully carry out the protective measures necessary to turn out the desired result.

Figure 2. Health Belief Model



Source: Strecher and Rosenstock (1997).

The health belief model helps to understand why some people do not respond to health promotion. Lichtenberg and Zimmerman (1999) noted that adverse health experiences change farmer's behavior regarding pesticide use. Results showed strong relationship between the farmers' experience of health problems from pesticides and their attitudes toward the seriousness of effects from pesticide application. Strong relation was also been found between the experience of health problems and the use of alternative pest management practices and/or the use of pesticides with fewer environmental effects. This implies that farmers who have had such experiences do care about the effects of application and do engage in alternative means of pest management, which at least involve the reduction in pesticide use. Similarly Napier and Brown (1993) found that respondents who supposed their families to be threatened by fertilizers and pesticides in groundwater perceive groundwater contamination to be chief environmental problem and were more willing to compel land operators to alter production practices to keep groundwater resources safe. An examination of environmental

and health risk literature indicate that the content of present study fits the HBM dimensions.

Perceived susceptibility: Farmer's own examination or view of the risk of receiving a health problem from pesticides or their self-confidence of contracting a health condition from pesticide use. 'The susceptibility component is most closely analogous to the health experiences' (Lichtenberg and Zimmerman, 1999).

Perceived severity: Farmer's personal belief about the severity of health condition associated with pesticide use and its overall cost. In other words their beliefs regarding the impact of the illness on overall utility or its negative effect on functional capacity (e.g. an illness prevents farmers doing certain social and economic things).

Perceived benefits: Farmer's belief and confidence of the effectiveness of strategy/plan (e.g. using protective clothing or using alternative pest management techniques) proposed to decrease pesticide use cost.

Perceived barriers: The possible hindrance in adopting better management practices, such as increased labour hours since integrated pest management practices usually involve more physical work than pesticide use or purchase of protective clothing or fear of economic loss due to less production.

Cues to action: Events, either physical symptoms of a health condition or environmental incidents such as death of fish, frog, poultry and birds from pesticide use that stimulate farmers to take action/adopt protective measures.

Self-efficacy: The farmer's belief in being able to effectively and successfully carry out the protective measures necessary to turn out the desired result.

Study Area and Justification

Because of differences in the use of pesticide in different geographical areas and crops, data from Pakistan agriculture statistics 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% of total pesticide use in Pakistan (NFDC, 2002), whereas more than 80% of cotton is produced in Punjab province and being the center of cotton crop the cotton zone of the Punjab has been recognized as the most intensive with respect to pesticide use.

Overall two districts (Lodhran & Vehari) of the cotton belt in Punjab province is selected for the study.

The study area represents 17.5 % of total area under cotton crop in Punjab. Because of same culture and agricultural practices the results obtained from the study can safely be generalized to represent the whole set-up in cotton producing areas in Punjab.

Data Methodology and Research Design

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 the similar World Bank studies in Bangladesh and Vietnam.

An investigation visit was carried out for general familiarization with the research area and the key players in pest management in the area. The familiarization process was assisted by the use of some informant interviews to obtain information about the general set-up. The questionnaire was then modified using the background knowledge from the reconnaissance visit. Final version of the questionnaire was used to collect information on pesticide use and practices, applicator precautions/ averting behavior and health/ environmental effects.

The technique of multi stage stratified random sampling was used to obtain cross-sectional data. As a sampling strategy, at least three villages were selected purposively from every tehsil in each district to get the pesticide-related information from pesticide applicators.

Survey Findings

Background information: Overall 163 respondents were interviewed in both districts (97 in district Vehari and 66 in district Lodhran). The 163 surveyed farmers were all male. The majority of farmers 75.5% owned their land. Age ranges from 18 to 60 years, with an average age of 35 years. The age and education breakdowns of the respondents were as follows: Over 71% of respondents had received education of different levels, 7% of the farmers had also attended university whereas 29% of respondents had never in the school and could not read or write.

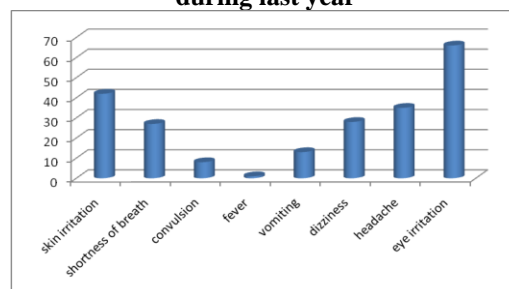
The average land area was 3.8 acre in district Vehari, and 10 acre in Lodhran district.

Risk Perception: The majority (86%) of farmers believed that they are at risk while using pesticides (53% some small risk, 20% a medium amount of risk, 10% a large and significant amount of risk, 3% very toxic risk), however 14% believed that there is no risk at all. It is important to note that pesticides are regarded as very important for successful production. It is common belief that they cannot grow crops without pesticides. Although many of them believed that spraying pesticide is dangerous but, they said they have "no other option" at all.

Health effects: Almost all the farmers interviewed (96%) believed that pesticides could have some affect on their health. 34% farmers rated that pesticides have little health effect, 17% of them said that effects are medium, compared to 11% and 2% believing it is large and fatal respectively. Few 4(2%) of them said that they don't know, whereas 6(3.6%) also believe that pesticides have no influence on their health.

More than 77% farmers in both the districts experienced one or more health effects while spraying, many of them experienced multiple symptom. However 22% of them never had any health problem during or after spray or they don't know about it.

Figure 3 Type of poisonings experienced by respondents during last year

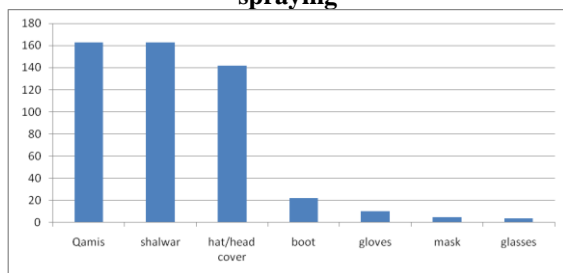


Pesticide application: The survey also found that farmers often apply pesticides very frequently. It was quite common for farmers (78%) to use pesticides more than 10 times on one crop particularly on cotton in a season. The spray frequency is as high as 16 on cotton crop in one season. Almost all the farmers found mixing several different brands together and the common reason of this practice was better control over different type of insects at a time. However they also believed that mixers are getting less and less effective which ultimately leads to frequent applications and more than recommended dose.

Protective clothing's and behavior: All the respondents said that they wear protective clothing when they carry out spraying operation which is usually consisted of qamis (long sleeved shirt), shalwar (long pants), head cover and boot. Figure 2 shows the types of protective clothing respondents use while spraying. However, not all farmers use these materials when they spray. The use of masks and glasses is almost nonexistent. Also the use of gloves is limited, only 6% of them used gloves during last year. The common reasons for not using these materials are carelessness, uncomfortable and non availability of these materials. Majority of the farmers said they change their clothes

shortly after spraying; only few of them reported not doing so. They also did not think it necessary to change their clothes. Approximately all the respondents usually take bath after spray, but again most of them do not consider it necessary.

Figure 4 Different types of protection farmers used while spraying



Analytical Model

Health experience and risk perception

Seriousness of health risk is important factor in shaping individual's behavior. Previous literature and theoretical background help to identify factors determining individual's risk perception. Following Lichtenberg and Zimmerman (1999), risk perception is taken as the function of health experience, age, education, training, income and geographical area. Regression results are reported in table III.

The findings support the hypothesis that there is a strong linkage between adverse health effects and heightened risk perception. The adverse health experiences in this study are positively related with the seriousness/perception with which farmers view health problems associated with pesticide use. The farmers who got training of safe pesticide handling were found perceiving more risk than the farmers who did not have such like training. It is widely accepted that education enhances awareness regarding health. The results also showed strong association between education and heightened risk perception. Similarly higher income farmers reported heightened perception of pesticide risk compared to low income farmers, explaining their access to information and extension. District controls reveal that perceived risk from pesticides are more or less same in both districts.

Health Experience and protective Behavior

The behavioral factor examined in this study in relation to health experience was the extent to which farmers used protections to avoid pesticide exposure. Result shows that the farmers who experienced health symptoms/problems during mixing or spraying pesticides are more likely to adopt protective/safety measures, *ceteris paribus*. The result is consistent with the theory and priory expectations. Similarly more educated farmers reported statistically significantly taking more protective clothing than farmers with less education. The result implies that education exerts a significant effect on the decision to adopt protective measures. Also trained farmers reported significantly higher concern about protection. This could be interpreted as indicating that the more learned farmers in terms of safety are more likely to select higher level of protection than non-trained farmers. Similar findings were noted by Lichtenberg and Zimmerman (1999).

There are a few well-defined coefficients associated with the farmer's socio-economic background. For instance, farmers with higher income and farm size category are more likely to choose higher level of protection than their counterpart. The farmer's perception of health risk also exerts significant effects on the probability of choosing more protection. District dummy shows no variability in taking protective measures.

Health effects and environmentally sound behavior of pesticide use

A probit model was used to study more thoroughly the relationship between health experience and environmentally safe pest management practices. The probability that any alternative pest management practice used by the farmers which is assumed environmentally safe was assumed to be a function of farm and farmers attributes, in addition to health experience. "The incorporation of the additional variables controls for factors that may be associated with health experience as well as decisions about using alternative pest management practices and thus allows isolation of the effects of health experience" (Lichtenberg and Zimmerman 1999). The probit results are reported in table V.

The probit result did not confirm the hypothesis that farmers who have had adverse health experiences related to pesticides are more likely to adopt alternate pest management practices that reduce reliance on pesticides than farmers who have not had such experiences. In the probit analysis, numbers of other variables are also identified that affect the decision to use alternate pest management that have implications. The alternative pest management practices are positively related to risk perception, age, training and income. District dummy reveals that alternative pesticide use is more in district Lodhran than in district Vehari.

Conclusion and Policy Implication

The specific focus of this paper is to systematically examine the factors that influence a farmer's decision making behavior of pesticide use at farm level. In our survey, 86% farmers perceived pesticides a health risk and more than 77% experienced at least one health effect when mixing or applying pesticides. However, practically all the farmers were found, using pesticides extensively and covering their body partially. About 78% farmers were reported spraying 10 or more times in a season on cotton crop.

The econometric analysis presented provides evidence that there is an association between the farmers' experience of health problems from pesticides use and their risk perception. There is strong association between health experiences and risk perception.

Association also existed between the experience of health problems and the use of protective measures. However, no association between the experience of health problems and the use of alternative pest management practices was found. This however does not mean that farmers who have had such experiences do not care about the effects of pesticides. The lack of proper know-how about alternative pest management practices and inaccessible or non-existent extension are probably the contributing factor for this comportment.

Finally, the research findings have some important implications, for example, the empirical relation that appears to exist between training of safe handling and alternative pest management would suggest that trained farmers significantly and effectively substitute for pesticide.

Hence, to improve more informed choices of pesticide use, specific and relevant information through training programs should be provided to farmers regarding the health and environmental risks of using pesticides. Increased effort by Government and NGOs to educate farmers on the externalities of pesticides through training on IPM techniques can help reduce dependency on pesticides while at the same time maintaining or improving production.

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