Understanding farmers' pesticide use in Jharkhand India

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Abstract. The World Vegetable Center (AVRDC) identified that indiscriminate pesticide use was common amongst vegetable farmers in Jharkhand State, India. Subsequently, an Integrated Pest Management (IPM) research and development project was initiated to promote safe vegetable production. This study employed the Theory of Planned Behaviour (TPB) to gauge farmers' attitudes, subjective norms and perceived behavioural control towards pesticides in combination with Participatory Rural Appraisal (PRA) tools to adapt an extension program promoting IPM in Jharkhand. Farmers had a strong behavioural intention and favourable attitudes, subjective norm and perceived behavioural control to apply pesticide in the coming season. The extension program is likely to be more successful if it dispels myths of pesticide function and includes women and marginal farmers in activities. The key learnings from the study are that farmers have a favourable intention towards pesticide use; attitude was the most important factor influencing behavioural intention; and the applicability of the TPB to a development extension context.

Keywords: Theory of Planned Behaviour, pesticides, Integrated Pest Management, extension

Introduction

India needs to increase its vegetable production while at the same time reduce the use, and in particular misuse, of pesticides. The overall question is how to achieve this goal in a country where the general education level amongst farmers is quite low? To increase the general education level is part of the long-term answer but in the short term, part of the answer lies in the agricultural extension system. We hypothesise that a goal-oriented extension effort may be able to help reduce the pesticide use and misuse among vegetable farmers in India.

As India has the highest rate of underweight children in the world, particularly among girls and rural rather than urban populations (Gragnolatti 2006), the need to address malnutrition in rural areas is unquestioned. One important component to combat malnutrition is a more nutritious diet through increased vegetable production and consumption. At the same time, as Indian incomes grow on average but in particular in urban centres, there is a greater demand from consumers for pesticide residue-free vegetables (Krishna and Qaim 2008). Krishna and Qaim (2008) found that people with higher incomes were willing to pay 50% more than the current market price for residue-free vegetables.

Previous studies have found that class I & II pesticides (WHO 2005), extremely to moderately hazardous, banned in other countries are still available in India and often the poorer and marginal farmers are more exposed to pesticides than larger farmers as the latter have more resources, such as appropriate application devices or hired labour, available to them to minimise their exposure risk (Mancini et al. 2008). Indian famers have been found to follow unsafe pesticide handling practices such as not wearing protective clothing (Sam et al. 2008), pesticide misuse (Baral et al. 2006) and serious health impacts are common, requiring medical attention (Mancini et al. 2008).

Pesticides represent an important ingredient in current Indian agriculture. The crop loss from pests is estimated to be 18% annually in India (Singh et al. 2003) where insecticides are the most popular pesticide and are predominantly used on cotton (Mancini et al. 2008). Since the 1980s, Integrated Pest Management (IPM), the combination of various management methods (Mason 2003), gained importance in India through favour in policy and extensive promotion of IPM programs in rice, sugarcane and some vegetables (Singh et al. 2003). However a lack of trained personnel, complex decision-making required on the part of farmers and farmer beliefs in relation to natural enemies have been identified as limitations to the widespread adoption of IPM in India (Singh et al. 2003).

Research into the adoption of IPM practices for eggplant in West Bengal has advocated studying farmers' socioeconomic characteristics in order to understand their practices (Baral et al. 2006). In 2007 AVRDC - The World Vegetable Center undertook a scoping study in Jharkhand, India, and found evidence of indiscriminate pesticide use by vegetable farmers (AVRDC 2007). Jharkhand was therefore chosen as the case for this study on how extension practices could be improved in order to reduce the use and misuse of pesticides by farmers, i.e. how to stimulate the adoption of IPM practices among Indian farmers.

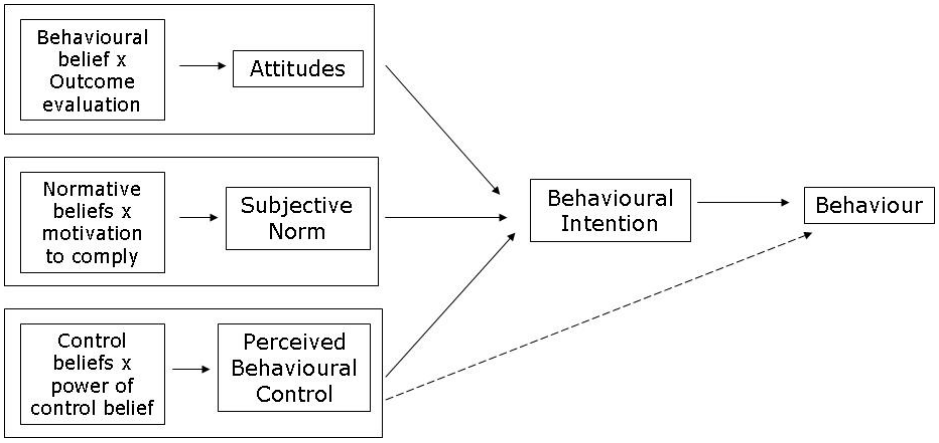
The specific objective of this study was twofold. Firstly, to investigate farmers' perceptions and the factors that influence their intention to apply pesticide to their vegetable crop for pest management with the purpose of improving the IPM extension program undertaken by AVRDC. Secondly, to assess the applicability of the Theory of Planned Behaviour (TPB) in the context of farmers' decision making on pesticide use in a developing country context. To achieve this, the Theory was used as a means of gauging farmer awareness, attitudes, social pressure and perceived control over pesticide application and Participatory Rural Appraisal (PRA) techniques were used in conjunction with the TPB analysis for triangulation.

Theoretical Frameworks

The Theory of Planned Behaviour (TPB)

The Theory of Planned Behaviour (TPB) is an extension of the Theory of Reasoned Action (TRA) and is designed to predict and explain behaviour in a specific context (Ajzen 1991). The framework denotes that behavioural beliefs, normative beliefs and control beliefs influence behavioural intention which in addition to actual control influences subsequent behaviour, as shown in figure 1 (Ajzen 1991).

Figure 1. The Theory of Planned Behaviour



Source: (Ajzen 2006)

Attitude refers to a person's positive or negative evaluation of the behaviour, subjective norm refers to the perceived social pressure to perform the behaviour or not and perceived behavioural control (PBC) is the perceived level of difficulty in performing the behaviour in light of past experience and anticipated obstacles or opportunities (Ajzen 1991). The inclusion of the PBC construct acknowledges that not all behaviours are under complete volitional control where performance of the behaviour may be reliant on external factors such as money, time or skill (Ajzen 1991). Generally, the more favourable an individual's attitudes, subjective norm and perceived behavioural control the stronger their intention to perform a behaviour (Ajzen 1991). Figure 1 shows that each of attitude, subjective norm and PBC is based on beliefs the individual has and the framework assesses the strength and the individual's evaluation of these beliefs in order to determine an overall measurement of the construct (Ajzen 1991, 2006).

The theory has been used extensively in decision-making contexts in various disciplines such as health and exercise science (Barberia et al. 2008; Brändström et al. 2004; Conner et al. 2003; Davies 2008; Francis et al. 2008; Johnston et al. 2004), marketing and consumer behaviour (Arvola et al. 2008; Lobb et al. 2007) and natural resource management and agriculture (Beedell and Rehman 2000; Bergevoet et al. 2004; Burton 2004; Coleman et al. 2003; Fielding et al. 2005; Fielding et al. 2008; Hattam 2006; Lynne et al. 1995; Petrea 2001; Vogt et al. 2005; Zubair and Garforth 2006). More recently the theory has been applied to transitional and developing economy countries (Åstrøm 2004; Burak and Vian 2007; Kakoko et al. 2006; Nasco et al. 2008; Wang et al. 2005; Zubair and Garforth 2006).

Suggestions have been made that in regard to agriculture and the complex decision-making process related to farming, the TPB is insufficient to account for all factors influencing behaviour but provides a solid grounding for further investigation (Beedell and Rehman 2000; Burton 2004). Other constructs such as self-identity have been added to TPB studies to improve its explanatory capacity in regard to agricultural practices (Fielding et al. 2008). However, when investigating agricultural safety behaviour in regard to pesticide use, Petrea (2001) found that the TPB was a useful framework for understanding farmers' behaviours for the development of targeted health and safety interventions. Similarly, this study has employed the TPB in order to

gain insight into the factors which influence vegetable farmers to apply pesticide with the aim of using these findings to develop an IPM extension program which will be more meaningful to them.

PRA tools

Participatory Rural Appraisal (PRA) techniques are beneficial for collecting data from a range of participants in a short period of time. Focus group discussions are a type of interview where the group make-up is relevant to the information trying to be gathered or the group dynamics of the situation and have the advantage of being less time-consuming than interviewing the group members individually (Mikkelsen 2005). Diagramming activities such as problem trees can be used to identify issues or problems from the participants' perspective and similarly problem or preference ranking is a tool for visually ranking the problems identified by the participants (Mikkelsen 2005). Venn diagramming is useful for mapping communicative and organisational links from the participants' perspective while seasonal calendars are effective tools for mapping the climatic, agricultural and other activities of a community such as cultural festivities throughout an entire annual season or other specified time period (Mikkelsen 2005).

Materials, Methods and Procedure

Case area and research team

Jharkhand is a relatively new state with Ranchi as its capital and was carved out of Southern Bihar in 2000 due to political pressure from tribal groups. Jharkhand is comprised of 24 districts and within each district there are various blocks (administrative divisions) which cover multiple villages. The population of 26.9 million reside in the 32620 villages of the state, of which 45% have electricity and almost 26% are connected by roads (Government of Jharkhand 2009).

The TPB study was undertaken through a questionnaire administered through individual structured interviews, while the PRA activities were undertaken as group activities simultaneously with the TPB study in order to provide more insight into the specific constructs being investigated and the farming systems in general. The research was undertaken in Ranchi and Khunti districts of Jharkhand, during November and December 2008 as a MSc. thesis study and all activities were undertaken by the one researcher. She was assisted by one interpreter who translated between English and Hindi and where necessary a second interpreter translated into Mundari, a local tribal language. The Regional Center for South Asia (RCSA) of AVRDC – The World Vegetable Center is implementing the IPM intervention as a component of the "Improving vegetable production and consumption for sustainable rural livelihoods in Jharkhand and Punjab, India" project which is funded by the Sir Ratan Tata Trust. It is partnered by various Non-Governmental Organisations (NGOs) operating in the region including Indian Grameen Services BASIX, Professional Assistance for Development Action (PRADAN), Nav Bharat Jagriti Kendra (NBJK) and Kishi Gram Vikas Kendra (KGVK).

The elicitation study

Prior to the full-scale implementation of the TPB questionnaire an elicitation study was undertaken to draw out the salient beliefs of the target population with respect to attitudes, subjective norms and PBC towards pesticide use. Three semi-structured interviews with vegetable farmers, a group discussion with NGO staff and key informant conversations comprised the elicitation process. The farmer respondents were asked open questions regarding the advantages and disadvantages of using pesticides for pest management in the coming season, which important individuals or groups of people would approve or disapprove of their pesticide use and what factors would make it easy or difficult to apply pesticide in the coming season. NGO staff and key informants were asked broad open questions regarding the current state of pesticide use in the area and factors influencing this.

The main study

The TPB questionnaire was administered through structured interviews to 85 respondents (81 males and 4 females) who were purposively sampled based on availability and their participation in the mixing and applying of pesticides in their respective farming operations. Prior to the main survey the TPB questionnaire was piloted on an additional two respondents and adjusted accordingly. Only the respondents who were actually involved in the mixing or applying of pesticide were included in the regression analysis thereby rendering a sample size of 80, which is outlined as suitable in the literature regarding TPB questionnaire construction (Francis et al. 2004).

The TPB constructs were measured using 5-point Likert scaling and items measuring perceptions of environmental, personal and food safety risk were also included in the questionnaire as Likert items and Likert-type items (Uebersax 2006). Attitudes were measured directly using a semantic differential item (e.g. *Overall I think that applying pesticide to my vegetable crop for pest management in the coming season would be: good-bad, worthless-useful, enjoyable-unenjoyable*). Indirect measures of attitudes gauged the salient beliefs identified during the elicitation study and questionnaire items asked respondents about behavioural beliefs (e.g. *Applying pesticide to my vegetable crop for pests in the coming season will increase my yield. – likely/unlikely*) and outcome evaluation (e.g. *Increasing my yield is: desirable/undesirable*).

Subjective norms were measured directly (e.g. *People who are important to me want me to apply pesticide to my vegetable crop for pests in the coming season – strongly disagree/strongly agree*) and indirectly addressing normative beliefs (e.g. *My neighbours do/do not apply pesticide to their vegetable crops for pest management*) and motivation to comply (e.g. *Doing what my neighbours do for pest management in vegetable production is important to me – not at all/very much*).

Perceived Behavioural Control was measured directly (e.g. *For me to apply pesticide to my vegetable crop for pests in the coming season would be extremely difficult/extremely easy*) and indirectly addressing control beliefs (e.g. *The price of pesticide will be expensive – extremely unlikely/extremely likely*) and power of control beliefs (e.g. *Even if the price of pesticide increases I will still apply pesticide to my crop – strongly disagree/strongly agree).*

The main study employed several PRA tools including focus group discussion, semi-structured interviews, seasonal calendar, Venn diagramming, problem tree and general group discussions in conjunction with the TPB questionnaire. To obtain general information regarding the farming systems in the area, the seasonal calendar was undertaken and further to this information was gathered regarding the crops with the most pest problems and those which received the most pesticide applications, through the use of pair-wise and problem ranking. The focus group discussion was undertaken with the women to obtain a different perspective than that offered through the male-dominant TPB survey while the Venn diagram focused on the information channels utilised by farmers in regard to pest management. The problem tree enabled the perceptions of the causes and effects of pesticides to be illustrated by the farmers and has found to be useful for this purpose in other studies (Williamson et al. 2003).

Results

Farmer respondents and farming systems

According to both the seasonal calendar and participatory interview techniques the application of pesticide was found to be a male role in the farming system and this was reflected in the gender balance of the questionnaire respondents. 69% of the respondents were head of their household and the average age of respondents was 36 years old while the mean number of household members was 7 and the average farm size 2.5 hectares. The average size of the vegetable area was considerably less than the total farm size (0.5 hectares) as the farming systems in the region are predominantly rice based. Several respondents stated that they had been cultivating vegetables since ancient times although only doing this 'scientifically', or with improved varieties, more recently and generally respondents had been applying pesticides for a shorter time (mean = 7.5 years) than they had been growing vegetables (mean = 11.1 years). 15% of respondents (n=13) hadn't attended school while 40% hadn't progressed further than secondary level, 17% had received intermediate level education and 10% had higher education. As this survey only sampled a small proportion of the total population following a purposive technique no generalisations to the larger project population can be made from these analyses.

Through pair-wise and problem ranking, the crops with the greatest pest pressure from the perspective of the farmers' were cauliflower, eggplant, tomato, cabbage, cowpea and frenchbean and accordingly were the crops which received the greatest number of pesticide applications. The major crop pests identified were eggplant fruit and shoot borer, Bihar hairy caterpillar and bacterial wilt of tomato.

The TPB survey

Each of the direct measure constructs correlated significantly with each other and were favourable towards pesticide use in the coming season (Table 1). The attitude, subjective norm and PBC composites were then regressed against intention as the dependent variable to measure the relationship between the constructs. Table 2 shows the coefficients from the regression analysis, and illustrates that the model was able to predict 59.3% of the variance

(adj. R^2 =0.593) in intention and attitude contributed the greatest weight in the prediction of intentions (st.β=0.429). A prediction of 59.3% of the variance in intention shows that not all factors which influence respondents to apply pesticide to their vegetable crop have been captured by the study. Other studies have found the variance in intention to be anywhere from less than 40% (Bergevoet et al. 2004; Tonglet et al. 2004; Kakoko et al. 2006; Clayton and Griffith 2008), to approximately 50% (Conner et al. 2003; Åstrøm 2004; Fielding et al. 2005) to only a few greater than 70% (Åstrøm 2004; Nasco et al. 2008). A meta-analysis of 185 TPB studies published up until 1997, found that the variance in intention accounted for by the models was between 27% and 39% (Armitage and Conner 2001). Obviously the greater the variance in intention accounted for by a model, the greater its predictive ability. In relation to agricultural safety equipment, Petrea (2001) found the R^2 value of just 0.28, highlighting the importance of external factors to the explanation of variance in intention but also the relatively high variance in intention accounted for in this study.

Table 2 shows that PBC and subjective norm also significantly contributed to some of the variance in intention, although subjective norm was significant at the 0.05 rather than 0.01 level. Similar to other studies, attitudes contributed the most to the variance in intention followed by PBC and subjective norm contributing the least where Armitage and Conner (2001) found in a meta-analysis of TPB studies that subjective norm was often a weak predictor of intention. These findings suggest that in an extension program activities which target respondents' attitudes to pesticides would be useful in changing behaviour.

Table 1. Correlation and descriptive data of the direct measure constructs

Variable	Correlation				Mean	SD	Possible range
	1	2	3	4			
1. Intention	-				13.35	2.71	3-15
2. Attitude	0.641**	-			24.15	6.2	6-30
3. Subjective Norm	0.599**	0.606**	-		12.70	3.46	3-15
4. PBC	0.522**	0.191*	0.288**	-	4.85	0.58	1-5

* p<0.05 **p< 0.01 PBC – Perceived behavioural Control

Table 2. Direct measure regression coefficients for the TPB

Variable	Standardised β	t	R	Adjusted R^2	R^2 change
(Constant)		-1.307			
Attitude	0.429**	5.053			
Subjective Norm	0.231*	2.294			
PBC	0.373**	2.703			
			0.780*	0.593	0.32

* p<0.05 **p< 0.01 PBC – Perceived behavioural Control

Each of the behavioural beliefs was weighted by its corresponding outcome evaluation and the indirect-measure attitude composite was calculated from the sum of these weighted behavioural beliefs. Similarly, each of the normative beliefs were weighted by their corresponding motivation to comply scores and each strength of belief score was weighted by its corresponding power of control belief scores to calculate the indirect composites of subjective norm and PBC respectively. Each indirect composite was then correlated with its corresponding direct-measure composite to test for consistency and the results are displayed in Table 3.

Table 3. Pearson correlation values of direct and indirect construct composites

Construct	Pearson's r value
Attitude	0.530**
Subjective Norm	0.493**
PBC	0.289**

**p< 0.01 PBC – Perceived behavioural Control

Table 3 shows that each of the indirect construct composites was significantly correlated to the direct measure composite at the 0.01 level, meaning that we can be confident that the indirect

measures are valid. Consistent with the theory, when the indirect variables were regressed against intention, no extra variance was accounted for. To identify the salient beliefs within the survey population the indirect-measure weighted beliefs for each of the attitude, subjective norm and PBC constructs were regressed against intention and it was found that attitude 3 (pesticides increase plant vigour), PBC 1 (pesticides are expensive) and subjective norm 3 (my family would approve of me applying pesticide) were the more salient beliefs (table 4), where the model accounted for 49.7% of the variance in intention.

Table 4. Regression analysis of indirect salient beliefs

Variable	Standardised β	T	R	Adjusted R^2	R^2 change
(Constant)		9.681			
Attitude 3 (Plant vigour)	0.381**	4.174			
PBC 1 (Price)	0.375**	4.209			
Subjective Norm 1 (Family)	0.234**	2.838			
			0.719*	0.497	0.05

* p<0.05 **p< 0.01 PBC – Perceived behavioural Control

Similarly to the direct composite regression, attitude followed by PBC and subjective norm accounted for the variance in intention. This model of salient beliefs accounted for less of the variation in intention (49.7%) than the direct composite model (59.3%) suggesting that perhaps the direct measures of each of the constructs covered a broader range of salient beliefs than those captured by the indirect measures which might have been reduced with a more thorough elicitation study. However the results are significant and can be used in the development of an intervention to promote IPM practices and reduce indiscriminate pesticide use in the project area. As consistent with the theory, all demographic factors were added to the regression but no extra variance was accounted for.

In relation to behavioural intention to apply pesticide in the coming season respondents were asked if they 'intend', 'want' and 'expect' to apply pesticide. Only 66% of respondents agreed that they intended to apply pesticide, 71% agreed that they wanted to apply pesticide but 90% of respondents stated that they expected to apply pesticide in the coming season, where perhaps respondents interpreted this as the likelihood that pests would be present. A popular response was that people 'have to' apply pesticide and this feeling of obligation has been found in other pest management studies (Palis 2006) and a study related to under-the-table payments for health care in Albania (Burak and Vian 2007) and perhaps relates to the degree of volitional control over the behaviour.

These TPB results show that attitudes, social pressure and perceived control over pesticide are able to explain, to an extent, the factors which influence the farmers to apply pesticide for pest management in their vegetable systems. Specifically, the belief that pesticides increase plant vigour and growth accounts for the largest variance in intention suggesting that dispelling myths of pesticides might alter farmer attitudes and subsequent behaviour regarding their application. Similarly, but to a lesser degree, the beliefs that pesticides are expensive and that family members want respondents to apply pesticide are also influential. Yet, as the model accounted for 59.3% of the variance (as opposed to 100%) there are other factors which influence this behavioural intention which have not been accounted for in this study. Despite this, the IPM intervention can address these salient beliefs, such as through awareness raising of the actual function of pesticides to dispel current myths or to promote the economic viability of alternative pest management methods such as pheromone traps, as a means to improving IPM adoption. At the methodological level the results suggest that the TPB can be used as an effective tool to identify key themes and tasks to help focus the effort of agricultural extension workers.

The PRA tools

Several PRA tools were used to triangulate the data captured through the TPB analysis. Particularly, the problem tree provided insight into farmers' perceptions of the effects of pesticide and this technique has been used by other studies investigating pest management and found to be useful (Williamson et al. 2003). The problem tree indicated that the participants believed pesticides to indirectly increase yield through greater crop protection, the environmental effects were restricted to air pollution, sometimes human health was effected but only when using 'high-power' pesticides and on occasions where pesticides didn't work the farmers would change to another company's pesticide, rather than change the active ingredient. This diagram showed that farmers are aware of some of the risks from pesticide use but not

others. The women's focus group supported the questionnaire results of the men - that pesticides are useful for protecting the crop and essential for attaining a yield but can be harmful to human health.

Discussion

This study set out to analyse farmer beliefs and perceptions in relation to pesticide use for pest management in vegetable cultivation in Jharkhand and the context in which they operate. It was intended to inform an IPM extension program so as to make it more meaningful to farmers. The salient beliefs within the surveyed population that accounted for the most variance in intention were found to be that pesticides increase plant vigour and growth, pesticides are expensive and family groups think farmers should apply pesticide to their vegetable crop for pest management.

In regard to farmer perceptions and salient beliefs, generally respondents were aware that pesticides do not directly increase plant growth or vigour as plant growth hormones or 'tonics' do. However, there was evidence that some farmers did not understand this (e.g. one 28 year old respondent claimed that "pesticides directly increase plant growth"). Through key informant discussions it was suggested that this discrepancy often arises from the dishonest behaviour of some chemical shopkeepers who may sell a plant growth hormone under the guise of a pesticide in order to secure a sale. The other salient beliefs found were that farmers thought pesticides were expensive and to a lesser extent, family was an important referent group. Using these findings, the subsequent IPM program could target farmers by framing IPM as an economically-viable alternative to pesticide use, dispelling the myth that pesticides act as plant growth hormones and awareness raising of pesticide mode of action and safe handling techniques through education while also including other family members, such as women, in the program activities. The findings also highlighted that farmers felt obliged to use pesticides due to a lack of alternatives, suggesting that an IPM extension program may be well received by the target farmers. At the methodological level the findings indicate that the TPB and PRA in combination can help to identify effective specific focal points of extension programs.

The findings suggest that attitude change e.g. through discussion and learning, will need to be a major component of the extension program. The adoption of IPM principles by farmers has been found to rely heavily on education and experiential learning to allow farmers to become experts as the concept of IPM is quite complex and location-specific (Scarborough et al. 1997). As IPM is built on the principle of farmer as expert in their own field, there will need to be the acknowledgement of co-learning among the technical facilitators. Farmer groups, including women's self-help groups, already exist in the project area and these could be used to facilitate an education program to allow farmers to develop skills in pest management decision making and empower them to overcome the obligation to use pesticides (Palis 2006). The specific activities suggested for inclusion in the IPM extension program were; IPM field study groups; IPM and safe pesticide handling workshops; a predominantly pictorial safe pesticide handling poster; and radio drama segments. These activities are able to be inclusive of women and marginal farmers.

The use of the TPB as a research framework with the aim to design an adapted extension project was found to be very useful. It was possible to investigate farmers' attitudes, subjective norms, perceived behavioural control and perceptions of pesticide use. The information provided was of value as a means to improving an extension program – in this case aiming to reduce indiscriminate pesticide use through the adoption of IPM techniques. The fact that the researcher was conducting all standardized interviews on her own, without the help of enumerators, allowed for the collection of information that was of a qualitative nature and not usually captured via a standardized questionnaire survey. Her presence also allowed for the clarification of questions by respondents and the translation from English into Hindi and other local languages. Further to this, the use of PRA tools to triangulate the TPB findings and assist in collecting information regarding farming systems and farmers' current pest management practices was of great benefit. For example, it allowed for other perspectives, such as those of women, to be captured in the study. However, some of the questionnaire items included words which were difficult to differentiate between in Hindi and perhaps a more thorough elicitation study would have increased the clarity or specificity of the questionnaire items. A key learning from this outcome is the need for a thorough elicitation study prior to the TPB survey and we would encourage the use of PRA tools in this elicitation process to gain insight into a range of issues from a broad demographic base. Despite this limitation however, the present study suggests that the TPB is a useful framework for investigating farmer perspectives and behaviour which can then lead to effective context-specific interventions as part of goal-oriented

agricultural extension programs. This extension approach has much scope in the area of agricultural development.

Conclusion

This study aimed (1) to identify the factors which influence vegetable farmers to apply pesticide and (2) to assess the applicability of the Theory of Planned Behaviour in the context of farmers' decision making on pesticide use in a developing country context. By combining the TPB and PRA tools it was possible to gain insight into the farmers' pesticide handling behaviour and their perceptions of pesticide risks. Respondents were found to have a favourable intention, attitudes, subjective norm and perceived behavioural control towards pesticide use, and the salient beliefs within the target population were identified. The administration of the TPB questionnaire through a structured interview increased the clarity and qualitative data collected by the study compared to more traditional mail-out surveys of more developed country contexts. The data provided by the study made it possible to identify key themes and focal points for future IPM extension programs in the region. The study supported the need for sound scientific practice of a thorough elicitation study and the use of triangulation. The three key learnings from the study are: 1) farmers have a favourable intention towards pesticide use, 2) farmer attitude is the most important factor influencing behavioural intention of pesticide use and should therefore be addressed in the extension program, and 3) the applicability of the Theory of Planned Behaviour in the context of agricultural extension in a developing country.

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