Analysing Farmer Decision-Making in Pest Management.

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Background

Most people involved in the development and promotion of sustainable crop production strategies recognise the continued problem of poor adoption of research outputs by farmers, especially smallholders. Social scientists have highlighted a lack of understanding or consideration of farmers' knowledge and decision-making processes by research and extension agencies as a significant cause of poor adoption of useful technologies. Nevertheless, the few projects pay specific attention to the farmer decision making process and the process is rarely considered in planning research agendas. Partly as a consequence of this, research recommendations passed down through extension frequently fail to be adopted by farmers.

This study was funded by the Crop Protection Programme (CPP) of the Department for International Development (UK) (DFID), and was undertaken between November 1999 and April 2000. It was one of several crosscutting studies commissioned by DFID CPP to inform research management policy and project design.

The overall objectives of the study were:

- to synthesise current knowledge on farmer decision making processes in pest management
- to develop and test methodologies for exploring pest management decision making
- to provide recommendations for research managers and policy makers to improve IPM research and implementation

A multi-disciplinary and multi-institutional team carried out the study. The project had two distinct, but closely linked components, summarised in Box 1: Overall co-ordination and methodological guidance was provided by the Agricultural Extension & Rural Development Department (AERDD) of the University of Reading.

Box 1: The study components

	Component1: High input systems	**Component 2: Low input and subsistence systems**
Lead organisation	CABI Bioscience	NRI
Locations	Maharashtra, India Tamil Nadu, India Nairobi province, Kenya	Districts, in Uganda: Bushenyi, Masaka, Masindi, Pallisa, Iganga, Kapchorwa, Kibale and Mubende.
Cropping systems	Cotton (India), vegetables (Kenya)	Banana, cassava, maize
Local collaborators	Central Institute for Cotton Research (CICR), India Agriculture Man Ecology (AME), India Voice Trust, India Ministry of Agriculture, Livestock Development & Marketing Ministry, Kenya	National Agricultural Research Organisation (NARO) Makerere University

Component 1: Farmer decision-making in high input cropping systems.

Introduction

This component was led by CABI and focused two relatively high input cropping systems; cotton in India and vegetables in Kenya. The key objectives were:

- To examine the impact of different training models on farmer decision-making in pest management.
- To develop and test methods for analysing farmers' decision-making processes in pest management, in the broader context of crop production.
- To recommend how and where the usefulness of the methods may be tested and refined through field studies and relevant pest management project activities.

IPM training interventions usually seek to change and influence farmer decision making in pest management to some extent. Comparisons of different pest management interventions show that these can be broadly divided into two quite different types, and examples of both were studied during the project.

Message-based interventions concentrate on farmers' pest management actions, using simple, easily applied messages that have clearly visible benefits. Learning-centred interventions concentrate on helping farmers to learn more about the agro-ecosystem in their own fields, and to make their own management decisions, based on their observations and understanding of the system. This type of intervention focuses on using and evaluating new information and technologies and enabling farmers to make better informed decisions, rather than attempting to persuade them to adopt a given pest management technology or strategy.

Both message-based and learning-centred interventions have been successful in different situations. Message-based interventions rely on simple messages or rules, where they exist, and are usually specific to one pest problem situation. They may also cease to be effective or relevant if circumstances change, for example the pest becomes resistant to a pesticide. Learning-centred interventions are much more knowledge intensive, and cost more initially. However, they are also usually more sustainable, since what is learned is often applicable to a range of crops and enables farmers to adapt their pest management strategies to changing circumstances.

The study sites

The team visited a total of three sites. Two were in India, in Maharashtra and Tamil Nadu states, where they worked on cotton based systems. The third site was in Kenya where they focused on vegetable systems.

Maharashtra state, India

Maharashtra is one of the major cotton producing states of India, and has a history of intensive use of insecticides for control of cotton pests. Over the years, some pests, especially bollworms, have become resistant to some of the chemicals used against them. As part of an insecticide resistance management (IRM) strategy, the Central Institute for Cotton Research (CICR) of India and the Natural Resources Institute (NRI) developed a strategy to help farmers manage insecticide resistant pests. The project aimed to eliminate unnecessary sprays by establishing economic thresholds[1] for key pests, in particular the cotton bollworm, *Helicoverpa armigera*. Farmers were trained to recognise the different stages of key pests, and to identify many natural enemy species. They observed their fields at regular intervals, recorded levels of important pests, and used the economic thresholds to decide whether or not spray. Over the season, several different pesticides were used in a predetermined sequence to delay or prevent the development of resistance to any one pesticide. This is a good example of a message-based intervention.

The team visited one group of farmers in the village of Karanji Kaji who had been involved in the project, and a second group in the village of Pujai, who had not been involved.

Tamil Nadu state, India

Many cotton farmers in Tamil Nadu also rely heavily on insecticides for control of cotton pests. A small local NGO, Voice Trust and Agriculture Man Ecology (AME), an organisation funded by a bilateral agreement between the Indian and Dutch governments, managed a Farmer Field School (FFS) project to promote IPM in cotton in the state, to help farmers reduce their reliance on synthetic insecticides. The FFS focused on building farmers capacity to make well informed crop management decisions through increasing their knowledge and understanding of the agro-ecosystem. Farmers learned to recognise all the different stages of key pests and natural enemies, and learned about the role of beneficial insects in pest management. They made regular field observations and used their findings, combined with their knowledge and experience to judge for what if any, action should be taken. Other activities included conducting simple trials to test alternatives to synthetic insecticides including the use of intercrops to encourage natural enemies and the release of *Trichogramma,* a tiny parasitic wasp that attacks the eggs of Lepidoptera, for control of bollworms. This is a good example of a learning based intervention.

The team visited one group of trained farmers, in the village of CR Palem, and a group of untrained farmers in the village of Sceedvi Marnglam.

Kiambu District, Kenya

In Kenya, the team visited two groups of women farmers in Kiambu district near Nairobi: one group from the village of Thayu, and the second group, called the 'Urumwe' from another village close by. Both groups were smallholders, growing coffee and vegetables. The Thayu group had participated in a FFS project in 1996, co-ordinated by CABI Bioscience in collaboration with the Kenya Institute of Organic Farming (KIOF), the Coffee Research Foundation (CRF), the Kenya Agricultural Research

Trained farmers assessing rooknot nematode damage to tomato seedlings

[1] Economic thresholds are predetermined pest populatio
farmer is likely to incur economic loss if the pest is not managed.

Institute (KARI) and the Extension Division of the Kenyan Ministry of Agriculture, Livestock Development & Marketing (MOALDM). Farmers learned to recognise the different stages of development of key pests and diseases, and to understand the importance of beneficial insects. They experimented with cheap alternatives to synthetic pesticides for example, milk to control tomato blight, and chilli extract to control diamondback moth on cabbage. They also carried out simple experiments to test the efficacy of physical control methods for root knot nematodes in tomato nurseries and for cutworms in Kale. Subsequently, in 1998, they worked with local research and extension staff and CABI Bioscience to validate these methods more scientifically in the context of a farmer participatory research project.

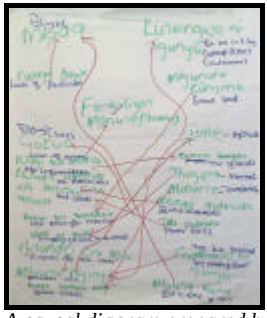
Methodology

Three 3 methods were used to collect information on farmer decision-making:

- Causal diagrams, to identify the knowledge base underlying farmers' decisions
- Participatory budgeting, to assess the economic rationale behind farmers' decisions
- Semi-structured interviews with individual farmers, or farming families, to discuss specific aspects of pest management and the impact of IPM training, as well as more detailed farm-specific perceptions and experiences.

Causal Diagrams

In groups of 10 - 30, farmers discussed the problems they faced and their causes, and ranked the problems in order of importance. Initially, problems relating to any aspect of crop production and marketing were discussed, before focusing more specifically on pest and disease problems. The main problems and their causes were written down on a large piece of paper.



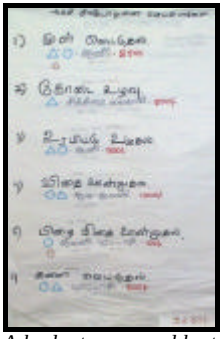
A causal diagram prepared by untrained vegetable farmers in Kenya

Preparing a causal diagram with trained vegetable farmers in Kenya

The next step involved drawing arrows from 'cause' to 'problem', to help visualise cause and effect relationships, and how, for example, by solving one problem you could also solve or create a second. Through this exercise and the supporting discussions, the team were able to build up a picture of the main constraints and their causes, and the knowledge base on which farmers based their crop and pest management decisions.

Participatory budgeting

Farmer groups prepared a typical budget for a complete cropping season. Many smallholder farmers do not have much money to invest, and this exercise helped the team to understand how farmers allocate limited resources.



A budget prepared by trained cotton farmers in Tamil Nadu,, India

The farmers listed all the crop production activities in chronological order, starting with land preparation through to marketing. For each activity they noted: The cost; The amount of time spent on each activity; Who carried out the work (men, women or children) and whether family or hired labour was used.

Individual Interviews

The group sessions generated a great deal of information about the problems farmers faced, their perceptions of those problems and how farmers allocated limited time and financial resources. However, they did not provide details of the decision making *process*. To address this issue the team carried out semi structured interviews with individual farmers and farming families, covering many aspects of crop and pest management including:

- Crops grown
- Important factors in pest management decision - making
- The choice of pesticides and the timing of sprays.
- The type of training farmers had received (*trained farmers only*)
- The benefits gained as a result of training (*trained farmers only*)
- Action they would take on finding a new insect pest or disease problem.

An interview with an untrained cotton farmer in Maharashtra, India

Findings

Key elements in farmer decision making.

The complexity of the cropping system.

In Maharashtra, the cropping system was very simple with respect to pest management. Most farmers managed pests only on cotton and relied almost entirely on pesticides, applied mostly against bollworm and occasionally against sucking pests. Pest management decisions were therefore largely a question of whether or not to spray and if so, which pesticide to use and when. In Tamil Nadu and Kenya, where cropping systems were more mixed and farmers managed pests on several crops simultaneously, decision making was more complex, and a wider range of pest management methods was used.

Sources of information and advice

The source of information on pest management had a very strong influence on farmer decision making. Most farmers relied heavily on their own knowledge and experience. They also drew on information from a variety of other sources. In Maharashtra, the main source of information and advice among untrained farmers was the pesticide dealers. On observing a pest problem, farmers consulted a dealer who recommended a particular pesticide for immediate application. Effectively, therefore, the dealers and not the farmers, took many of the pest management decisions. In Tamil Nadu and Kenya farmers obtained information from a much wider range of sources including leading farmers, extension staff, family and friends and relatives, and input suppliers (including pesticide dealers).

The credibility of sources of information was of utmost importance. In Maharashtra, the dealers had the confidence of the farmers, partly because they were a readily available source of pest management advice and information, but also because many of the dealers were cotton farmers themselves, and were perceived to have a much better understanding of farmers' problems and needs. The confidence of farmers in the extension services was in some cases severely compromised by isolated instances where recommendations had failed to deliver effective control. In Tamil Nadu, for example, extension officers recommended the use of *Trichogramma* for control of cotton bollworms. For whatever reason control failed, resulting in heavy losses, which undermined the credibility, not only in the extension services, but also of IPM technologies generally.

The market

The market played a key role in farmer decision-making. Some crops, such as tomato, have a very low 'damage threshold', and cannot be marketed if they are even slightly blemished. This led to tomato farmers in Kenya to make preventative calendar applications of fungicides to prevent damage.

Perceived benefits

Farmers often needed to see clear benefits to adopting a particular technology. In some cases the benefits were very apparent. For example in Maharashtra the trained farmers were able to reduce pesticide inputs by about 40%, while maintaining yields, and therefore made substantially higher profits.

In Tamil Nadu, the financial benefits of IPM were not so clear. FFS trained farmers reduced pest management costs by up to 50%, mainly as a result of reduced pesticide application. However, yields were approximately half those of farmers who relied on calendar application of pesticides. Even though the net incomes of the two groups were similar, many untrained farmers identified low yields as an important reason for not adopting IPM technologies. The FFS group cited a number of non-financial benefits to reduced pesticide use, including improved health as a result of less exposure to pesticides and reduced labour. The latter was particularly important to women, who carried the water for spraying from a well, sometimes for distances up to 3 Km.

The influence of different training models on farmer decision-making.

This study showed that training could profoundly affect the way in which farmers make decisions. Figure 1 compares the decision-making processes of untrained, IRM trained and FFS trained farmers. Both IRM and FFS trained farmers made pest management decisions based on careful observations of the field, in contrast to untrained farmers, who sprayed immediately after seeing the pest or on a calendar basis.

In terms of what technologies to apply when, IRM trained farmers followed project recommendations. FFS farmers made their own decisions and used a range of monitoring tools. For example, cotton farmers in Tamil Nadu used light and pheromone traps to time releases of egg parasites for control of bollworm.

FFS training, in particular, also broadened the options available to farmers to manage pests, which included:

- Application of botanical insecticides, such as neem on cotton in Tamil Nadu and chilli extract on vegetables in Kenya.
- Physical and cultural methods, for example for control of root knot nematodes and cutworms in vegetables in Kenya.
- Use of complex intercropping systems to increase natural enemy populations, for example in cotton in Tamil Nadu.

Most trained farmers appeared to be more confident in their pest management capability. FFS farmers drew heavily on their own knowledge and on that of their group to solve problems. IRM farmers were much less reliant on pesticide dealers for advice, but this seems to some extent to have been substituted by reliance on project staff for advice.

Methodologies for analysing farmer decision-making.

Experiences in Kenya and India showed that causal diagrams and participatory budgeting were useful in examining the problems that farmers face, their perceptions of the causes of those problems, and their priorities when allocating limited resources, but did not reveal how these influenced the day-to-day pest management decisions farmers make. Semi-structured interviewing were more effective in examining the decision making processes, and individual farmers' perceptions, experiences, confidence in and understanding of pest management.

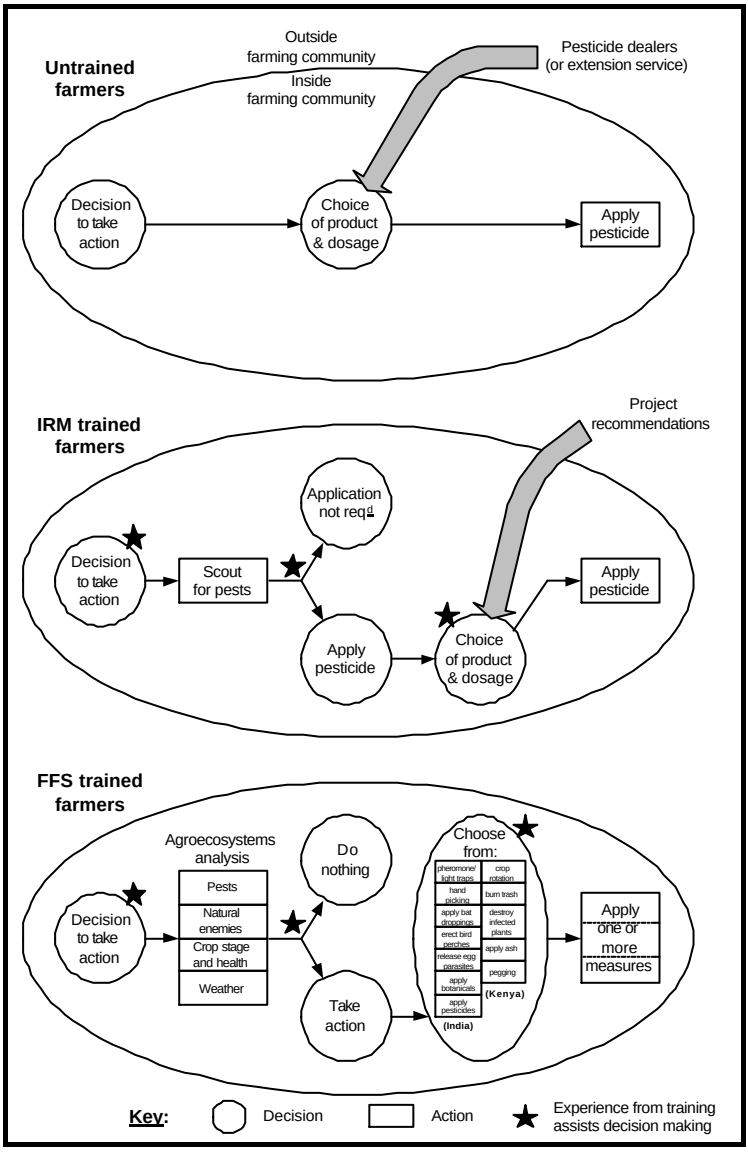


Figure 1: Flow charts showing pest management decision making for different groups of farmers.

Component 2: Farmer decision-making in low input and subsistence systems.

Introduction

This component was led by NRI, working with banana, cassava and maize systems in Uganda. Rather than focusing on IPM technologies and interventions, this component aimed to find out how farmers made decisions and what influenced them, and to explore whether this knowledge could help to improve uptake of CPP technologies. No attempt was made to "model" decision-making processes, nor to predict the uptake of crop protection technologies.

Specific objectives were:

- To assess the impact of a better understanding of farmer decision making on the development of appropriate technologies and uptake pathways for crop protection.
- To recommend ways to improve current research-farmer interfaces, and the uptake and adoption of pest management strategies through a better understanding of farmer decision making in pest management.

The study sites

Fieldwork was undertaken in eight districts in Uganda: Bushenyi, Masaka, Masindi, Pallisa, Iganga, Kapchorwa, Kibale and Mubende.

Bushenyi and Masaka districts represent areas where banana is the dominant crop. In Bushenyi, banana production is relatively recent whereas in Masaka there is a long history of banana production, which is now in decline. Masindi and Pallisa were chosen as districts where cassava is dominant. In Iganga and Kapchorwa, maize is dominant and In Kibale and Mubende, all three crops were of similar importance.

Methodology

The team used participatory methods that attempted to elicit what farmers do and why. They recognised that farmers do not necessarily perceive problems in the same way as researchers, and therefore asking farmers directly about their pest problems was not considered the most appropriate approach. A great deal of information was obtained by asking three simple questions: 'What do you do?' 'Why do you do it?' and 'How did you find out about it?'

Map of farmer's field and pest problems

A total of 67 farmers were interviewed. In each district, a parish was chosen at random. In each parish, five to ten farmers were chosen from a list obtained from official records. For the main part, the farmers selected were 'ordinary farmers' in terms of land holdings, education, farming technologies and approaches etc.

Farmers first drew a map of their farm, and showed the team around the farm. They

frequently highlighted the use to which different crops were put (such as subsistence or for market) and the pest problems that they had encountered. After the tour, the map was used to facilitate an informal, guided discussion on general aspects of farm management, including:

- What crops were grown and why.
- What crops had been grown previously had been grown, and when.
- Whether the crop would be switched in the future.

The discussion then focused on pest problems and pest management, including:

- What pests they had encountered.
- When they first encountered them.
- How much damage they did.
- What steps, if any, were taken to manage them.
- Sources of pest management information.

Basic socio-economic information such as the size of the household, whether the household undertook any non-farm activities, and the roles of each of the crops and their relative importance was also collected during the discussion.

The study took a 'soft-systems' approach to analysing the data, which recognises that who is involved in the analysis is as important as the analysis itself. This is essential where inclusive approaches to data collection and a non-structured interview process are key elements of the work. By their nature, soft systems approaches rely on subjective analysis by key stakeholders. The team undertook a preliminary analysis of the raw data, which generated several hypotheses. The hypotheses were analysed in detail in a seminar, involving researchers and practitioners from both non-profit and for-profit organisations. These are summarised in the findings below.

Researchers and participants analyse fieldwork at the analysis seminar

Findings

Key elements in farmer decision making.

Sources of information and advice

Like the farmers Kenya and India, farmers in Uganda were also influenced by many different groups of people including leading farmers, extension staff, politicians, family. Credibility of the source of information was, again, of paramount importance. For example, many farmers were advised to use Furadan (carbofuran) by the agricultural extension officers to control banana soil pests. However, many found that after using the Furadan, their banana plants started to topple and whole plantations were devastated, compromising the credibility of the extension service in the area.

The market

Farmers decision making was strongly influenced by the market, and farmers often made decisions on whether to implement pest management technologies based on access to market for the particular crop. For instance, farmers growing a crop for a particular purchaser at a particular pre-determined price, for example e.g. tobacco for British American Tobacco (BAT), might follow prescriptive, costly, and often precautionary pest management practices, involving

little farmer decision-making beyond the initial decision to grow the crop. At the other extreme, farmers are often reluctant to purchase expensive inputs or implement labour intensive management practices on crops for home consumption or for occasional sale, or where there were large fluctuations in market price.

Complexity of cropping systems and problems
Farmer decision-making was also influenced by the complexity and number of farm enterprises that they undertook, and the complexity of the problem. For instance, banana has particularly complex pest and disease problems, making it difficult for a farmer to determine whether an individual innovation, or a combination of innovations, pays off. Priority setting for research must take account of this complexity.

Understanding farmer decision-making

Perception of farmer decision-making in research and extension communities.
The research and extension communities often perceived that farmers were 'passive' or 'active' with respect to pest management. Many farmers chose to avoid the pest problems, for example by switching to another crop, or abandoning a pest-ridden crop altogether. While the research and extension communities might perceive this as 'not bothering' to do anything about what they consider to be a serious problem, it is often more of a reflection of the importance of the crop, environment, or pest, rather than of the farmer him or herself.

Taking a holistic approach
To understand decision-making for a particular crop or pest it is essential to take a holistic view. Farmers often have complex cropping systems, and deal with several pest problems on various crops simultaneously. In this context, dealing with one problem can create another. For instance, farmers in one district followed extension service recommendations to cut down *Ficus* trees to reduce coffee wilt. However, farmers perceived that the pest problems on banana worsened as a result of this, and few farmers carried out the practice, having heard about the problems. It is also essential to consider pest management in the context of the entire production system; several farmers made comments such as, 'why control pests if soil fertility is low.'

Methodologies for analysing farmer decision making.

Experiences in Uganda suggested that an indirect approach should be taken if the decision-making processes of resource-poor farmers are to be understood. A questionnaire approach was not considered appropriate, nor was the use of a farmer decision-making model. Instead, farmers were given the time to discuss how pest problems had evolved over time, and how networks of people whose advice they sought and valued developed. Moreover, researchers are more likely to identify approaches to managing pests such as switching crops, or choosing a different plot to grow a particular crop, if they take a broad perspective and recognise that farmers do not have to tackle a pest problem directly.

Over all conclusions

Understanding farmer decision making

- The study showed farmer decision-making processes to be highly complex. It is difficult, and often inappropriate, to try and reduce decision-making to a single, simple model. Decision-making is often determined by rapidly changing circumstances, and in response to variability in the agro-ecological and socio-economic conditions of individual farms and farmers.

- It is important to see pest management decision making as part of a more holistic system. For example, farmers may "manage" pests by simply switching crops. Sometimes they may not manage pests on one crop because they are focusing their efforts on another. Programmes and extension efforts that focus on just one crop or pest may not take into account farmers' alternatives to direct management of a particular pest.

- The market, in terms of price, availability, accessibility and quality criteria, is a very important factor in decision-making. It is important that this and other factors such as access to credit are given due consideration in the design and implementation of interventions.

- Sources of information have a profound effect on farmer decision making. Researchers need to understand who they are "competing" with to reach farmers, and how much influence each has. It is important to characterise "external" influences, to establish relative importance, and either to work with those "closest", or try to get "closer."

Impact of training on farmer decision making

- The study showed that training could profoundly affect the way in which farmers make decisions. Trained farmers are more likely to base pest management decisions on field observations in contrast to untrained farmers, who tended to use preventative measures such as calendar applications of pesticides.

- Training, particularly learning centred training, appeared to be effective in building farmers' increased capacity of farmers to make informed, independent crop and pest management decisions and equip them to cope better with the agro-ecological and economic variability that is an integral part of smallholder systems. It can also broaden the range of pest management options available to farmers, and diversifies sources of information

Methods for analysing farmer decision-making

- A combination of several different methods to examine farmers' problems and priories, their knowledge base, and the decision-making process itself was most effective. It is important that methodologies are inclusive and allow sufficient scope for discussion of the issues.

Short interactions with farmers by outside researchers do not produce complete and accurate accounts of decision making. Interactions such as those described for this project can generate a lot of information on the decisions farmers make, and about the economic parameters within which they are made, but less about the reasons and the process. Much longer-term interaction is needed to explore processes fully.

Recommendations

- Further research is needed to explore the benefits of understanding farmers' decision-making processes. This could be done by looking at specific instances of success and failure in pest management interventions, to examine the extent to which farmer decision-making was taken into account and the effect this had on the outcome. This would help prioritise how resources should be invested in understanding decision making processes, in what circumstances and at what stages of a project.

- An analysis of farmer decision should be included in CPP research projects where appropriate. Project proposals should indicate whether information is already available and, where it is not, how the analysis will be built into the project activities.

- CPP should produce guidelines for researchers on how to look at farmer decision making, including conceptual frameworks and research methods.

- Research on the cost-effectiveness of different approaches to inducing change in pest management decision making in different situations would be beneficial and should be carried out where appropriate.

- Farmers should be involved at all stages of the research process, from setting the agenda to interpreting the results. In this way, many key elements of farmer decision-making are integrated into the research system, ensuring that the research is more appropriate and relevant to farmers.

References

Ali, M.A., Little, A Kimani, M., Oruko, L. Williamson, S. (2000) 'CPP programme development study 'Analysis of Farmers' Decision Making in Pest Management' DFID/CPP Project ZA0352 (R7500): A report on fieldwork carried out in Kenya and India, December 1999 - February 2000

Williamson, S., Robinson, E., Garforth C., Little A., Meir, C. (2000)) 'CPP programme development study 'Analysis of Farmers' Decision Making in Pest Management' DFID/CPP Project ZA0352 (R7500)' Final Technical Report

A. Little, E. Robinson, S. Williamson, R. Lamboll, C. Meir, G. Acola, A. Ali, G. Bagirwa, G. Bockett, M. Kimani, R. Miro, L. Oruko, B. Sekamatte, W. Serubombwe and J. Ssemwanga (2000) 'Analysis of farmers' decision-making in pest management' in 'Sustaining change: Proceedings of a workshop on the factors affecting uptake and adoption of research outputs', pp81 - 91