POLLINATION SERVICES FOR SUSTAINABLE AGRICULTURE • FIELD MANUALS

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HANDBOOK FOR PARTICIPATORY SOCIOECONOMIC EVALUATION OF POLLINATOR-FRIENDLY PRACTICES

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HANDBOOK FOR PARTICIPATORY SOCIOECONOMIC EVALUATION OF POLLINATOR-FRIENDLY PRACTICES

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This publication provides guidance on the socioeconomic evaluation of pollinator-friendly practices, as part of the GEF supported Project "Conservation and Management of Pollinators for Sustainable Agriculture, through an Ecosystem Approach" implemented in seven countries - Brazil, Ghana, India, Kenya, Nepal, Pakistan, and South Africa. The project is coordinated by the Food and Agriculture Organization of the United Nations (FAO) with implementation support from the United Nations Environment Programme (UNEP).

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PREFACE

In agro-ecosystems, pollinators are essential for orchard, oilseed crop, horticultural and forage production, as well as the production of seed for crops. Pollinators such as bees, birds and bats boost 35 percent of the world's crop production, increasing outputs of 87 of the leading food crops worldwide, such as coffee, cocoa, chilies, apples, palm oil, tomatoes, papaya, mango, avocado, cardamom, vanilla, pigeon pea, most spices, most vegetable seeds, plus many plant-derived medicines in the world's pharmacies.

Just as the agricultural community is appreciating the contribution of pollination to crop production, populations of managed pollinators (the Western honey bee *Apis mellifera*, the Eastern honey bee *Apis cerana* and their Asian relatives) are facing new and poorly understood threats such as pests and diseases. The most critical form of insurance for managed pollinators are the services provided by wild pollinators that work in agricultural landscapes.

Within the context of its lead role in the implementation of the Initiative for the Conservation and Sustainable Use of Pollinators (also known as the International Pollinators Initiative-IPI) of the United Nations Convention on Biological Diversity adopted in 2000 (COP decision V/5, section II), FAO has established a "Global Action on Pollination Services for Sustainable Agriculture". FAO has also developed a global project, supported by the Global Environment Facility (GEF) through the United Nations Environment Programme (UNEP) entitled "Conservation and management of pollinators for sustainable agriculture, through an ecosystem approach". Seven countries (Brazil, Ghana, India, Kenya, Nepal, Pakistan and South Africa) have worked together with FAO to identify and carry out targeted activities that can address threats to pollinators in agricultural landscapes. The outcomes of the global project are expected to expand global understanding, capacity and awareness of the conservation and sustainable use of pollinators for sustainable agriculture.

As a contribution to the IPI, FAO and its partners have collaborated with the International Institute for Environment and Development (IIED) to develop guidelines for a participatory approach for farmers, forest dwellers, and other agroecosystem managers to distinguish, evaluate, appreciate and demonstrate the positive impact of pollinator-enhancing practices on their livelihoods. Field testing and adaptation of the protocol as applied to variable cropping systems in different countries was made possible through a grant from the International Fund for Agricultural Development (IFAD) and the UNEP/GEF/FAO project in 2009 and 2010. This document thus presents a handbook for the application of the guidelines, as it may be used in farmer-field school formats, community meetings with farmers, or other instances where farmers can benefit from keeping records to better assess the value of specific practices. As the guidelines are applied, FAO and its partners will facilitate sharing information on the results from farmer-led evaluations of the wider impacts of pollinator-enhancing practices in a crop production system.

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INTRODUCTION

AIM OF THE HANDBOOK

The aim of this handbook is to provide guidance on how organizations can work with farmers to evaluate the impact of pollinator-friendly practices on their livelihoods. Pollination is a service that traditionally has been provided by nature, serving farming communities at no explicit cost to them, so long as agriculture remained small-scale and inherently diverse. But as production in many parts of the world has intensified and the use of agricultural chemicals that impact beneficial insects such as pollinators along with plant pests has increased, pollination services are showing declining trends in a number of instances.

In North America and Europe farmers commonly bring colonies of honey bees (*Apis mellifera*) or purchase colonies of bumble bees (e.g., *Bombus terrestris* in Europe) to insure the pollination service of their crops (Carreck *et al.* 1997, Velthuis & Van Doorn 2006). However, the domesticated honey bee, *Apis mellifera (*and its several Asian relatives) are often not as effective as wild pollinators. Recent studies show that pollinator diversity is essential to achieve optimal pollination and that in some instances pollinator diversity may be even more important than the abundance of pollinators. The presence of wild pollinators has also been shown to increase the efficiency of managed honey bee foragers (Figure Intro.1).

Figure Intro.1

PRESENCE OF WILD POLLINATORS MAY INCREASE THE EFFICIENCY OF MANAGED HONEY BEES

© S. Greenleaf

In sunflower (*Helianthus annus* L.) grown for hybrid seed production, the pollination efficiency of honey bee foragers was enhanced up to 5 times by the presence of wild bees. When wild bees landed on a flower head occupied by a honey bee, the honey bee was more likely to move onto the next flower head, thus promoting greater cross-pollination (Greenleaf & Kremen 2006).

There is thus a keen interest in identifying practices that will encourage the presence of diverse wild pollinators on farms growing pollinator-dependent crops.

Losses of pollination services are difficult to perceive; unlike pests which damage crops, pollinators leave no immediate traces of their beneficial work. The benefits of their work, moreover, do not become evident for weeks if not months, as reflected in crop yields at the time of harvest. It is quite understandable that farmers may not readily link the presence of pollinators to much later improved yields.

It could be argued that all that is needed is to show evidence of improved pollination in side-by-side demonstration trials in agricultural research centres; however there are two major difficulties with this form of evidence.

Pollination is the flagship example of a "positive externality"; bees kept or encouraged by one person will provide a benefit to many fruit growers within their flight range, without the growers recognizing or paying for the costs to maintain the bees. In the same sense, the service of pollinators, whether wild or managed, cannot be constrained to one field, to show a comparison with the adjacent field – comparisons between high and low levels of pollination service need to situated at least one kilometre apart (Vaissière *et al.* 2011).

More generally, demonstration sites highlighting improved agricultural practices at agricultural research centres often show significant advantages compared to conventional practices. But agricultural innovations that give promising results in research centre trials do not always work out as expected when farmers apply them in their own plots, for example requiring greater effort and giving lower yields (de Groote *et al.* 2010). For this reason, and because of other constraints such as lack of cash to cover initial investment, perceived risk and time gap before benefits materialize, adoption rates for new agricultural practices can be low (Sain and Zurek 2002).

Increasingly it is recognized that farmers themselves need to be at the center of testing and adapting any proposed improved practices. "Farmer Field Schools" is a form of extension and farmer-led research that supports ecologically-informed decision-making by farmers (Braun *et al.* 2006). Farmer field schools are based on learner-centered curricula for experiential learning, taking place in farmers' fields, allowing producers to observe, measure, analyze, assess and interpret key agro-ecosystem relationships as the basis for making informed management decisions.

With respect to pollination services, farmers may best come to appreciate the role of pollinators by seeing for themselves in their own farms, the effects, over one or more cropping seasons, of introducing practices that encourage pollinators to visit their crops. This handbook starts from the premise that if farmers evaluate these practices for themselves – by comparing with their farming experiences before introducing pollinator-friendly practices, or with control fields at a sufficient distance - and find them positive they will be more likely to adopt them than if they are shown only the results from research centre trials or from economic feasibility analyses. They will also be more equipped to explain the impacts to other farmers and motivate them to adopt these practices as well.

TARGET AUDIENCE FOR THE HANDBOOK

This handbook is targeted at organizations working with farmers and farmers' groups to help them improve their production systems and practices so that they better meet their livelihood needs. This could include extension services, Farmer Field Schools, producer organizations and cooperatives.

Figure Intro.2

TRAINING OF TRAINERS ON POLLINATION SERVICES, LAO PDR

Extension agents and trainers consider what might affect the pollination of jujube (*Ziziphus jujube Mill.*) in the People's Democratic Republic of Lao.

SCOPE

This handbook focuses on socioeconomic evaluation of pollinator-friendly practices. It addresses the impact of these practices on the inputs and outputs of crop production systems. To a lesser extent it suggests some ways in which farmers could take into account some less tangible impacts of these practices such as health (Figure Intro.3).

Figure Intro.3

LESS TANGIBLE IMPACTS: FAMILY HEALTH CONCERNS

© B. Gemmill-Herren

Children near Fulbari, Chitwan, Nepal

Particularly where families live on or close to farms, concerns about exposure of family members to agricultural chemicals may motivate efforts to reduce toxic pesticide applications.

The procedures outlined here therefore propose a way for farmers to evaluate the 'total' impact of pollinator-friendly practices on their livelihoods and well-being. In the process, it is envisaged that farmers will identify adaptations to the practices subject to tests which might reduce observed negative impacts or enhance positive ones and could form the subject of further experiments. The emphasis is on impacts of pollinator-friendly practices which directly affect the farmers. External environmental impacts of such practices and of the resulting improved pollination are not the focus of this handbook as by definition they do not affect the farmers. For example, reducing the use of toxic pesticides may have positive impacts for the quality of water used by villages further downstream from the farmers. Likewise the conservation of threatened insect species may have biodiversity value for the global community. These values will not be captured in the evaluation approach outlined here. However, the evaluation of the impact on farmers may reveal situations where there are insufficient net benefits to the farmers for a practice to be adopted permanently. This will indicate the need to examine the external impacts and explore ways that the value of these can be captured and reflected in incentives for the farmers.

The handbook also does not aim to give guidance on how impact of the practices on pollination or the impact of pollination on yield can be measured. It is considered that other guidance may be available for this or that the socioeconomic evaluation will take place alongside application of the Pollination Deficit Protocol (Vaissière *et al.* 2011).

CONTEXT

The evaluation may start as a group-sponsored experiment with just a few trial and control plots as part of a Farmer Field School. Alternatively, it may be taken up by farmers on their own plots. A combination of a group plot initially and extending subsequently into farmers' own fields is also possible. In all cases it is presumed that there is already an active process of discussion with farmers about their production systems and the key constraints they are facing.

STRUCTURE OF THE HANDBOOK

The handbook is structured around a series of steps that facilitators and farmers can follow in evaluating pollinator-friendly practices. Each step is described briefly, followed by discussions of key issues. A number of examples are given from farmers' groups in the demonstration sites selected under the GEF-funded project. Resources that can aid facilitators are given in tables and templates for record-keeping. These are indicative and will need to be adapted by facilitators to their particular context.

Box Intro.1

STEPS TO FOLLOW IN EVALUATION OF POLLINATOR-FRIENDLY PRACTICES

STEP ONE

1. CHARACTERIZING CURRENT PRODUCTION SYSTEMS

1.1 Identify challenges that farmers face

1.2 Examine farmers' current use of pollinator-friendly practices

1.3 Collect baseline information

STEP TWO

2. IDENTIFYING APPROPRIATE POLLINATOR-FRIENDLY PRACTICES TO TEST

2.1 Draw up a shortlist of practices

2.2 Discuss implications of short-listed pollinator-friendly practices and make final selection

STEP THREE

3. SELECTING THE PLOTS WHERE THE POLLINATOR-FRIENDLY PRACTICES WILL BE TESTED

STEP FOUR

4. PLANNING THE TESTS OF SELECTED PRACTICES WITH FARMERS

4.1 Explore the impacts in more detail

4.2 Select indicators and determine how they will be recorded and tracked

STEP FIVE

5. ANALYZING AND EVALUATING THE PRACTICE

5.1 Analyze the quantitative information on the indicators

5.2 Draw comparisons between plots

5.3 Evaluate based on qualitative information

STEP ONE: CHARACTERIZING CURRENT PRODUCTION SYSTEMS

1.1 IDENTIFYING CHALLENGES THAT FARMERS FACE

This step will already have been done in many cases as part of a Farmer Field School or as part of the organization's work with the farmers. Low yields, and/or inadequate pollination may have been identified as areas for improvement. But it is often the case that the main problems listed by farmers do not appear to be related directly to pollination. A fine balance is required, in respecting the priority challenges as identified by farmers for their experiential learning, and helping farmers to perceive and manage an ecosystem service such as pollination that generally operates in the background, with little public awareness. Farmer Field School formats have shown great value in addressing problems, situations and opportunities that, *inter alia*:

- Require a location-dependent decision or management.
- Entail articulation and implementation of changes in behaviour within the farm enterprise, household, or community or among institutions at varying scales of interaction.
- Can be improved through development and application of location-dependent knowledge (Braun *et al.* 2006).

As these situations apply well to the introduction of pollination management, it is suggested that it is important to be flexible in the entrypoint for the discussion, starting from the critical constraints or problems as perceived by farmers.

In almost all cases, with respect to pollinator-dependent crops, practices to address critical constraints also have implications for pollination management. It is also often the case that many pollinator-friendly practices have benefits for other aspects of the farming system and can also help to address these problems. For example, irregular rainfall or lack of access to irrigation water are problems that many farmers face (see Box 1.1).

Box 1.1

PRACTICES TO ADDRESS WATER PROBLEMS AND IMPROVE POLLINATOR HABITAT

The Kilimambogo site in Kenya, approximately 80 km from Nairobi, is an area of small-scale farming with mixed cropping. One of the main constraints mentioned by farmers is the unreliable rainfall resulting in poor crop yields. Farmers are increasingly concerned about the impacts of climate change. The draft pollination management plan for the Kilimambogo, Kenya site identifies a number of measures that can be taken to both address water-related problems and improve pollinator habitat.

- **Introduction of soil management techniques such as composting to help hold water better may also assist the agroecosystem to sustain more vegetation that benefits pollinators.**
- **Introduction of small-scale water harvesting structures will store water for use by farmers in periods of drought and also provide water to pollinators.**
- **Integration of plant varieties into cropping systems that can both prolong the period in which forage is available for pollinators and provide some resilience against climate change.**
- **Encourage indigenous hedgerow plants as live fence and uncultivated section of the farm as refugia for pollinators.**

Figure 1.1

CHILLI PEPPER FARMERS IN KILIMAMBOGO, KENYA

© B. Gemmill-Herren

Pollinator-friendly practices cannot resolve these water-related problems directly but mixed cropping and mixed crop varieties - with differences in growing cycle and different tolerances to drought - may reduce the risk of total crop failure in the event of a prolonged period of low rainfall. Moreover, efforts to increase efficiency of water use through replacing flood irrigation by drip irrigation could also be beneficial for pollinators as they will reduce the potential for damage to ground-nesting bee nest sites.

This identification of challenges may also indicate some of the likely constraints to farmers' adoption of certain pollinator-friendly practices. For example if farmers are concerned about labour shortages, they are not likely to favour practices such as manual weeding that increase the amount of labour requirements (Figure 1.2).

Figure 1.2

VEGETABLE FARMER IN KOSI-WATERSHED, ALMORA (UTTARAKHAND, INDIA)

For many farmers, labour costs are an important factor that will help to determine whether pollinator-friendly practices can be readily incorporated in their farming systems.

While there are some commonalities in problems facing farmers, the examples given in Box 1.2 show that each local situation has its particularities.

It is important therefore to go beyond generalizations and understand the particular situation. In many cases, where farmers are producing for the market, the most obvious challenges may be commercial or economic. There are difficulties in competing with large scale farmers who can produce at low cost, in getting products to market and getting a good deal from intermediaries, and dealing with the paradoxical situation that in seasons of high production, overall revenue may actually go down because of the downward pressure of abundant supply on prices.

In such circumstances the increase in yield associated with improved pollination may seem of little consequence. But some of the practices and the effect of improved pollination may lengthen the production period and allow production outside of the peak season. Pollinator-friendly practices are likely to reduce the cost of purchased inputs as pesticide use is reduced or made more effective per unit. For some small farmers that rely on family labour, it is the cost of the purchased inputs that is critical for viable operation.

Figure 1.3

PRODUCING IN A HOME GARDEN

Kosi-Watershed, Almora (Uttarakhand), Patharkot village, India

Figure 1.4

DISCUSSING PRODUCTION ISSUES

Jutpani village, Chitwan, Nepal

Figure 1.5

HIGHLIGHTING ISSUES RELATED TO ACCESS TO WATER

Mwampko Mpya Womens' group, Tala District, Thika, Kenya

Box 1.2

HOW FARMERS PERCEIVE THEIR MAIN PROBLEMS – SOME EXAMPLES

INDIA – KOSI-WATERSHED, ALMORA (UTTARAKHAND)

Patharkot village has nearly 53 families and until recently was not accessible by road. The farmers - who are mainly women - primarily cultivate wheat, mustard and lentils, but also millet, local pulses and sesame seeds. In their home gardens they grow a wide variety of fruit and vegetables: curcurbits, pumpkins, bananas, cabbage, onion and garlic amongst others. Land is very limited, and agriculture is rainfed. This means that a family's crop production is sufficient to cover only 2-3 months of their needs over a year. Other activities are livestock rearing and milk production.

The farmers indicated the following problems in order of priority:

1) Kurmula, or white grubs that attack crop roots.
2) Lack of water – with more water the farmers could produce enough for subsistence and sell cash crops.
3) Wild animals – wild boar which goes after potato and corn, porcupines which go for the kurmula grubs and in the process destroy the crops (mainly pulses) and monkeys which go for the fruits, vegetable, pulses and other crops. But the underlying problem is that the wild animals do not have enough food in the forest because of deforestation.

NEPAL - CHITWAN

The farmers' group in Jutpani village has 21 farmers of whom half are women. This is a resettlement area, where farming has been going on for 30-35 years. In the beginning it was famous for production of potatoes and mustard as well as traditional staples, maize and rice. But very few farmers grow mustard now because of pest problems.

Farmers cited the declining yields with both open and hybrid seeds, increasing problems of pests, requiring expensive outlay on pesticides and subsequent soil fertility declines. The general feeling was that they were producing less and less with more and more costs.

KENYA - THIKA

In Tala District on the eastern slope of Ol Donyo Sabuk national park, there are a number of self-help farmer groups. The Mwamko Mpya Womens' group (which can be translated as 'working early in the morning' or 'new beginning') started in 2005 with a focus on widowed and elderly women and orphans. The group has a 2 acre plot on which they grow tomatoes, green beans and chillies, experimenting with new varieties and planting methods.

The main problem this farmers' group highlighted was the lack of convenient access to water. The women have to carry water to the plots in jerry cans.

1.2 FARMERS' CURRENT USE OF POLLINATOR-FRIENDLY PRACTICES

It is also necessary to understand the practices that farmers currently use, and the extent to which they are pollinator-friendly as this will indicate areas for improvement. If current practices already seem pollinator-friendly to the extent that areas for improvement cannot be identified, it will not normally be appropriate to follow the steps in this Handbook (Box 1.3).

However, it may be the case that current practices are about to change in that farmers are contemplating, or starting to experiment with, new crops or varieties or new practices in an effort to increase production or address other problems. This may threaten the continued use of pollinator-friendly practices. In such situations, it could be helpful to incorporate pollinator-friendly practices in tests of new crops and practices.

Box 1.3

POLLINATOR-FRIENDLY PRACTICES IN KAKAMEGA, KENYA

Farmers in the densely-settled Kakamega district in western Kenya do not deliberately manage the pollination of their crops. However, farms are close to the highly diverse Kakamega rainforest, with an exceptionally rich mixture of flora and fauna. Farmers also have long-standing practices that benefit pollinators, such as planting hedgerows of flowering plants to separate their fields. As a result, the levels of pollination service observed in farmer's fields seem to be amongst the highest possible. But one force that is changing cultivation practices in this area is the opportunity for farmers to grow sugar cane under contract; in this case, the sugar milling company buys the output from the farmers and also provides them with planting material, inputs and harvesting equipment, at rates charged to farmers against their sales revenue. In such schemes, pollinator-friendly practices such as hedgerows and small fields may not be favoured. Comparing different practices for growing sugar cane in terms of their effect on other pollinator-dependent crops grown by the farmers could be an interesting use of the socioeconomic assessment.

1.3 COLLECTING BASELINE INFORMATION

If this information has not already been collected as part of the organization's previous work with the farmers, a survey could be conducted of a random sample of farmers in the area. This survey would include questions about cropping systems, practices used and main challenges faced by farmers. Alternatively a rapid assessment could be done by means of focus group discussions – see Box 1.4.

Figure 1.6

FOCAL GROUP MEETINGS AMONGST FARMERS IN PEPEASE, GHANA, AND MANAGEMENT PRACTICES SELECTED TO BE TESTED

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Focal group meeting, Pepease, Ghana

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Farming practices promoting pollinators, Mankessim area of Ghana

Farmers in the Mankessim area of Ghana have discussed ways to improve the pollination of their horticultural crops, and have decided to focus on:

- **Encouraging field borders with flowering plants or crops (such as cassava)**
- **Protecting sacred groves for pollination as well as religious values**
- **Protecting riparian vegetation for pollinator resources as well as flood control**
- **Reducing pesticide applications**

Box 1.4

BASELINE RAPID ASSESSMENT

The aim of the focus group discussion is to get a rapid assessment of the current situation of the farmers, the agricultural production systems and practices they use and the challenges that face them in pursuing their livelihoods. This will indicate the extent to which improved pollination and the introduction of pollinator-friendly practices in agriculture could be relevant to these farmers.

QUESTIONS/TOPICS FOR DISCUSSION

Current livelihood strategies and conditions

It is necessary to know how important agriculture is to the farmers' livelihoods as this will affect their willingness to take risks and to try out new approaches. If agriculture is the main source of livelihood, farmers may be unwilling to take risks unless there are good safeguards, e.g., participation in a group-based activity using group land.

- **Main activities and sources of income**
- **Extent of dependence on agricultural production**
- **Size of landholdings and tenure system – formal land title, informal, rented, communal**
- **Average area under cultivation per farmer**
- **Access to forest resources (distance and rights of access)**

Agricultural systems

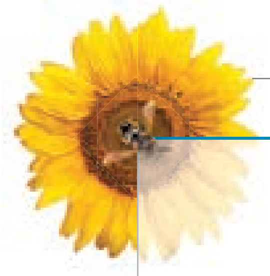
This section aims to assess whether farmers are growing pollinator-dependent crops, whether their practices are pollinator-friendly and whether there are clear areas for introducing pollinator-friendly practices. By examining changes in crops and practices over the last few years, the discussion will reveal the extent to which farmers are accustomed to innovating and the factors driving this.

- **What are the main crops grown?**
- **How much of production is for own use, how much for local markets, national, export?**
- **What type of cropping system and agricultural practices are used, e.g., mixed cropping, use of chemical fertilizers and pesticides, irrigation, tractors?**
- **How have these changed if at all over the last five years?**
- **What are the reasons/motivations for farmers' current cropping systems and production practices? E.g., response to land or labour scarcity, promotion by extension services, community initiative**

Challenges and constraints

This aims to identify problems or challenges that improved pollination and the introduction of pollinator-friendly practices could address.

- **What do farmers consider to be the main challenges facing them in crop production?**
- **How have these challenges changed over the last few years?**
- **What challenges do farmers see in the future?**
- **What other challenges are farmers facing in their livelihood strategies? E.g., difficulties in collection of animal fodder or fuel wood.**



STEP TWO: IDENTIFYING APPROPRIATE POLLINATOR-FRIENDLY PRACTICES TO TEST

2.1 DRAWING UP A SHORTLIST OF PRACTICES

There are a wide range of pollinator-friendly practices which could be introduced. Figure 2.1 profiles a village in Ghana that has considered practices that they would like to test. The scope of some other possible practices are illustrated in Figures 2.2 through 2.8. A more complete, but not comprehensive list of practices for which there is either evidence in scientific literature of effectiveness in improving pollination, or reasonable empirical evidence is given in Box 2.1. Farmers may already be using some of these practices, not always with the aim of promoting pollination explicitly. Practices such as mixed cropping may be part of traditional agricultural systems, while avoidance of pesticide use may reflect financial constraints rather than a specific choice.

Farmers may as well have additional practices to suggest based on their own observations. For example, one organic farmer in Nepal stakes his plants to increase accessibility for the bees. There may not be evidence in scientific literature of the effectiveness of practices suggested by farmers in improving pollination, but it would be important not to ignore this local knowledge, if there is interest from other farmers in testing these practices. There is the possibility though that any positive change in production systems identified when these farmer-led practices are employed have little to do with pollination. It would be good therefore to ensure that some tests of the impacts of these practices on pollinators are also carried out - for example, observation of pollinator visitation rates for plants that are staked and for those that are not staked.

Box 2.1

POLLINATOR-FRIENDLY PRACTICES

FORAGE FOR POLLINATORS

- **Mixed crop types over a growing season to reduce or eliminate dearth period with no crops in flower**
- **Mixed crop types within a field to attract pollinators**
- **Mix of crop varieties to extend the foraging period**
- **Patches of non-crop vegetation, flower-rich field margins, buffer zones and permanent hedgerows**
- **Shade tree cultivation**
- **At landscape scale conservation of natural and semi-natural habitat providing pollen sources for pollinators**

REDUCE USE OF CHEMICALS

- **Selective weeding to conserve weeds good for pollinators**
- **Use of less toxic pesticides and better application procedures**

MANAGING FOR BEE NEST SITES

- **No till agriculture**
- **Leave dead trees and branches standing**
- **Leave patches of bare ground undisturbed**
- **Avoidance of flood irrigation**

MANAGED POLLINATORS

- **Introduce managed pollinators**
- **Improve traditional beekeeping – modern hives and increased number of colonies per ha**

Key questions in selection of practices to shortlist

- Is the practice relevant to current production systems of the majority of farmers in the group? e.g. if only a few members have access to irrigation, avoidance of flood irrigation will not be widely relevant.
- Does the practice address perceived aspects of production systems where improvement is needed?
- Could the practice address challenges in other aspects of farmers' livelihood strategies: e.g. introducing more legumes into farming systems to attract pollinators can also address problems of insufficient fodder crops for livestock.
- Is the practice a realistic decision variable for the farmers (do they have sufficient control over this)? e.g., farmers cannot change their proximity to natural habitat, but they can allocate small areas on-farm for biodiversity or habitat restoration. Alternatively, if farmers opt to manage for bee nest sites by leaving patches of bare ground along roads undisturbed, will road maintenance personnel support this choice?
- Is the practice sufficiently different from current practice to enable comparison?

Box 2.2

SELECTING PRACTICES IN PAKHUDA VILLAGE, INDIA

The farmers in this village which is located in District of Almora, Uttarakhand State in the West Himalaya of India cultivate rice, potato and coriander as cash crops and mustard for own consumption as well as keeping livestock. They have a series of small terraces separated by bunds with very few trees. To prevent soil erosion the farmers keep *Rumex* and some other grasses on the bunds.

OPTIONS FOR POLLINATOR-FRIENDLY PRACTICES

Incorporating more trees in the farming system would be beneficial to pollination but farmers do not want to do this because it would take up too much land in their already small landholdings. Another option to improve pollination is to replace *Rumex* by a plant that is more attractive to pollinators, while still providing protection against soil erosion and providing other products such as fodder and medicinal plants.

It is suggested that the group facilitator review the practices in Box 2.1 together with any identified by the farmers and draw up an initial shortlist that would be considered further and narrowed down in Step 2.2.

2.2. DISCUSSING IMPLICATIONS OF SHORTLISTED POLLINATOR-FRIENDLY PRACTICES TO MAKE FINAL SELECTION

The pollinator-friendly practices can be associated with changes to outputs and to inputs and ultimately the viability of production systems for farmers. Table 2.1 sets out these impacts for a range of pollinator-friendly practices and is a way of systematically organizing and comparing the possible impacts to be investigated by farmer groups.

The introduction of pollinator-friendly practices can affect farmers' livelihoods and well-being in less tangible ways. It is important to be aware of these and examine how important they are relative to the impacts that have more clear-cut financial and resource implications. These impacts may affect a farmer's decision to take up a pollinator-friendly practice. They may be difficult to measure though. These impacts could include:

- Reduced risk and diversification through planting of mixed crop types and/or mixed crop varieties.
- Reduction in health risk, with the application of less toxic pesticides.
- More tiring work - for example manual weeding rather than applying herbicide.

Some of these impacts such as reduction in health risk will be difficult to quantify in the course of the trial. What can be assessed are the perceptions of the farmers. Some impacts may be more associated with the process of learning and trying out new approaches than the practice *per se*. Table 2.2 gives some examples of less tangible impacts that might be associated with each of the main pollinator-friendly practices. Tables 2.1. and 2.2. can be a prompt in a discussion with the farmers on the implications of the shortlisted pollinator-friendly practices at a specific site to narrow them down further. Farmers' views on the implications for yield, costs and less tangible impacts will help in the filtering process. The two tables are of course only meant to be indicative of possible practices and their implications. Farmers should be encouraged to do their own thinking on what the implications are, and facilitators should not be bound by these tables.

The aims of this step are to ensure that any obvious non-starters are avoided, for example where the level of risk is considered too high, and to record the reasoning behind the final selection. At the end of this step, the group should have a selection of practices to test, perhaps ranked in order of priority, and a list of practices that were considered but not taken further with the reasons why. At a later stage after a cycle of testing, the group may want to return to the list and review the choices made.

2.3 KEY ISSUES IN THE SELECTION OF PRACTICES

How many practices should be tested?

It is recommended to keep the evaluation simple by selecting one or two practices only to test, or one practice with different gradients of application. This means that it is important to select practices carefully. Some possible comparisons might be:

- Planting of pulses such as blackgram or beans on the bunds separating rice paddies where vegetables are grown before or after rice, versus no such planting.
- Planting of hedgerows versus no such planting.
- Intercropping of pollinator-dependent crops with crops attractive to pollinators versus mono-cropping of pollinator-dependent crops.

These types of comparisons are relatively simple to test. Whether all the farmers should select the same practice will depend on the size of the group and the size of the plots available for testing. There may not be consensus within a group on the pollinator-friendly practices to try out. If there is sufficient land for testing, and if plots are sufficiently far apart to avoid spillover effects (see Step 3) it would be good to accommodate different interests within the group. Ultimately it is important that the farmers are happy with the choice so that their motivation to see the test through is high.

There may be situations where a package of practices is preferred by the farmers and/or is likely to have a more discernible impact on pollination than a single practice. In such cases there are advantages in examining the whole package. However, it will not be possible to attribute the impacts on yields to a single practice within the package. This would be appropriate therefore where it makes sense to introduce the practices in combination (for example introduction of organic farming techniques versus continuous application of pesticides over the growing season and where it will not be necessary to understand the contribution that each component of the package makes).

Box 2.4 gives a checklist of factors to consider in making the decision whether to evaluate a single practice or a package of practices.

Box 2.3

EXAMPLE – KWOSAU VILLAGE KENYA (MATUNGULU DISTRICT)

Kwosau village, in Kyanzave Division is located on the border of Kenya's Central and Eastern Provinces near to the Ol Donyo Sabuk National Park. The Sustainable Agriculture Community Development Programme (SACDEP), a Kenyan NGO, is working in this village to raise farmers' awareness of pollination as well as promoting sustainable agriculture. The park management as part of a benefit-sharing programme is promoting bee-keeping. Declines in the bee population have been observed by the villages as trees have been cut down. SACDEP has started giving training to the farmers on planting hedgerows to provide food and nesting sites for bees. The farmers have also started to leave patches of native vegetation amongst their crops, with the specific aim of providing habitat to pollinators. These two practices, hedgerows and patches of native vegetation could be good candidates for farmer-led testing.

Box 2.4

SINGLE PRACTICES VERSUS COMBINED PRACTICES

WHEN TO EVALUATE A PACKAGE OF PRACTICES

- When farmers are interested in the whole package and not individual practices within the package.
- When some of the individual practices are likely to have only a small effect.
- When practices go well together and have synergistic effects e.g., hedgerows and small field sizes, or organic farming techniques as a package.
- When certain combinations of practices make sense to the farmers, e.g., contributing to restoring bee forage trees in a nearby protected area, and also planting some of these same trees on farms.
- When all the practices in the package are practical for all of the farmers in the group to adopt.

WHEN TO EVALUATE A SINGLE PRACTICE

- When it is possible to identify a single practice that is likely to make a significant difference.
- When farmers are not willing to make too much of a change to their practices.
- When the scope for change in practice is very limited as farmers may already be employing pollinator-friendly practices.
- When farmers in the group have different interests with some for example wanting to reduce pesticides and others wanting to plant hedgerows.

Table 2.1

Potential (hypothesized) impacts on inputs and outputs of using pollinator-friendly practices

PRACTICE	CONTROL/ COMPARISON	IMPLICATIONS (OTHER THAN POLLINATION)	OUTPUTS: YIELD PER PLOT/QUALITY	MATERIAL INPUTS	LABOUR INPUTS
FORAGE FOR POLLINATORS					
Mixed crop types over a growing season sustaining population over a season	Mix of crops that have a dearth period with no crops in flower	Greater diversification of income; greater income with multiple harvests (but these may be true even if the specific crops do not favor pollinators) Better disease control (best remedy for disease is usually crop rotation; again, benefits are not specific to pollination) Nitrogen-fixing crops planted earlier may reduce fertilizer need for subsequent crops	Higher level of pollination service, thus increases in yields and quality	Diversity of crop seeds	Probably more labour with more diversity over a season
Mixed crop types within a field, one or more which attracts pollinators to the other (and probably also natural enemies and, if a legume, improves soil fertility)	Single crops	Crop combination reduces fertilizer and pesticide requirements (nitrogen-fixing plants and companion planting) Different crop types may require production activities at different times in the season	Overall yields are usually higher Higher levels of pollination service may increase yield per plant	Diversity of crop seeds Lower fertilizers and pesticides	Possibly higher with more complex harvesting times and needs
Greater crop genetic diversity with varieties that flower at different times	Plot with single variety of crop(s)	Varieties have different yields Varieties may require production activities at different times in the season Builds in resilience, risk mitigation if varieties have different tolerances	Lower yield than if all high yielding varieties used, and meet their yield potential If varieties flower at different times, may extend the foraging period leading to higher level of pollination service and increased yield and quality	Diversity of seed sources, farmer saved or purchased	Affects the timing of labour inputs and harvest

TABLE FOLLOWS ON THE NEXT PAGE >>

PRACTICE	CONTROL/ COMPARISON	IMPLICATIONS (OTHER THAN POLLINATION)	OUTPUTS: YIELD PER PLOT/QUALITY	MATERIAL INPUTS	LABOUR INPUTS
Patches of non-crop vegetation Flower-rich field margins, buffer zones and permanent hedgerows (See Figure 2.1 Strips of non-crop vegetation)	Whole or agreed conventional proportion of the plot used for crops	Reduces the proportion of the plot that is used for crops unless not possible to use for cropping anyway May support natural pest control along with pollination, buffer zones may reduce farm runoff and pollution from farm chemicals	Possible lowers yield per plot, although higher levels of pollination service (or natural pest control) may increase yield per plant	Lowers inputs per plot for some production stages (if a lower proportion of the plot is used for crops)	Lowers inputs per plot for some production stages (if a lower proportion of the plot is used for crops)
Shade tree cultivation (See Figure 2.2 Sequential bloom management practice from India)	Whole or agreed conventional proportion of the plot used for production crops	Reduces the proportion of the plot that is used for production crops	Lowers yield per plot for main crop as lower proportion is used for main crop Higher levels of pollination service may increase yield per plant Shade trees may provide other commercial and own consumption products	Often lower than under sun cultivation	Could be lower if material inputs are reduced
Strip crops e.g. coriander to attract pollinators and natural enemies of crop pests (see Figure 2.3 Strip cropping of coriander)	Conventional cropping system with crops chosen for commercial and own consumption value	Reduces the proportion of the plot that is used for main crops. Strip crops may not have same commercial or nutritional value as main crops Inputs (seeds) and labour required	Lowers yield per plot for main crops but additional output from the strip crops Higher levels of pollination service may increase yield per plant	Higher per plot if it means greater cropping intensity but lower for main crop	Higher per plot if it means greater cropping intensity but lower for main crop

TABLE FOLLOWS ON THE NEXT PAGE >>

PRACTICE	CONTROL/ COMPARISON	IMPLICATIONS (OTHER THAN POLLINATION)	OUTPUTS: YIELD PER PLOT/QUALITY	MATERIAL INPUTS	LABOUR INPUTS
At landscape scale conservation of perennial grasslands, old fields, shrubland, woodlands comprised of (often wind-pollinated) plants providing pollen sources for bees (see Figure 2.4 Wind pollinated plants may provide pollen forage for pollinators at critical times)	Complete clearing or larger proportion of land cleared at the landscape level	Lower yield per landscape area as not all of it will be cultivated	Lower yield per landscape area/ collection of fields Higher levels of pollination service may increase yield per plant	No effect at the plot level	No effect at the plot level
REDUCING USE OF CHEMICALS					
Selective weeding to conserve weeds good for pollinators (see Figure 2.5 Weeds and Pollinators)	Weeding with herbicides	Replace herbicides by manual weeding	Lowers yield if remaining weeds compete with crops for nutrients Higher levels of pollination service may increase yield per plant	Lower as less herbicide used	Higher labour inputs with manual weeding Labour inputs for harvesting per plot may be lower / higher if yield per plot lower/higher
Use of less toxic pesticides and better pesticide application procedures in intensively farmed areas	Conventional use of pesticides	May lower yields if less toxic means less effective but reduces amount of material inputs	Yields may be lower Higher levels of pollination service may increase yield per plant	Lower cost as reductions in amount used	Could decrease if less applied but could increase if application procedure is more careful or complicated
Less use of purchased fertilizers, using legumes to restore soil fertility	Conventional use of fertilizers	Improvement in soil health, soil biodiversity, no disturbance of ground nesting bees.	Over long term yields may be higher, short term they may decrease	Seed sources of legumes	Higher labour inputs to establish legume cover crop
MANAGING FOR BEE NEST SITES					
No-till agriculture, reduced tillage or hand tillage	Land preparation with tillage	Lower labour for land preparation Possibly more weeds so more material inputs (herbicides) or labour inputs/ or lower yields	Lowers yield if remaining weeds compete with crops for nutrients Higher levels of pollination service may increase yield per plant	May be higher (unless weeding is manual)	Lower for land preparation May be higher for weeding unless herbicides used

TABLE FOLLOWS ON THE NEXT PAGE >>

PRACTICE	CONTROL/ COMPARISON	IMPLICATIONS (OTHER THAN POLLINATION)	OUTPUTS: YIELD PER PLOT/QUALITY	MATERIAL INPUTS	LABOUR INPUTS
Leaving standing dead trees and fallen branches undisturbed a) On the fields, or b) Adjacent to the fields	a) Plot is completely cleared b) Adjacent dead trees/branches cleared	Minimal interference with crop growth	Minimal interference with crop growth Higher levels of pollination service may increase yield per plant	a) Lowers inputs pro-rata for some production stages b) No difference if not in field	a) Lowers inputs pro-rata for some production stages b) No difference if not in field
Conserving sites where cavity-nesting bees may nest, such as in structural timbers, bamboo stems, or other large culms	Remove all such nesting sites, or kill the bees nesting in the cavities	Minimal interference with crop growth; sites not usually in farm fields May cause damage to structural timbers	Minimal interference with crop growth Higher levels of pollination service may increase yield per plant	None, unless bamboo or other vegetation needs to be planted	None, unless bamboo or other vegetation needs to be planted
Managing for bee nest sites – leaving patches of bare ground (such as along road and path sites) undisturbed a) On the plot b) On adjacent land not used for cropping	a) No bare ground left on the plot b) No management of adjacent land not used for cropping	a) Reduces the proportion of the plot that is used for production crops	a) Lowers yield per plot b) No effect as nests are on unused land But, higher levels of pollination service may increase yield per plant	a) Lowers inputs pro-rata for some production stages b) No effect	a) Lowers inputs pro-rata for some production stages b) No effect
Avoidance of flood irrigation; Rain fed or drip irrigation (see Figure 2.6 Irrigation practices and pollinators)	Flood irrigation		Ground nesting pollinators may be impacted, leading to lower yields.	Considerable one-time investment for equipment if drip Less water use	High initial labour cost, high maintenance costs, but possibly lower costs over time
MANAGED POLLINATORS					
Introduce managed pollinators	No managed pollinators	Costs of establishment and management and benefits from honey output	Higher level of pollination service, thus increases in yields and quality	Not for the crops but necessary for the managed pollinators	Not for the crops but labour needed for the managed pollinators
Improve beekeeping practices	Traditional beekeeping – low density	Costs of improvement and benefits from increased output – honey and colonies	Higher level of pollination service, thus increases in yields and quality	Not for the crops but likely for the beehives	Not for the crops but likely for the beehives
Introduce nesting sites for wild pollinators (i.e. nesting blocks or "bee hotels" for leaf cutter bees, sand playgrounds for ground-nesting bees) (see Figure 2.7 Offering nesting sites for cavity-nesting bees)	No introductions	Costs of establishment	Higher level of pollination service, thus increases in yields and quality	Not for the crops but necessary for establishing the nesting sites	Not for the crops but labour needed for establishing the nesting sites

STEP ONE STEP TWO STEP THREE STEP FOUR STEP FIVE

Table 2.2

Potential (hypothesized) non-financial/less tangible impacts (other than pollination) of using pollinator-friendly practices

PRACTICE	CONTROL/COMPARISON	POSITIVE IMPACTS	NEGATIVE IMPACTS
FORAGE FOR POLLINATORS			
Mixed crop types over a growing season sustaining population over a season	Mix of crops that have a dearth period with no crops in flower	Reduced risk of total crop failure Improved nutrition as wider range of food grown for own consumption	
Mixed crop types within a season, one or more which attracts pollinators to the others	Single crops	Reduced risk of total crop failure Diet diversity	
Greater crop genetic diversity with varieties that flower at different times	Plot with single variety of crop(s)	Reduced risk of total crop failure	
Patches of non-crop vegetation Flower-rich field margins, buffer zones and permanent hedgerows	Conventional proportion of the plot used for crops	May be useful resources – medicinal plants, fodder, and safety net food resources if crops fail	Encourages snakes
Strip crops e.g. coriander to attract pollinators and natural enemies of crop pests	Conventional cropping system with crops chosen for commercial and own consumption value	May provide useful resources for the household and food safety net	
Shade tree cultivation	Whole plot used for production crops	Microclimate – reduces heat making agricultural work less arduous; trees may provide medicinal resources, fodder, and safety net food sources	
At landscape scale conservation of perennial grasslands, old fields, shrubland, woodlands comprising wind-pollinated plants providing pollen sources for bees	Complete clearing or larger proportion of land cleared at the landscape level	Medicinal resources, fodder, and safety net food sources	
REDUCE USE OF CHEMICALS			
Selective weeding to conserve weeds good for pollinators	Weeding with herbicides		Tiring work which has to be done on regular basis
Use of less toxic pesticides and better pesticide application procedures in intensively farmed areas	Conventional i.e. intensive use of pesticides	Reduced health risks to farmer and family	
MANAGING FOR BEE NEST SITES			
No-till agriculture, reduced tillage or hand tillage	Preparation with machinery		More arduous work to do hand tillage
Leaving standing dead trees and fallen branches undisturbed	Plot is completely cleared		Fire hazard Less available for firewood
Leave patches of bare ground (such as along road and path sites) undisturbed	No bare ground left on the plot		
Avoidance of flood irrigation	Rain fed or drip irrigation	More water available for other household uses	
MANAGED POLLINATORS			
Introduce managed pollinators (honeybees)	Reliance on wild pollinators	Diversification of food and income sources – consumption and sale of honey	Hazard for children
Improve traditional beekeeping	Traditional beekeeping practices	Increased honey production	

Figure 2.1

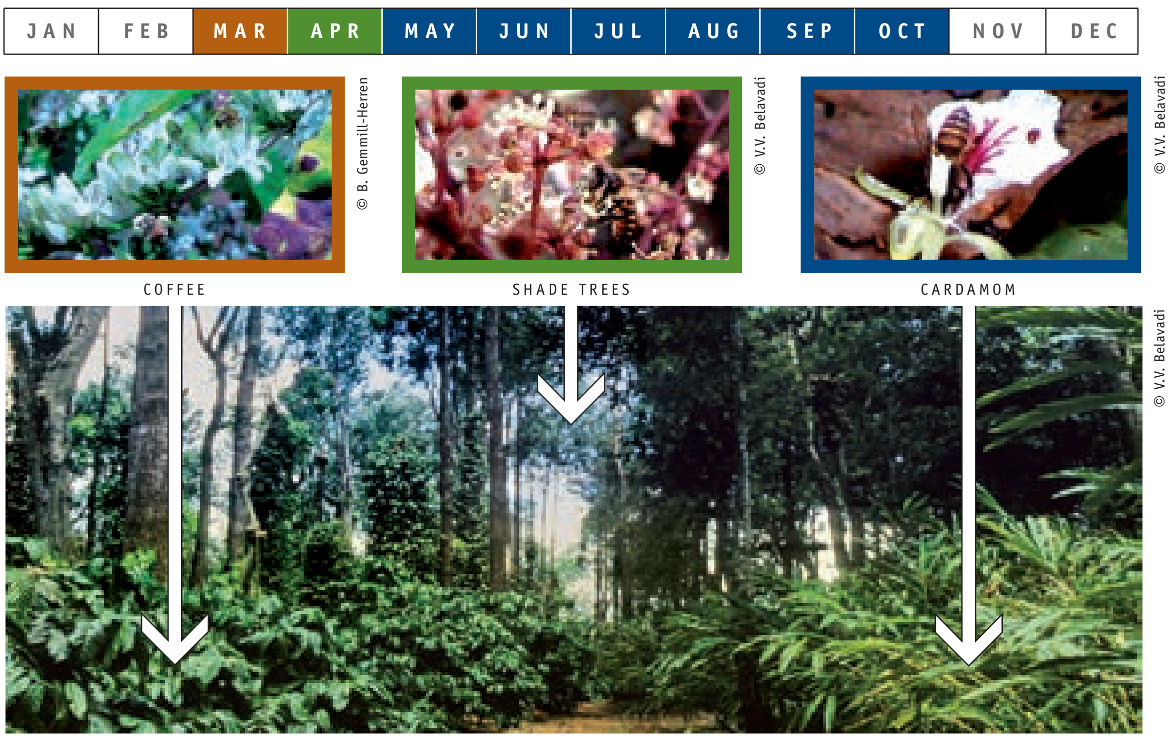
STRIPS OF NON-CROP VEGETATION

Left: *French bean production, Kenya;* right: *Persephone Farm, Lebanon, Oregon*

Commercial farmers in a number of places have learned to apply "farmscaping practices" to encourage beneficial insects, including pollinators and natural enemies. They seed and transplant crops or plants that will encourage beneficial insects – such as alyssum, cosmos, mexican marigold or calendula - in rows next to their cash crop.

Figure 2.2

SEQUENTIAL BLOOM MANAGEMENT PRACTICE FROM INDIA



Farmers in southern India select shade trees to keep pollinators on-farm between flowering of coffee and flowering of cardamom. Trees are selected that are economically important and maintain floral resources throughout the a season.

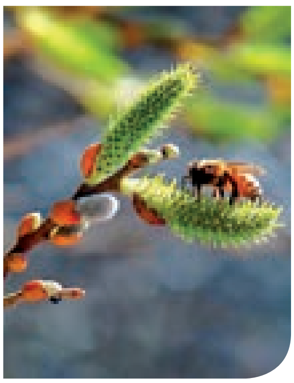
Figure 2.3

STRIP CROPPING OF CORIANDER

Insectary plants, such as coriander, are plants that provide nectar and pollen that are attractive to beneficial insects such as natural enemies of crop pests and pollinators. They may also provide shelter to natural enemies. If carefully planned, insectary plantings can attract, retain, and enhance the presence of a wide range of beneficial insects. Often, insectary plants, which have feathery leaves that will not interfere with crop plant growth, can be planted in strips next to crops.

Figure 2.4

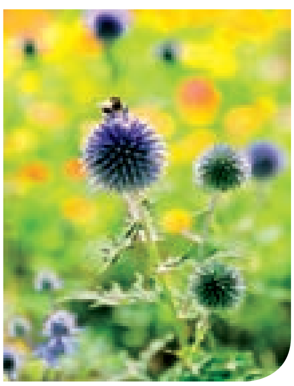
WIND POLLINATED PLANTS MAY PROVIDE POLLEN FORAGE FOR POLLINATORS AT CRITICAL TIMES



Willows are one of the first major spring nectar and pollen sources over many countries in the Northern Hemisphere. Pollinators are not needed for the reproduction of the tree, as it depends on wind for pollination. But the tree, along with many other native trees - some also wind-pollinated - are important for pollinators. Pollinators may gather extensive quantities of pollen from wind-pollinated plants, particularly early in the season before crops begin to flower.

Figure 2.5

WEEDS AND POLLINATORS



Selected weeds may often provide valuable forage resources for pollinators, and increase the level of pollination services to the nearby crops. One mango farmer in Ghana, realizing this, chose to handweed - at four times the price of using herbicides - so as to selectively conserve those weeds that are beneficial for pollination (Gordon 2008).

Figure 2.6

IRRIGATION PRACTICES AND POLLINATORS

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© Jim Cane, USDA

Left: *Ground nesting bee entry tube, Kenya;* right: *Squash bee, Peponapis pruinosa*

Soil nesting bees - including both solitary bees and some social colonies (e.g. sweat bees, stingless and bumble bees) - are among the most important crop pollinators. For example the squash bee *Peponapis pruinosa* is a specialist bee, only collecting pollen from the genus Cucurbita (squash, pumpkin) and nests in the ground, sometimes amid its host crop plants. Irrigation management is only a concern during the nesting period. Flood irrigation covers the soil with a standing layer of water that may saturate bee nests below.

Figure 2.7

OFFERING NESTING SITES FOR CAVITY-NESTING BEES

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© Antonio Felicioli

Left: *"Bee Hotels";* right: *Nesting sites for Osmiine bees in orchard near Pisa, Italy*

Many bees, such as leafcutters and masons, next in holes in wood, and will readily come to artificially created wooden blocks with holes, or containers of hollow rods or straws that mimic their traditional nesting sites. These photos show some options in creating "bee hotels".

STEP THREE: **SELECTING THE PLOTS WHERE THE POLLINATOR-FRIENDLY PRACTICES WILL BE TESTED**

The selected pollinator-friendly practices need to be tried out in designated plots (treatment plots) and compared with plots where these practices are not used but are as similar as possible in every other respect (control plots).

3.1 LOCATION OF THE PLOTS

The plots where the pollinator-friendly practices will be tried out need to be sufficiently far away from the control plots so that the latter are not affected by any pollination effect of the new practices. This will depend on the flight range of the most likely important pollinators and could be at least 1km (Vaissière *et al.* 2011). Distance between the two types of plot is also needed so that the treatment plot is not affected by any of the conventional practices in the control plot such as heavy use of toxic pesticides.

The control plots need to have similar conditions of soil fertility, slope, altitude, moisture and microclimate so that differences in impacts observed between them and the treatment plots can be attributed to the use of the pollinator-friendly practices.

Ideally each participating farmer should have both a treatment plot and control plot on their farm. This would make it more likely that any difference in inputs and outputs between them reflect the introduction of the pollinator-friendly practice rather than the farm management skills of different farmers. But where farms are small it may not be possible to achieve the necessary distance between the treatment plot and the control plot. The treatment and control plots would then have to be located on different farms.

An alternative would be for farmers to record their current practices, inputs and outputs in the first year or season before introducing any changes. This would then constitute the control or baseline. In the second year/season, the farmers could introduce pollinator-friendly practices and continue to record their inputs and outputs. The disadvantage is that weather conditions may vary considerably from one year to the next. But if the farmers continue their record-keeping over a number of years this may not be such a problem.

For pollinator-focused Farmer Field Schools, where the farmers are likely to have a group plot or plots for testing, the before and after comparison approach discussed in the paragraph above may be the best option. This will be strengthened if the individual members of the group subsequently try out the practice on their own plots and keep records before and after introduction.

3.2 HOW MANY PLOTS ARE NEEDED?

The answer to this question depends on whom the tests are for. Because of the variation in plot conditions, for statistical representativeness it is important to have a number of pairs of treatment plots and control plots or before and after comparison sites, ideally selected through a random sampling process. This would generate information on the impacts of pollinator-friendly practices that could convince an external audience, pollination experts or economists for example.

This is rarely practical, particularly in the context of Farmer Field Schools where group plots will be used. Moreover, the exercise and analyis may end up being so far removed from the farmers that their interest and engagement is reduced.

For the purpose of stimulating interest on the part of farmers, a small number of plots may still be useful. For Integrated Pest Management (IPM), a three by three design (three treatments and three replicates) has been recommended by Van den Berg (2001) as a reasonable compromise which allows observation and analysis by the farmers themselves. For pollination, two treatment levels – for example, with hedgerows and without hedgerows - would be appropriate so this would imply six plots for simultaneous comparison, or three plots for before and after comparisons. Even this number may not be practical for testing pollinator-friendly practices in the Farmer Field School context given the need for at least 1 km distance between treatment and control plots. However, the results from one group plot in a Farmer Field School may be sufficient to persuade other farmers' groups to try out the same practices or to convince the members of the group to try out the practice on their own land.

Thus over time, provided records are kept, there will be a greater chance of producing results that not only are meaningful to the farmers but can also at least partially meet requirements for rigour and statistical representativeness of external audiences, such as government agencies and donors.

The more plots that can be involved the more the effects of natural variation can be taken into account but the more dependence there will be on the facilitating organization for processing and analysis of the data.

Figure 3.1

EXAMPLE OF TESTING BY FARMER'S GROUP IN SHARADANAGAR, CHITWAN

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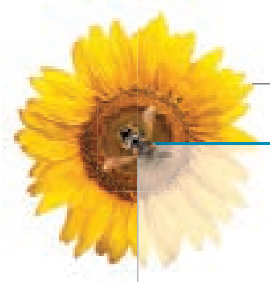
© B. Gemmill-Herren

Left: *Farmer Field School experimental field;* right: *Botanical pesticide*

A Farmer Field School group in Nepal shows the potential for group experiments to test pollinator-friendly practices. While the group is primarily focused on IPM, the practices tested are also relevant to pollination. The group has 28 members of which two-thirds are women. It is lead by a facilitator who has gone through Farmer Field School training on IPM and who is also the owner of the land used by the group. One of the experiments of the group is to compare the use of chemical fertilizers with botanical spray, which acts as a combined 'natural' fertilizer and pesticide. The botanical is a mix of cattle slurry, Artemisia, chilli and garlic, and other plants obtained from the forest. It is believed that the mix of strong smells in the botanical makes it effective in repelling insects.

The lead facilitator is using her own labour and providing some of the inputs but with some help from the group members who observe the experiment with her. The group is taking records including the amount of labour they are putting in.



STEP FOUR: PLANNING THE TESTS OF SELECTED PRACTICES WITH FARMERS

4.1 EXPLORING THE IMPACTS IN MORE DETAIL

Based on the discussions and choices made in Step 2 and 3 a selected number of practices will have been identified, and treatments applied in selected fields, compared with fields with no treatment. To explore the impacts, the group could continue to use the tables of financial impacts (Table 2.1) and less tangible impacts (Table 2.2) as a basis for this exploration of impacts, drawing up a table specifically for the site. A checklist of questions that the group might also find helpful is given in Box 4.1. Not all of these questions will be relevant to each practice and farmers may well have other questions to add. But the list may stimulate discussion and help to bring out issues of concern to the farmers.

An alternative or complementary approach would be to follow that used in community IPM (Van den Berg 2001) whereby facilitators could work with farmers to draw up an ideas matrix for each of the selected pollinator-friendly practices. This would encourage farmers to come up with their ideas about the possible effects of the selected practice on their cropping system and wider effects on their livelihoods and wellbeing. In the second column farmers note the source of these ideas and in the third discuss what they think about the ideas, to stimulate discussion about how these ideas might be tested. This ideas matrix is meant to be indicative only, and farmers should be encouraged to identify the effects of each practice themselves.

Box 4.1

CHECKLIST OF KEY QUESTIONS TO EXPLORE

INPUTS

- **How would the practice affect the area in the plot that can be used for crops?**
- **How would the practice affect the amount of inputs needed– seeds, fertilizer, herbicides, pesticides?**
- **How would the practice affect labour inputs needed?**

OUTPUTS

- **How would the practice affect yields?**
- **How would the practice affect quality and timing of harvest?**

MARKETING

- **Would the practice affect the price at which the product would be sold?**

DIVERSIFICATION OF LIVELIHOODS

- **Would the practice bring an additional income source? E.g. beekeeping**
- **Would the practice provide additional food sources for the family?**
- **Would the practice provide additional food sources for family's livestock?**
- **Would the practice reduce risk of total crop failure?**

OTHER IMPACTS

- **Would the practice reduce health risks to farmer and family?**
- **Would the practice reduce or increase other hazards for farmer and family? (fire, snake bites, insect bites)**
- **Would the practice involve work that is more tiring?**
- **Would the food produced taste better?**

Box 4.2

IDEAS MATRIX ON USE OF LESS TOXIC PESTICIDES

WHAT EFFECTS	SOURCE OF EACH IDEA	WHAT DO WE THINK? DOES IT NEED TO BE TESTED?
Will do less harm to wild pollinators, improve pollination and hence yield	Visiting experts	Not convinced; needs to be tested locally
Will reduce yield as pest control will be less effective	Experience of other farmers	May be less than the increase in yield if pollination is effective. Depends on how pesticides applied. Need to observe
Will reduce the cost of inputs	One of the participants	Yes but to what extent?
Reduced inputs will lead to reduction in labour time to apply pesticides	Farmers' provisional calculations	But may be minimal. Needs to tested
Less risk to health for farmers and family	One of the participants	Need to observe – but how?

Source: adapted from Van den Berg (2001)

4.2. SELECTING INDICATORS AND DETERMINING HOW THEY WILL BE RECORDED

The aim of this step is to identify indicators that are meaningful to farmers and that they can record easily. Taking the impacts explored in the previous step, the facilitator should work with the farmers to identify the indicators that would be appropriate and practical. Box 4.3 gives some examples of indicators. Not all of these will be relevant to each practice or to each farmers group and there may well be others that farmers can suggest. The list below is meant to be a starting point for discussion.

Box 4.3

CHECKLIST OF POSSIBLE INDICATORS

INPUTS

- **Volume of seeds used per plot per season**
- **Volume of mineral fertilizer used per plot per season**
- **Volume of manure used per plot per season**
- **Volume of herbicides used per plot per season**
- **Volume of insecticide used per plot per season**
- **Number of days/hours of labour per plot per season**

OUTPUTS

- **Yield per plot per season of pollinator-dependent crops in cropping system**
- **Yield per plot per season of non-pollinator-dependent crops in same cropping system**
- **Price received for crops that are sold**
- **Quality of crops produced**
- **Timing of harvest**

COSTS

- **Cost of seeds used per plot per season**
- **Cost of mineral fertilizer used per plot per season**
- **Cost of other purchased inputs e.g. manure**
- **Cost of herbicides used per plot per season**
- **Cost of insecticide used per plot per season**
- **Cost of irrigation water used per plot per season**
- **Cost of hired labour per plot per season**
- **Cost of family or hired labour to apply practices, such as planting of hedgerows or mixing of botanical pesticides**

OTHER IMPACTS

- **Volume used of other products (fodder, medicinal plants, food) in hedgerows, and patches of native vegetation, planted or left to regenerate specifically for pollination**
- **Frequency and severity of sickness related to application of pesticides**
- **Frequency of snake bites**
- **Frequency of insect stings**

The ideas matrix identified the main hypotheses about the impact of the pollinator-friendly practice and the impacts that need to be tested. One approach to take this further is for farmers to draw up an observation matrix (again based on IPM). To do this they would discuss what needs to be observed to test the hypotheses, how measurements should be made and when, as shown in the example below. A key issue will be the units for measuring material inputs and crop outputs. The participants will need to determine the most practical units for measuring the volume or weight of each and agree on a standardised approach (same size can, matchbox, etc) so conversion to metric units can be made later. Box 4.4 gives an example.

Box 4.4

OBSERVATION MATRIX ON USE OF LESS TOXIC PESTICIDES

WHAT SHOULD BE OBSERVED	HOW? WHAT UNITS?	WHEN AND HOW OFTEN?
Yield per plot	Record number of bags	At harvest
Labour inputs for the production cycle on the plot	Record number of hours of own labour/ other family members and hired labour	Daily and weekly
Material inputs (seeds fertilizer, pesticides) applied to the plot in one production cycle	Record volumes/weights with fertilizer (can) pesticides (litres)	When inputs are made
Health	Farmer assessment of symptoms – nausea, dizziness etc. after application of pesticides: none, mild, moderate, severe.	When pesticides are applied

Source: adapted from Van den Berg (2001)

4.3 APPROACHES TO INFORMATION COLLECTION

Understanding how farmers currently assess their production practices, the extent to which they keep records, mental or written, and their motivations for this will be important for identifying feasible approaches to information-gathering. Most subsistence and small farmers do not keep written records although they are able to recall prices and observe general trends such as decline in yields. Keeping records is time-consuming and often tedious. If it is to be done in the evenings it requires good lighting in homes. It also requires farmers to be literate and numerate or to have family members that are. Where farmers are producing in small quantities and primarily for own consumption, record-keeping may not seem worthwhile. Recording one's own labour is particularly problematic. Farmers generally need an incentive to carry out record-keeping and so they are more likely to do this when they are producing for a market that demands this, in particular organic markets.

Box 4.5

EXAMPLES OF RECORD-KEEPING

NEPAL

Mr. Chandra Prasad Adhikari of Fulbari-3, Sripur in the Chitwan district of Nepal, has been an organic farmer for 16 years and leads an organic cooperative which has 123 members (the majority being women)(Figure 4.1). He made the switch to organic farming because he saw that he was using more and more pesticides and producing less and less output. Mr Adhikari's main crop is rice planted over an area of one hectare, but he also grows wheat, maize, and a range of summer and winter vegetables in a number of inter-cropping, mixed cropping and relay cropping systems.

In spite of the complexity of his farming system, Mr Adhikari keeps records of inputs and outputs, including labour on a daily basis. These records help him to decide which crops and crop varieties are good. For example he has tried out 16 varieties of rice, assessing a number of criteria such as grain production, grain quality, taste, and length of rice straw. Similarly, he tests and compares different kinds of pulses, including many local varieties.

KENYA

The Burimburi Young Farmers Group in Kakamega started in 2007 with 40 members and now has 12 active members (Figure 4.2). The members were trained in the Farmer Field School programme, and learnt how to cultivate vegetables such as kales and traditional vegetables for sale. The group has received loans from a Farmer Field School project and from the Ministry of Agriculture and has a bank account with Equity Bank. This money was invested in buying seeds and fertilizer. The group keeps records of sales, expenditure on inputs and hired labour but not their own labour.

Figure 4.1

FULBARI ORGANIC COOPERATIVE, CHITWAN, NEPAL

Figure 4.2

BURIMBURI YOUNG FARMERS GROUP, KAKAMEGA, KENYA

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Left: *Some members of the Burimburi Young Farmers Group;* right: *Farmers' experimental fields*

Key questions to consider include:

- What do farmers currently measure in their production systems?
- How do they do this? – quantitative approaches with precise recording of volumes or monetary value of inputs and outputs, or more qualitative approaches which record inputs and outputs in rough categories such as low, medium, high.
- Would farmers be interested in doing more record-keeping?
- Which types of information would farmers be able and willing to collect in the form of regular quantitative records?

If farmers are not comfortable with record-keeping, the group facilitator will need to help them by taking on this task. This may make sense if there is a strong likelihood that farmers will be motivated by the demonstration to begin record-keeping later on. An alternative approach where there is little production for the market, and where less tangible impacts might be important is for farmers and/or the facilitator to record qualitative information. This is discussed in Section 4.4.

Examples of templates for quantitative record-keeping

Three types of template will be needed, and are presented in the annexes to this document. They are also available under the documents tab of the International Pollinators Initiative website (www.internationalpollinatorsinitiative.org).

- ***Plot characteristics (Annex 1. Cover sheet template)*** - A cover sheet to describe the key characteristics of the plot. This will help to ensure that the treatment plots and control plots are as similar as possible in their key characteristics and land use history. If before and after comparisons are being made, this information will help to understand differences between farmers participating in the trials.
- ***Inputs (Annex 2. Weekly Template or Annex 3. Daily and Weekly Template)*** - Weekly (or other agreed frequency) sheets to record labour and material inputs.
- ***Outputs (Annex 4: Templates for output – single crop for whole harvest period; or Annex 5: Templates for output – single crop harvested weekly; or Annex 6: Templates for output – multiple crops over whole harvest period)*** – depending on the crop these can be for a whole crop or cropping system harvest and be filled out after the harvest and sale have taken place. Alternatively, record sheets of harvested volume and sales could be filled in once a week (or other appropriate frequency) during the harvesting period. This would be appropriate, for example, for garden eggs in Ghana as these are harvested on a weekly basis over several weeks and the price varies considerably over the season.

These templates can be adjusted to meet the needs of the farmers and the experiments concerned. Pictures rather than words for example, can denote activities. Records of labour input can be made per activity and/or per plot depending on what farmers agree is appropriate and feasible.

4.4 RECORD-KEEPING FOR QUALITATIVE INFORMATION AND PERCEPTIONS OF CHANGE

Some types of information such as own labour time may be too challenging and burdensome for farmers to record with precise measurement of number of hours or days for different activities. The farmers may however, be able to record the labour spent for different production activities with rough qualitative categories agreed by the group such as 'low, medium, high' or 'lower than normal, normal, higher than normal'. This could be sufficient for the purposes of comparing inputs to treatment plots and control plots (or before and after comparisons). This would make it possible for the comparisons based on the easily quantifiable information on inputs to take into account any major differences in own labour inputs.

Where it is not practical for farmers to record even qualitative information on a regular basis, an alternative approach would be for the facilitator to track perceptions of change in periodic group meetings. The facilitator could periodically lead a discussion with the farmer group on their perceptions of change with the introduction of the pollinator-friendly practice. A possible format for this and checklist of questions is given in Box 4.6.

Box 4.6

RECORDING FARMERS' PERCEPTIONS OF CHANGE

A periodic meeting (weekly or monthly) meeting where the facilitator would lead a discussion with the group based on the following questions. The facilitator would note down main changes identified and overall assessment by the group at each meeting.

CHANGES IN PRODUCTION PRACTICES

- **What activities (in the production system) have you done this week/month?**
- **What changes have you made to how you have done them (because of the pollinator-friendly practice?)**
- **What inputs did you use - how much – was this more or less than in previous seasons/or in the control plot?**

LABOUR

- **Did you feel that it took longer or less time than in other seasons/ or in the control plot?**
- **Did the work feel more or less tiring – why?**
- **What other differences did you notice about this activity this week/month?**
- **What other factors might explain any differences identified - e.g. the work might have seemed more tiring because it was hotter this year than last year, or done at a different time of day than (higher sun) than last year?**

IF IT IS HARVESTING TIME

- **How much did you harvest - how did this compare with last year?**
- **What quality - how did this compare with last year?**
  - **What aspect of quality changed – e.g. taste, length of stalks, seed production, perishability**
- **What other factors might explain any differences identified?**

OTHER LESS TANGIBLE IMPACTS

- **Are there any other changes or impacts that you think relate to this change in your practices?**

OVERALL ASSESSMENT

- **What is your overall assessment so far of this change in your agricultural practices? - Good, bad, no difference.**

4.5 KEY QUESTIONS IN THE PLANNING OF TESTS

Pollinator-dependent crops only or the whole cropping system?

If comparing sites with and without a pollinator-friendly practice in the context of multi-cropping and crop rotation, how important (and how feasible) is it to record outputs, inputs and labour for each constituent crop including those that are not dependent on pollinators?

This depends on the pollinator-friendly practice that is being examined as some may affect the non-pollinator dependent crops as well. For example, planting of species attractive to pollinators adjacent to fields may take nutrients away from the main crops, adversely affecting yield of non-pollinator-dependent crops, or may reduce pest problems with a positive effect on all crops in the cropping system. If such effects for the pollinator-friendly practice being assessed are thought likely to be significant, or if there is insufficient knowledge about them, it will be necessary to record data for all of the constituent crops in the cropping system.

Records on inputs for each activity or for the crop production cycle

Is it important and practical to record labour for each activity or will total labour per crop production cycle be sufficient?

It will be important if the information gathered:

- Will be useful to explain how the pollinator-friendly practice affects labour inputs adding to credibility of the results.
- Will be useful to identify scope for improvement.

If the practice being evaluated affects only one activity, for example application of pesticides is it necessary to record volumes of other types of inputs and amount of labour inputs throughout the production cycle?

It will be important if:

- The information gathered will serve to capture any differences in volumes of seeds, fertilizers and amounts of labour between the treatment plot and the control plot.
- It is a possible impact that the reduction in labour in pesticide application may be offset by greater need for monitoring at other times during the production cycle.

Is it important for farmers to know how different types of labour input will be affected? Hired labour, own labour, labour of family members?

This will be important if:

- Family labour is already close to being fully employed.

Physical data only or price and cost data as well

How important is it to collect information on prices of outputs as well as volume?

Crop price information can be sensitive and changes in price can reflect external factors that have little to do with pollination (Figure 4.3). It may be simpler to work with physical volumes only. Price information on outputs will be useful if:

- Changes are expected in the output of different components of multi-cropping systems with some crops increasing in volume and others declining in volume. But even in this case it may be possible to use price ratios if these are reasonably stable.
- A change in price of the pollinator-dependent crop can be expected because of changes in quality or timing of production.
- Significant changes in the cost of inputs are expected, and farmers want to examine changes in revenues net of cost.

How important is it to collect information on input costs?

Such information will not be needed if prices of inputs are standard and stable. It will be necessary if:

- If the pollinator-friendly practice involves replacement of a high cost input by a low cost one or vice versa.

Figure 4.3

MARKETING OF POLLINATOR-DEPENDENT CROPS

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Crop price information is subject to many drivers, many not linked to pollination. Nonetheless, for many farmers it may be most relevant to show that pollinator-friendly practices have price impacts, due to increases in quality, quantity or timing of production. There is some indication that higher levels of pollination services may help to produce fruit earlier in the season, when prices are higher. Also, in a blind panel test in Australia, people significantly preferred bee pollinated tomatoes over hand-pollinated ones, finding them to have a greater depth of flavor (Hoogendorn *et al.* 2010).

How to get accurate data on farmers' own labour?

This is challenging, as farmers are not likely to keep records of time spent on different activities. If farmers do agree to start record-keeping this will be the most challenging aspect of this as they will need to separate the time they spend on the 'treatment' plot from the time they spend on the rest of their land or their other livelihood activities. It is likely that the facilitator will need to assist the farmers in this aspect of record-keeping.

Where recording labour inputs proves impractical, an alternative is to record farmers' perceptions of change from the previous year (if a "before and after" comparison is pursued) or from the control plots. This can also take into account more qualitative issues such as strenuousness or tediousness of the work.

How should farmers' own labour be costed?

There is no easy answer to this other than to try and work as much as possible with physical units and examine returns to labour (volume or value of output per unit of labour). The local rate paid for agricultural labour may give an indication or a rural minimum wage rate but is misleading if there are very few alternative employment opportunities available. When these rates are used, much small-scale agriculture will appear to be operating at a loss, raising the question why these farmers continue in this activity. For example economic evaluation of different maize production technologies in Western Kenya found that monocropping of maize, the most common production approach, was not profitable when labour costs were included at a standard rate (De Groote *et al.* 2010). But farmers continue because it is an important livelihood option, that they have some control over, unlike paid employment and because there are few other options. This means that the opportunity cost of farmers' own labour is lower than typical rural wage rates would suggest. Extension officers in Kenya suggested based on their experience that it could be counter-productive to record labour costs as it would be disheartening for the farmers to see that they were operating at an apparent loss.

Where farmers are operating on a more commercial basis, with a large part of their production directed at high value markets, or where there are clear alternative sources of employment, it may be more appropriate to assign a cost based on a typical agricultural wage rate.

How can data collection on less tangible impacts be undertaken?

This can be data-intensive, for example tracking use of resources from patches of non-crop vegetation so it is important for the farmers to identify the impacts that are most relevant to the practice being tested and are of the most concern to them. Some of the impacts identified in Table 2.2 could also be quite subjective such as better tasting food. Tracking this over time would require farmers to agree on some system of ranking the taste of food and apply it consistently.

If farmers consider that collecting data on these variables is too onerous, an alternative is for the facilitator to record their perceptions of change in periodic group discussions (see Section 4.4). This would also give an opportunity to record impacts that were identified only after the experiment started.

How many production cycles to collect data for?

Repetition of the trials for both treatment plot and control plot in subsequent production cycles will increase the reliability of the results. It will also allow farmers to record other impacts that are not foreseen and only emerge as the practice is tried out.

For example, higher prices received for higher quality crops or for crops harvested at a different point in the season may emerge as a beneficial impact. Farmers may decide to restrict data collection to physical production initially but leave open the possibility to address price changes in subsequent production cycles.

STEP FIVE: ANALYZING AND EVALUATING THE PRACTICES

5.1 ANALYZING QUANTITATIVE DATA ON THE INDICATORS

Analysis needs to be based on discussion with farmers on what would be useful and what degree of disclosure about individual farms they would be comfortable with. Simple ratios of input and output per unit of production in both physical terms and if possible monetary terms can be estimated for each plot.

Physical data

Outputs

- Yield per plot (or per agreed land unit if treatment and control plots are not the same size)
- Yield per plot of different quality gradings

Inputs

- Materials
  - Volume of material inputs per unit of output
- Labour
  - Number of hours/days of labour per plot per production cycle
  - Number of hours/days of labour per unit of output
  - Number of hours/days of hired labour per plot/unit of output

Monetary data

Outputs

- Market value of production per plot or agreed land unit

Inputs

- Cost of material inputs per unit of output
- Cost of labour – hired and family

Profitability/Returns

- Returns to labour
  - Market value of production less total material input costs per plot – divided by the number of hours/days spent, this gives a unit wage rate
- Returns to land
  - Market value of production per plot (agreed land unit) less total costs of production
- Returns to material inputs/value added
  - Market value of production less amount spent on material inputs
  - Market value of production per USD (or local currency unit) spent on material inputs

5.2 DRAWING COMPARISONS BETWEEN PLOTS

From physical data to monetary data

Comparisons between trial plots and control plots and between production cycles could be made for physical data and for monetary data (if collected). It is recommended to use physical data as much as possible.

Monetary data on price and costs may be difficult to obtain and farmers may not always want to disclose these even if they have kept records. Conclusions can be drawn however about the effect of the pollinator-friendly practice by examining simple ratios in physical terms as given above. For example the treatment plot may be shown to produce more output per plot than the control plot, and with lower material and labour inputs.

Such comparisons become more complicated when there are several crops and several types of input involved with different prices. In these cases, if the ratios of crop and input prices do not vary too much, a weighting system can be used. For example if the main crop in a cropping system usually commands a price double that of the secondary crop, an increase in the output of the main crop in the treatment plot that is offset by a reduction in the output of the secondary crop as compared with the control plot would still be considered to be an improvement (see Table 5.1). For subsistence crops that are not marketed, this system of weights could be derived through farmers' assessment of the importance of each crop to their livelihoods or food supply.

Table 5.1

An example of using price ratios or importance weightings to compare plots with mixed crops

CROP	CONTROL OR 'BEFORE' PLOT	TREATMENT OR 'AFTER' PLOT
Main crop output: nº of bags	20	22
Secondary crop output	10	8
Total output of the plot	30	30
Total output with weighting of 2 for main crop and 1 for secondary crop	50 (2x20 + 1x10)	52 (2x22 + 1x8)

Taking account of variation

The difference between one treatment site and one control site may be due to variations in other factors like soil compactness and not the impact of the pollinator-friendly practice. As no two plots can ever be identical it is important to take account of variation by averaging the results from a number of treatment plots and a number of control sites and comparing the averages. It is also necessary to consider the variation between the measurements.

A simple way of doing this, which can involve the farmers, is to look at the range between the lowest and highest measurement for the treatment plots and the control plots (or for the "before" plots and the "after" plots), and see to what extent they overlap. This is appropriate for tests involving just three replicates and can be done by the farmers themselves in a diagram as shown in Figure 5.1 (Van den Berg 2001).

In the first example, there is a clear separation between the yield in the control plots and the yield in the treatment plots. In the second example there is some overlap, indicating that further assessment is needed through observation of more plots before conclusions can be drawn.

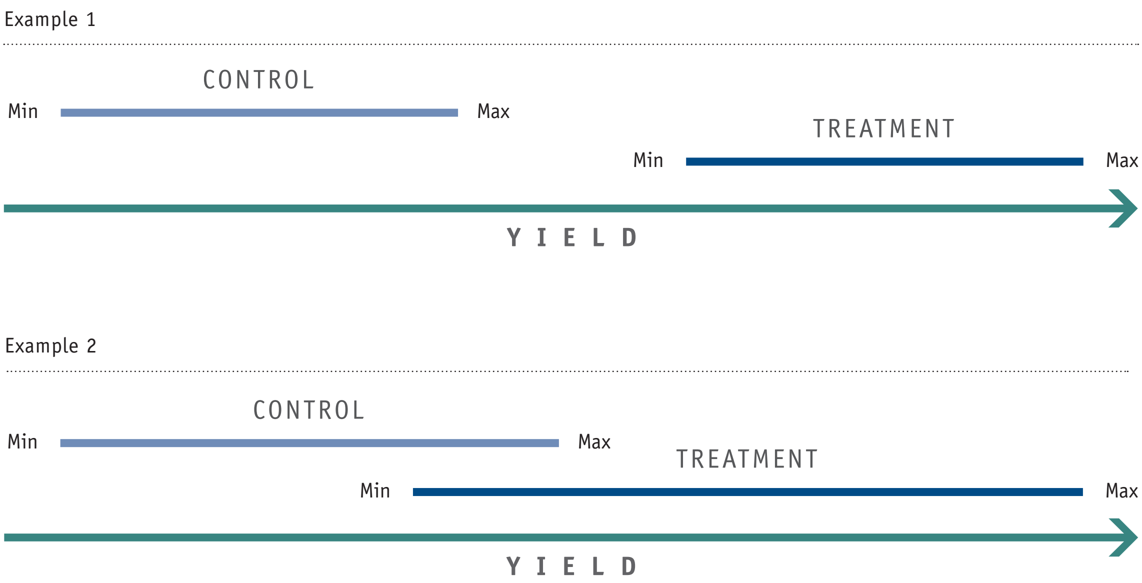
As more farmers participate and the number of replicates increases, it will be necessary to supplement this simple approach with statistical analysis of the significance of the difference between treatment plots and control plots or between before and after the introduction of the pollinator-friendly practice.

5.3 EVALUATION BASED ON QUALITATIVE INFORMATION

If farmers are not able or willing to keep records with quantitative information, or the records are not comprehensive, there is still scope for evaluation using qualitative information. This can be used in two ways: to complement evaluation based on quantitative information or as the main form of evaluation.

Figure 5.1

DRAWING COMPARISONS BETWEEN PLOTS



Source: adapted from Van den Berg (2001)

Using qualitative information to complement evaluation based on quantitative data

A likely situation is that farmers will at most keep quantitative records of purchased inputs including hired labour, but not their own labour. Comparisons of the quantitative data between the treatment plots and the control plots may indicate that the pollinator-friendly practice is beneficial (or that it results in a loss). But consideration of other factors, in particular the amount of own labour used with and without the practice, may change the overall assessment by the farmers.

Qualitative records on whether own labour required for each production activity is low, medium or high, can be compared for the treatment and control plots (or the before and after trials). The facilitator can then initiate a discussion amongst the farmers on the extent of the differences identified, the importance of these differences and whether there are other factors that might explain the ranking of own labour use. In this context, the most likely other factor would be substitution by hired labour. Own labour might have been ranked as high for a particular activity for the treatment plot, not because of the pollinator-friendly practice, but because less hired labour than normal was used.

If there are clear differences identified that are not obviously attributable to other factors, the farmers need to discuss whether they are significant enough, when examined against the quantitative information, to affect their assessment of the practice.

A similar process can be followed for assessment of less tangible impacts (see Table 2.2) that have been considered relevant for the tests.

Qualitative information as the main form of evaluation

This type of evaluation would be based on the perceptions of change tracking discussed in Section 4.4. Although not very precise, it has some advantages in that the open-ended questions discussed may lead to the identification of impacts that were not foreseen by the farmers in the planning of the tests.

The facilitator and the farmers' group at the end of the cropping season can review the assessments they gave for the pollinator-friendly practice at each of their periodic meetings and the rationale for the assessment. They can discuss whether these assessments still seem reasonable, produce a final list of advantages and disadvantages of the practice and make an overall assessment of the practice.

It is important to do such evaluation as this will help to reveal how farmers perceive the pollinator-friendly practices tested and the factors that will influence their decision whether or not to adopt them.

CONCLUSION

This guidance has been provided for use by the seven countries in the GEF/UNEP/FAO project on the "Conservation and Management of Pollinators for Sustainable Agriculture through an Ecosystem Approach": Brazil, Ghana, India, Kenya, Nepal, Pakistan, and South Africa. It is by no means meant to be restricted to these countries. Indeed, the approach presented herein has been developed so as to encompass a broad array of farming situations. It is anticipated that it can be applied within an even wider range of farming communities and systems and in many countries so that it becomes possible to better document the value of pollinator-friendly practices on a worldwide basis. It is therefore hoped that many people will find this guidance useful and will adopt it and share their experience with it in return and provide feedback so as to improve it.

This document can be downloaded for free on the web site at
http://www.internationalpollinatorsinitiative.org/jsp/documents/documents.jsp
To provide feedback and comments, please send a message to
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ANNEX 1: COVER SHEET TEMPLATE

TREATMENT PLOT/CONTROL PLOT	LOCATION REFERENCE
KEY CHARACTERISTICS	
Size of plot	
Elevation	
Soil type	
Aspect	
Slope	
Rainfall	
Irrigation	
Distance to natural vegetation (forest)	
Distance to semi-natural vegetation	
LAND USE HISTORY	
Forest/natural vegetation cleared	o In last 12 months o Between 1 and 5 years ago o Between 5 and 10 years ago o Over 10 years ago
Plot has been under fallow	o In last 12 months o Between 1 and 5 years ago o Between 5 and 10 years ago o Over 10 years ago
OTHER IMPORTANT CHARACTERISTICS	

ANNEX 2: WEEKLY TEMPLATE

TREATMENT PLOT	REFERENCE (LOCATION)	
CROPPING SYSTEM		
WEEK		
LABOUR INPUTS		
ACTIVITY*	NUMBER OF HOURS/DAYS OF HIRED LABOUR	NUMBER OF HOURS/DAYS OF OWN/FAMILY LABOUR**
Land Preparation		
Planting		
Application of fertilizer		
Weed control		
Pest control		
Harvesting		
Total		
MATERIAL INPUTS	VOLUME	UNIT
Seeds		
Chemical fertilizer		
Manure or organic inputs		
Herbicides		
Pesticides (fungicide, insecticide)		
Natural pest control products (e.g. natural enemies, botanical pesticides)		

*Instead of recording hours for each activity, an alternative would be to give the total hours worked on the plot in the week and indicate which activities involved by placing a tick in the box

** If recording number of hours or days is not practical, a qualitative approach, e.g. 'low medium or high' could be used.

ANNEX 3:
DAILY AND WEEKLY TEMPLATE

TREATMENT PLOT	PLOT REFERENCE							
CROPPING SYSTEM								
WEEK								
LABOUR INPUTS								
ACTIVITY*	NUMBER OF HOURS (FAMILY LABOUR AND HIRED LABOUR)							
	Weekly Total	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
o Land Preparation								
o Planting								
o Application of fertilizer								
o Weed control								
o Pest control								
o Harvesting								
Total								
MATERIAL INPUTS	VOLUME				UNIT			
o Seeds								
o Chemical fertilizer								
o Manure or organic inputs								
o Herbicides								
o Pesticides (fungicide, insecticide)								
o Natural pest control products (e.g. natural enemies, botanical pesticides)								

ANNEX 4:
TEMPLATES FOR OUTPUT – SINGLE CROP FOR WHOLE HARVEST PERIOD

TREATMENT PLOT	LOCATION (REFERENCE)		
Cropping system			
Crop			
Harvesting period	Start.....................	End..................................	
QUANTITY	AMOUNT	UNIT	COMMENTS
Quantity produced			
Quantity sold			
Price at which sold			
o Start of harvest period			
o Middle of harvest period			
o End of harvest period			
QUALITY	GRADE	GRADING SYSTEM	COMMENTS
Quality (for market)			
Quality for own consumption/use			
o Taste			
o Length of stalks/fodder			
o Seeds			
o Perishability			
o Other			
Unusual factors affecting output (e.g. weather conditions, disease outbreak)			
Overall assessment for crop			

ANNEX 5:
TEMPLATES FOR OUTPUT – SINGLE CROP HARVESTED WEEKLY

TREATMENT PLOT	LOCATION (REFERENCE)		
Cropping system			
Crop			
Week/date	Day................ to................ Month...................Year...........................		
QUANTITY	AMOUNT	UNIT	COMMENTS
Quantity produced			
Quantity sold			
Price at which sold			
QUALITY	GRADE	GRADING SYSTEM	COMMENTS
Quality (for market)			
Quality for own consumption/use			
o Taste			
o Length of stalks/fodder			
o Seeds			
o Perishability			
o Other			
Unusual factors affecting output (e.g. weather conditions, disease outbreak)			
Unusual factors affecting price at which sold (e.g. change of buyer or location of sale)			
Overall assessment for crop			

ANNEX 6:
OUTPUT TEMPLATE – MULTIPLE CROPS

TREATMENT PLOT		LOCATION (REFERENCE)		
Cropping system				
Crop		Crop 1.................	Crop 2..............	Crop 3..............
Harvesting period		Start....... .... End................	Start....... .... End................	Start....... .... End................
QUANTITY	UNIT			
Quantity produced				
Quantity sold				
Price at which sold				
o Start of harvest period				
o Middle of harvest period				
o End of harvest period				
QUALITY	GRADING SYSTEM			
Quality (for market)				
Quality for own consumption/use				
o Taste				
o Length of stalks/fodder				
o Seeds				
o Perishability				
o Other				
Unusual factors affecting output (e.g. weather conditions, disease outbreak)				
Overall assessment for crop				
Overall assessment for the plot				

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As a contribution to the International Pollinators Initiative, FAO and its partners have collaborated with the International Institute for Environment and Development (IIED), UK, to develop a participatory approach to evaluating the costs and benefits to farmers of employing pollinator-friendly practices. This document thus presents a handbook for the application of the approach, outlining the different steps to be followed in assessing the value of practices. Formats for keeping records that are useful in the evaluation are provided in annexes.

GLOBAL ACTION ON **POLLINATION SERVICES**
FOR **SUSTAINABLE AGRICULTURE**

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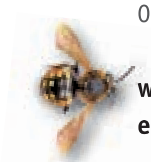

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