PROTOCOL FOR PARTICIPATORY SOCIOECONOMIC EVALUATION OF POLLINATOR-FRIENDLY PRACTICES

DRAFT PROTOCOL DEVELOPED

FAO/IFAD PROJECT,

"DEVELOPMENT OF TOOLS AND METHODS FOR CONSERVATION AND MANAGEMENT OF POLLINATION SERVICES FOR SUSTAINABLE AGRICULTURE"

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Contents

Introduction

Target audience for the protocol
Organisations working with farmers

Aim of the protocol
To provide guidance on how organisations can work with farmers to evaluate the impact of pollinator-friendly practices on their livelihoods. The assumption is that if farmers evaluate these practices for themselves and find them positive they will be more likely to adopt them than if they are shown the results from a questionnaire survey. They will also be more equipped to explain the impacts to other farmers and motivate them to adopt these practices as well.

Scope
This guidance 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. The procedures outlined here propose a way for farmers to evaluate the 'total' impact of pollinator-friendly practices as well as to identify adaptations which might reduce observed negative impacts or enhance positive ones and could form the subject of further experiments.

The protocol does not aim to give guidance on how impact of the practices on pollination or the impact of pollination on yield can be measured. The Global Pollination Project has developed other guidance documents on the application of a protocol to detect and assess pollination deficits in crops.

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 a few farmers to start with. In both cases it is assumed that there is already an active process of discussion with farmers about their production systems and the key constraints they are facing.

The Steps
1. Characterise current production systems, practices and main perceived needs for improvement
This step will already have been done in many cases as part of the Farmer Field School or as part of the organisation's work with the farmers. Low yields, and/or inadequate pollination may have been identified as areas for improvement.
It is useful to understand what other constraints or problems are perceived by farmers as this may help in the selection of pollinator-friendly practices to test. For example if animal fodder is getting harder to collect, cultivation of fodder crops that also attract pollinators could be appropriate.
It is also necessary to understand the practices that farmers currently use, and the extent to which they are pollinator-friendly.
If this information has not already been collected as part of the organisation's previous work with the farmers, a survey could be conducted of a random sample of farmers in the area. This

questionnaire would include questions about cropping systems, practices used and main challenges faced by farmers.

2. Identify appropriate pollinator-friendly practices to test

There are a wide range of pollinator-friendly practices which could be introduced – see Box 1. Farmers may already be using some of these practices, not always with the aim of promoting pollination. Farmers may as well have additional practices to suggest.
It is recommended to keep the evaluation simple by selecting one or two practices only to test and compare with current practices. 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 crop fields versus no such planting (this is an example from Nepal).
- Planting of hedgerows versus no such planting
- Intercropping of pollinator dependent crops with crops attractive to pollinators versus mono-cropping of pollinator-dependent crops.

Alternatively, introduction of a package of practices could be evaluated. This would be appropriate 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.

Key questions in selection of practices to evaluate

- Is the practice relevant to current production systems? Eg: avoidance of flood irrigation
- Does the practice address perceived aspects of production systems where improvement is needed?
- Is the practice a realistic decision variable for the farmers (for example, farmers generally do not control, or cannot change, their farm's proximity to natural habitat. But they may make decisions about the management of patches of semi-wild vegetation on their farms).
- Is the practice sufficiently different from current practice to enable comparison? Eg: mixed cropping

It is suggested that the group facilitator review Box 1 and select amongst the list practices that will be considered further in Step 3.

Box 1 Pollinator-friendly practices

Managed pollinators
Introduce managed pollinators
Improve traditional beekeeping – modern hives and increased number of colonies per ha
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*
No-till agriculture (for legume forage)

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 (so as not to disturb soil-nesting bees)
Leave dead trees and branches standing
Leave patches of bare ground undisturbed
Avoidance of flood irrigation
Increasing accessibility of crops for pollinators
Staking plants so that it is easier for bees to access the flowers

*Also important for bee nest sites

3. Identify relevant and possible pollinator-friendly practices for a specific site, and discuss their implications

The pollinator-friendly practices can be associated with changes to outputs and to inputs and ultimately the viability of production systems for farmers. Table 1 sets out these possible impacts for a range of pollinator-friendly practices, and is a way of systematically organising and comparing the possible impacts to be investigated by farmer groups.

Key questions on inputs and outputs

- How would the practice affect yields?
- How would the practice affect the area in the plot that can be used for crops?
- How would the practice affect inputs – seeds, fertiliser, herbicides, pesticides?
- How would the practice affect labour inputs?

At this stage it is useful to discuss the range of possible practices that farmers might like to introduce to encourage pollinators, and what they predict will be the implications, outcomes on yields, and costs in terms of material and labour.

The table below is of course only meant to be indicative of possible practices and their implications; the actual discussions with farmers should not be bound by this table. Farmers should be encouraged to suggest other practices as well. At the end of this step, you will be able to generate a (shorter list of a) table like this for your site, with all relevant and possible practices considered.

Table 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; possible greater income with multiple harvests (but these may be true even if the specific crops do not favour pollinators. Better disease control (best remedy for disease is usually crop rotation)	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, - if a legume, improves soil fertility	Single crops	Crop combination reduces fertilizer and pesticide requirements (nitrogen-fixing plants and companion planting)	Overall yields may be higher Indirect effect of pollination may increase yield per plant	Diversity of crop seeds Lower fertilisers and pesticides	Higher as more complicated?
Greater crop genetic diversity	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 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

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	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	Lowers yield per plot Indirect effect on pollination will increase yield	Seed or plant sources, if not naturally regenerated 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	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 as lower proportion is used for main crop Indirect effect on pollination may increase yield Shade trees may provide other commercial and own consumption products	Lower than under sun cultivation	Could be lower if material inputs are reduced.
Strip crops eg: coriander to attract pollinators and natural enemies of crop pests	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 Indirect effect of pollination may increase yield	Seed or plant sources Higher per plot if it means greater cropping intensity but	Higher per plot if it means greater cropping intensity but lower for main crop

Practice	Control/Comparison	Implications (other than pollination)	Outputs Yield per plot/Quality	Material inputs	Labour inputs
				lower for main crop	
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	Lower yield per landscape area as not all of it will be cultivated-	Lower yield per landscape area/collection of fields Indirect effect on pollination may increase yield per plot	No effect at the plot level	No effect at the plot level
Reduce use of chemicals					
Selective weeding to conserve weeds good for pollinators	Weeding with herbicides	Replace herbicides by manual weeding	Lowers yield if remaining weeds compete with crops for nutrients Indirect effect of pollination may increase yield	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 farm areas (including attention to timing of application)	Conventional i.e. intensive use of pesticides	May lower yields if less toxic means less effective but reduces amount of material inputs	Yields may be lower Indirect effect of pollination may increase yield	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 fertilty	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

Practice	Control/Comparison	Implications (other than pollination)	Outputs Yield per plot/Quality	Material inputs	Labour inputs
Managing for bee nest sites					
No-till agriculture, reduced tillage or hand tillage	Preparation with machinery	Lower labour for land preparation More weeds so more material inputs (herbicides) or labour inputs/ or lower yields	Lowers yield if remaining weeds compete with crops for nutrients Indirect effect of pollination may increase yield	May be higher (unless weeding is manual)	Lower for land preparation May be higher for weeding unless herbicides used
Leaving standing dead trees and fallen branches undisturbed a) On the fields b) Adjacent to the fields	a)Plot is completely cleared b) Adjacent dead trees/branches cleared	a) Reduces the proportion of the plot that is used for crops	a)Lowers yield per plot as less of it used for crops b) No effect as adjacent to field Indirect effect on pollination may increase yield	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
Maintain bamboo shoots or other hollow twigs/stickes for wood-nesting bees	Remove all such nesting sites	May reduce the proportion of the plot that is used for crops	May lower yield per plot Indirect effect on pollination may increase yield	None, unless bamboo needs to be planted	None, unless bamboo 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	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 b)	a)Lowers yield per plot b) No effect as nests are on unused land Indirect effect of pollination may increase yield	a)Lowers inputs pro-rata for some production stages b) No effect	a) Lowers inputs pro-rata for some production stages b)No effect

Practice	Control/Comparison	Implications (other than pollination)	Outputs Yield per plot/Quality	Material inputs	Labour inputs
land not used for cropping/fallow land					
Avoidance of flood irrigation	Rainfed or drip 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 for leaf cutter bees, sand "playgrounds" for ground-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

* these are not interventions to benefit wild pollinators specifically, but as they are part of the pollination deficit protocol, they should be assessed for giving an estimate and proxy of the value of increasing pollination services. In addition, given synergistic and interactions and complementary roles between wild and managed pollinators, the presence of managed pollinators may add to the value of wild pollinators (see for example Greenleaf and Kremen 2007, and Rader et al. 2009).

Other impacts

The introduction of pollinator-friendly practices can affect farmers' livelihoods and wellbeing 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 clearcut 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 – mixed crop types, mixed varieties,
- Reduction in health risk – less toxic pesticides
- More tiring work
- Multiple benefits from planting pollinator-friendly plants, such as medicinal values or utility as fuelwood.

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 is 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 gives some examples of less tangible impacts that might be associated with each of the main pollinator-friendly practices.

Through discussions with farmer groups, you may want to generate a table like this as well, for the non-monetary impacts of (a shorter list of) all possible and relevant practices considered for your site.

Table 2 Potential (hypothesized) non-financial/less tangible impacts (other than pollination) of using pollinator friendly practices

Practice	Control/Comparison	Positive impacts	Negative impacts
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	
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	
Greater crop genetic diversity	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	Whole or agreed 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 eg: 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 or agreed conventional proportion of the plot used for production crops	Microclimate – reduces heat making agricultural work less arduous	
At landscape scale conservation of perennial grasslands, old fields, shrubland, woodlands comprising	Complete clearing or larger proportion of land cleared at the landscape level	Availability of wild resources for household use and food safety net	

Practice	Control/Comparison	Positive impacts	Negative impacts
wind-pollinated plants providing pollen sources for bees			
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 Better tasting food	
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	Rainfed or drip irrigation		

4. Exploring implications of selected practice(s) with farmers

Based on the discussions in section 3, a selected number of practices will have been identified. Following the approach used in community IPM (van den Berg 2001) facilitators may wish to then 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 idea matrix is meant to be indicative only, and farmers should be encouraged to identify the effects of each practice themselves.

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)

5. Select 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).

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 (Gemmill-Herren et al 2006). 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, microclimate to the treatment plots. This is so that differences in impacts observed between the control plots 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 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, the above may be the best option.

How many plots are needed?

Because of the variation in plot conditions, it is important to have a number of pairs of treatment plots and control plots, or before and after comparison sites. Initially, though even a small number of plots may be still be useful. For 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 treatments levels – for example, with hedgerows and without hedgerows – may be sufficient. This is a very small sample size so may lack credibility with external audiences. However, the results from a small experiment like this may be sufficient to motivate other farmers to participate in the trials. 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 organisation for processing and analysis of the data.

6. Select indicators and determine how they will be recorded and tracked

Aim: Identify indicators that are meaningful to farmers and that they can record easily.

Current record-keeping and assessment

It is first necessary to understand how farmers currently assess their production practices, the extent to which they keep records, mental or written, and their motivations for this. This will be important for identifying feasible approaches to information-gathering.

Key questions

- How do farmers assess their production practices?
- What do farmers currently measure in their production systems?
- How do they do this? – quantitative, qualitative
- In what ways could more record-keeping be useful?

Revisit ideas Matrix for each selected pollinator-friendly practice

The ideas matrix identified the main hypotheses about the impact of the pollinator-friendly practice and the impacts that need to be tested. The farmers can draw up an observation matrix to 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 practical 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.

Observation Matrix – Use 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 fertiliser, pesticides) applied to the plot in one production cycle	Record volumes/weights with Fertiliser – 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)

Key questions

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?

- 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

- Will be important to capture any differences in volumes of seeds, fertilisers and amounts of labour between the treatment plot and the control plot
- 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

- 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. 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.

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.

Proposed templates

Three types of template will be needed:

- 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.

- Weekly (or other agreed frequency) sheets to record labour and material inputs

- Outputs

Some models of templates are shown below. These can be adjusted to meet the needs of the farmers and the experiments concerned. Activities for example, can be denoted by pictures rather than words. Records of labour input can be made per activity and/or per plot depending on what farmers agree is appropriate and feasible.

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	☐ In last 12 months ☐ Between 1 and 5 years ago ☐ Between 5 and 10 years ago ☐ Over 10 years ago
Plot has been under fallow	☐ In last 12 months ☐ Between 1 and 5 years ago ☐ Between 5 and 10 years ago ☐ Over 10 years ago
Other important characteristics	

Weekly template

Treatment Plot	Reference (Location)	
Cropping system		
Week		
Labour inputs		
Activity*	**Number of hours (family labour and hired labour)**	**Share of hired labour (%)**
• Land Preparation		
• Planting		
• Application of fertiliser		
• Weed control		
• Pest control		
• Harvesting		
Total		
Material Inputs	**Volume**	**Unit**
• Seeds		
• Chemical fertiliser		
• Herbicides		
• Pesticides (fungicide, insecticide)		

*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

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
• Land Preparation								
• Planting								
• Application of fertiliser								
• Weed control								
• Pest control								
• Harvesting								
Total								

Material Inputs	**Volume**	**Unit**
• Seeds		
• Chemical fertiliser		
• Herbicides		
• Pesticides (fungicide, insecticide)		

Templates for output - Single crop

Treatment plot	Location (Reference)		
Cropping system			
Crop ……			
Harvesting period			
Quantity	**Amount**	**Unit**	**Comments**
Quantity produced			
Quantity sold			
Price at which sold			
-Normal harvest period			
-Post harvest period			
Quality	**Grade**	**Grading system**	**Comments**
Quality (for market)			
Quality for own consumption/use			
- Taste			
- Length of stalks/fodder			
- Seeds			
-Perishability			
-Other			
Unusual factors affecting output eg: weather conditions, disease outbreak			
Overall assessment for crop			

Output template – Multiple crops

Treatment plot		Location (Reference)		
Cropping system				
Crop ……		Crop 1……	Crop 2……	Crop 3……
Harvesting period				
Quantity	**Unit**			
Quantity produced				
Quantity sold				
Price at which sold				
-Normal harvest period				
-Post harvest period				
Quality	**Grading System**			
Quality (for market)				
Quality for own consumption/use				
- Taste				
- Length of stalks/fodder				
- Seeds				
-Perishability				
-Other				
Unusual factors affecting output eg: weather conditions, disease outbreak				
Overall assessment for crop				
Overall assessment for the plot				

6. Analysing the data

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.
Comparisons between trial plots and control plots and between production cycles could be made for some or all of the following.

- **Outputs**
  - Yield per plot (or per agreed land unit if treatment and control plots are not the same size)
  - *Market value of production per plot or agreed land unit*
- **Inputs**
  - Materials
    - Volume of material inputs per unit of output
    - *Cost of material inputs per unit of output*
  - Labour
    - Number of hours of labour per plot per production cycle
    - Number of hours of labour per unit of output
    - Number of hours of hired labour per plot/unit of output
    - *Cost of labour – hired and family*
- **Profitability/Returns**
  - *Returns to labour*
    - *Market value of production less total material input costs*
  - *Returns to land*
    - *Market value of production per plot (agreed land unit) less total costs of production*

From physical data to financial data

The items in italics involve price and/or cost information which may be difficult to obtain, or which farmers may consider to be sensitive. Conclusions can be drawn however about the effect of the pollinator-friendly practice by examining simple ratios in physical terms as shown below. 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

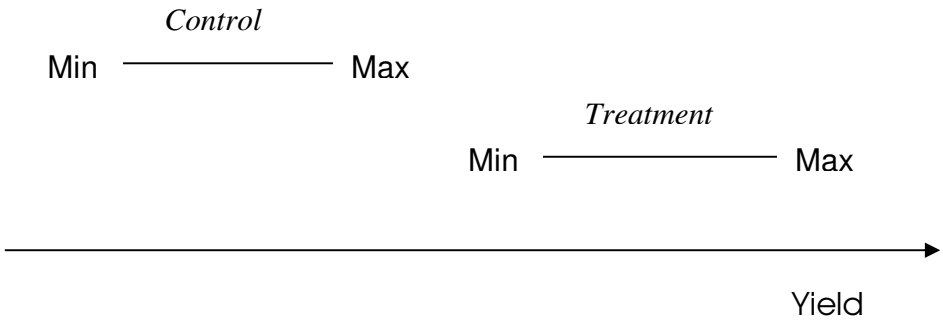
Such comparisons become more complicated when there are several crops and several types of input involved with different prices. In these cases if the ratios of crop and input prices do not vary too much, a weighting system can be used. For subsistence crops that are not marketed this system of weights could be derived through farmers' assessment of the importance of each crop to their livelihoods or food supply. For example if the main crop in a cropping system usually commands a price double that of the secondary crop, a 10% increase in the main crop in the treatment plot and a 10% reduction in the secondary crop as compared with the control plot would be considered to be an improvement.

Taking account of variation

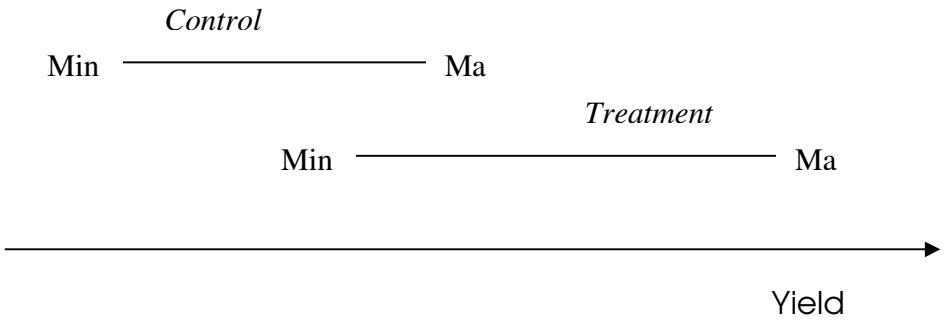
The difference between one treatment site and one control site may be due to variations in other factors like soil compactness and not the impact of the pollinator-friendly practice. As no two plots can ever be identical it is important to take account of variation by averaging the results from a number 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 the examples below[1]. 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.

[1] Adapted from van den Berg 2001.


Control
Min
Max
Treatment
Min
Max
Yield

Example



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.

References

Gemmill-Herren et al 2006 Development of Pollination Management Plans for Specific Cropping Systems. Tools for Conservation and Use of Pollination Services. FAO.
van den Berg, H. 2001 Facilitating scientific method as follow-up for FFS graduates. FAO Programme for Community IPM in Asia