Integrated Pest Management in Smallholder Farming Systems in Kenya

Evaluation of a pilot project

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Executive Summary

This paper reports on a wide-ranging evaluation of a participatory IPM project in Kenya. This pilot project was one of the first to employ the Farmer Field School (FFS) approach, a discovery-based, group learning model, in Eastern Africa. The approach was tried in 3 districts of Central Province (Murang'a, Nyeri and Kiambu) and 1 district in Coast Province (Taita-Taveta) through a partnership of the International Institute of Biological Control (IIBC), Kenyan Institute of Organic Farming (KIOF), Coffee Research Foundation (CRF) and Ministry of Agriculture, Livestock Development and Marketing (MOALDM). Other collaborating institutions were the Permanent Presidential Commission on Soil Conservation and Afforestation (PPCSCA) and the Kenya Agricultural Research Institute (KARI).

This evaluation seeks to document the adoption and adaptation of IPM technologies and their diffusion within the communities; the capacity in pest and crop management that has been built; the social, environmental and economic impact of the project; and the impact of the project within the partner organizations. It also makes recommendations about how the pilot effort should be followed up and possibly expanded. The evaluation employs an evolutionary framework to analyse the project's effect on innovation processes, comparing FFS graduates to a control group of farmers.

The project appears to have had significant impacts at the farm and community levels with respect to the use of integrated pest and crop management practices and the concepts that underlie them. There is evidence that farmers are making their crop management decisions differently as a result of the FFSs, for example, assessing crop health and natural enemy activity before employing insecticides. Graduates now rely more on and make more efficient use of local sources of compost, manure and botanical pesticides. At least some farmers have also reduced their reliance on hired labour. The cash savings from these changed practices are significant. By conservative estimate, they amount to Ksh 8,600/yr ($145/yr) per household. They are likely complemented by other economic and environmental benefits that it was not possible to accurately assess.

Farmer management capacity, assessed as the ability to make better decisions independently and under different conditions, has also been positively affected by the FFSs. These effects appear to have reached men and women in roughly equal measure. Women graduates have increased their role in managing coffee, a cash crop that has generally been controlled by men, though it is not clear that this has translated into greater influence in deciding how proceeds will be spent. Graduates employ what they have learned on crops and enterprises other than those targeted in the FFS. In many cases, they have modified practices and innovated where initial results were not satisfactory. They also explain what they have achieved to other farmers, who then go on to test and implement at least some of the new practices. The FFS groups have continued to meet in most cases and, depending on the village, play roles of varying importance in the further development and spread of management practices. Some of the groups are also taking on other functions, such as mobilizing savings for a revolving credit scheme for members.

A financial analysis that takes account only of the savings graduates realize on agrochemical inputs and that makes conservative assumptions about the durability of benefits and the rate at which IPM practices are taken up by neighbouring farmers, suggests that the project would repay the initial investment within a year or two. The greater intensity of supervisory

involvement in this pilot phase is among the factors that need to be weighed in projecting these results to a wider scale.

Though based on conservative assumptions, this assessment draws on observations at only one time, 1½ years after the project's end, and hence should be followed up. The overall positive tenor of the assessment needs to be tempered by several additional points:

- Labour-scarce households appear to be abandoning knowledge and labour-intensive practices faster than they are innovating. A wider range of technical options is needed for them.
- A number of botanical, cultural and physical pest control options are proving to be of limited effectiveness in certain conditions. Further research is needed in support of active farmer experimentation.
- Farmers have reduced their use of synthetic fertilizers by making efficient use of on-farm and local sources of organic materials that are currently of low cost. This situation is likely to change as these practices spread. Managing diverse organic an inorganic nutrient sources is likely to prove increasingly complex.
- FFS graduates have few viable options to commercialize their low pesticide produce that take account of its quality.

These are areas that would benefit from support by research organizations, notably CRF and KARI, although NGOs may be able to contribute options in some of them. It is suggested that on-station research be complemented by on-farm participatory research in a more intensive form than occurs in the FFSs. Graduates of the FFSs who are experimenting on their own on these issues would make excellent partners. The extent to which KARI and CRF can devote themselves to the problems faced by FFS farmers will depend on the scope and extent of an expanded IPM program. If it remains focused on just two crops in a limited geographic area, then the institutions' attentions are likely to be diverted by other priorities.

Among the features of the FFS' participatory approach that have proven the most successful has been the impetus given to farmer-farmer diffusion by organizing group visits. This has resulted in the rapid spread of several practices, particularly related to soil and nutrient management. Aspects that have proven problematic include effective encouragement by Trainers to farmer experimentation. An expanded project should pay particular attention to improving trainers' skills in this area and seek to assure quality.

Men and women were approximately equally represented in the FFS and after graduation have made similar use of their experience on their own farms. However, diffusion of knowledge by graduates is found to be strongly divided by gender, men diffusing mostly to men and women mostly to women. This fact heightens the importance of gender balance in the FFSs' composition, if benefits are to flow in roughly equal measure to men and women. Similarly, younger farmers were not well represented in the FFSs and older graduates did not generally pass on what they had learned to them. The effect of these diffusion patterns on equity will depend to a considerable extent on the degree to which knowledge is shared within households. Uneven diffusion may well be a greater concern from the perspective of the poor.

The project focused its capacity-building efforts on the operational levels of MOALDM, and to a lesser extent KIOF. Trainers experienced a certain amount of dissonance between what they were expected to practice in the project and what was and had been expected of them in their regular work. They responded to this in different ways. Some have found support from their colleagues and superiors, others have encountered negative reactions. In any expanded program, a more thoroughgoing approach to capacity building should be adopted. It is also crucial to involve the partner institutions in planning from the beginning and at an appropriate level.

A key issue that needs to be considered is the scope of the initiative. Will it continue to focus on IPM for coffee and vegetables, or will it develop a broader approach to integrated pest and crop management, across commodities and responsive to local priorities? It is difficult to imagine how a participatory IPM program with a very restricted area and commodity mandate could survive within the Ministry, surrounded by programs oriented differently. On the other hand, a program that takes on all crops would require very strong organizational and research support. A more realistic approach may be to allow Farmer Trainers to improve their competence by leading a few more FFSs in coffee/vegetable farming systems, then gradually bring in other crops on which farmers are facing important problems and the program feels it has some helpful ideas to offer.

An expanded IPM program should seek to build links with other participatory R&D programs, such as the National Soil and Water Conservation Program. It should also build on the collaboration that has been achieved between different organizations, governmental, non-governmental and international. This has made it possible to bring to bear skills and experience that no one organization could muster.

1. Introduction

1.1 Origin and objectives of the project

In 1995 a pilot Integrated Pest Management (IPM) training project in coffee and vegetable cropping systems was initiated in three districts of Central Province and one district of Coast Province, Kenya. Its aim was to introduce sustainable pest management methods to farmers to enable them to avoid the hazard posed by pesticides to their own health and, through residues in produce, to domestic and foreign consumers. Concerns about damage to the local environment and about the proportion of farmers' incomes spent on agrochemical inputs were additional motives. The pilot IPM project received support form the Global IPM Facility of the World Bank/FAO, which attempts to stimulate IPM implementation in areas of developing countries where pesticide use is particularly high. The project was one of the first to adapt to East African conditions the Farmer Field School (FFS), an approach to communicating IPM principles through discovery-based learning, pioneered in Asian rice environments.

The project had five objectives:

1. Identify suitable areas for executing the pilot projects, identify constraints of crop production and develop an appropriate training course on IPM for the small scale farming systems.
2. Develop and implement a Training of Trainers (TOT) program for Government farm extension staff, and NGO field officers
3. Formulate appropriate IPM approaches for Farmer Field Schools (FFS) suitable for local farming systems.
4. Extend the FFS approach to small groups of farmers in the area targeted by the pilot project and, in collaboration with the farmers, formulate suitable participatory methods to address key production constraints.
5. Formulate preliminary recommendations for farmers participatory approaches to crop production in mixed cropping smallholder production systems in Kenya which can be extended to other production systems.

Following an internal, participatory evaluation in February 1997, project partners expressed interest in an external evaluation to inform discussions on a possible further phase. The FFS model is being widely promoted in the region and a dispassionate evaluation of one of its first implementations in the country was thought important.

1.2 Scope and objectives of the evaluation

The project was evaluated by an ecologist and an economist from ISNAR and a socio-economist from KARI (Kenya Agricultural Research Institute) - Kakamega in November and December 1997.

The following objectives were agreed:

1. Assess the adoption, adaptation and development of pest management technologies and their diffusion within the communities.
2. Assess the capacity in pest management that has been built at the farm and community levels.

3. Evaluate the social (gender), ecological and economic impact of the project thus far at those levels.
4. Evaluate the impact of the project within the partner organisations and assess the capacity that has been built there.
5. Make recommendations about how the initial effort should be followed up and possibly expanded.

From ISNAR's perspective, the evaluation contributes to its research efforts in support of capacity building in developing countries. Its "Institutional Challenges in NRM Research" project aims to support NARS institutions in deciding whether to invest in what may be for them major new areas of NRM research, and how to manage that investment. The use of participatory approaches is one such area. A number of case-studies are being evaluated against a common framework and synthesized, in order to provide NARS policy makers with greater insight into the costs, benefits and institutional implications of the choices they must make when taking up participatory approaches. The Kenyan IPM project is one of these cases.

Participatory R&D in the area of natural resource management typically has one of two overall goals. "Discovery"-oriented efforts work with farmer experimentation to find solutions to specific resource management problems. "Literacy"-oriented initiatives, on the other hand, attempt to build farmers' and communities' capacities to manage resources on a continuing basis. Of course, that entails solving problems, but in large measure, these are problems for which solutions already exist, somewhere. In essence, the communities concerned rediscover them. The Kenyan IPM project was conceived as a pilot effort for a wide scale literacy-type program. As we shall see, however, farmers and trainers at times confronted problems which were more than locally new.

Participatory R&D initiatives can also be distinguished in terms of the scale of resource management they take on. The Kenyan IPM project focused on management at the level of the individual farmer and on the decisions she makes over the resources in and around her fields. Common property aspects were not considered, although as will emerge, several are present.. They may be significant for the long term success of efforts aimed at promoting IPM.

2. The IPM project

2.1 Activities

The project began with a Participatory Rural Appraisal (PRA) in four villages (Githunguri in Kiambu District, Karigu'ini in Murang'a District, Othaya in Nyeri District and Wundanyi in Taita-Taveta District) to identify important pest problems and opportunities for IPM intervention. Following this, a Training of Trainers (TOT) course was organized, involving 11 participants from the Ministry of Agriculture Extension Division (8) and KIOF (3). This lasted 8 weeks, in two blocks of 5 and 3 weeks. In the 2.5 months between, the officers initiated Farmer Field Schools (FFSs) in their home districts. The FFSs continued for a further 2.5 months after the second TOT session..

The TOT course covered the methods and subjects that the officers were to pursue in the FFSs. The two main elements were:

(i) **Participatory approaches to agricultural extension** This section was designed to improve trainers' skills in facilitation and in creating rapport with farmers in group settings. Emphasis was placed on building equal relationships based on mutual respect.

(ii) **IPM for small scale coffee/vegetable production**. This section focused on principles of good crop husbandry for vegetables and coffee, and integrated pest management. Additional topics covered group dynamics and farmer experimentation.

The FFSs were facilitated by the TOT trainees and backed up by the master trainers and resource persons. Key features included weekly meetings in the fields where experiments were conducted. Together with the trainers, farmers carried out "agroecosystem analysis" (AESA), which entails monitoring crop vigour and nutrient status and the occurrence of pests and their natural enemies. The role of natural enemies was determined by placing them together with pests in simple cages and observing the outcome. Cost sharing by farmers, for example for food and refreshments, was an important feature of their organization.

In two villages, Karigu'ini and Othaya, the groups involved had been organized several years earlier by KIOF for training in organic farming. In the two other villages with no prior KIOF experience, groups recently formed for other reasons were approached and agreed to take part in the FFSs. The Githunguri group had formed in response to a call by a Catholic sister, who is also an extension officer, to women interested in taking up livelihood activities. In Wundanyi, the group had been organized by a horticultural cooperative to facilitate extension on vegetables and coffee. The groups varied in size from 13 in Othaya to 24 in Githunguri. Except for the all women's group in Githunguri, the groups consisted of more men than women. In total, 65 farmers graduated from the 4 FFSs.

2.2 Timetable

December 95 -	February 96	Participatory Rural Appraisal
February 96 -	March 96	First part, Training of Trainers (TOT)
March 96 -	June 96	First part, Farmer Field School (FFS)
July 96		Second part, TOT
July 96 -	September 96	Farmers Field School (FFS)
February 97 -	April 97	Participatory internal evaluation of the impact of IPM/FFS training
April 97		End of pilot project

2.3 Institutions and personnel involved

The project was executed by the International Institute of Biological Control (IIBC) Kenya Station in collaboration with the Kenyan Institute of Organic Farming (KIOF), Coffee Research Foundation (CRF) and Ministry of Agriculture, Livestock Development and Marketing (MOALDM), Extension Division. Other collaborating institutions were the Permanent Presidential Commission on Soil Conservation and Afforestation (PPCSCA) and the Kenya Agricultural Research Institute (KARI).

IIBC provided farmer participatory training methods, and focused on the identification and use of indigenous natural enemies and IPM components for pests and weeds. CRF provided inputs on coffee insect pests, diseases and weed management. KIOF contributed technical inputs on the use of botanical extracts for coffee insect pest control and organic methods of soil fertility management. The Ministry of Agriculture Extension Division contributed staff to serve as trainers facilitating the FFSs.

The PPCSCA ran a 2 weeks' course on participatory community approaches to agricultural extension at the beginning of the TOT. KARI provided input on aspects of nursery bed preparation and management and on vegetable disease management for small scale producers.

3. The Evaluation

3.1 Methods and framework

objective 1

Assess adoption, adaptation and development of technologies and their diffusion within the communities.

Twenty farmers were selected at random from the 65 who had graduated from the four FFSs. As a control, 22 farmers were selected from villages nearby who managed similar farming systems but who had not had any contact with the field school farmers ("non-FFS farmers"). Two of the FFS groups (Othaya and Karigu'ini) had worked with KIOF on organic farming over several years. In these areas, the control farmers were also selected from KIOF groups. Likewise, control farmers in Githunguri were selected from an all-women group, to match the FFS group.

Both control and FFS farmers were interviewed individually, using a questionnaire that required approximately 1-1.5 hours to work through. A mixture of closed and open-ended questions were posed. An evolutionary framework guided our choice of questions and analysis (Loevinsohn 1997; Loevinsohn *in press*). Innovation in coffee and vegetables (kale and cabbage) in 1996 and 1997 was assessed as the "planned changes" from one year to the next that farmers had made in any management practice (Okali, Sumberg and Farrington 1994). We asked the origin of theses innovations, and whether there were any that they had modified or abandoned. Of the FFS graduates, we also asked to whom they had spoken of their experiences in the FFS and in the period since who showed real interest. A sample of these "diffused" farmers (21/82) was also interviewed, using a shorter questionnaire. They were asked what they had heard from the FFS graduates in terms of new farming ideas and what use they had made of these.

We calculated rates of innovation, modification, abandonment and diffusion for different crop and pest management practices. We then used a demographic model, known as the Leslie matrix (see Sperling and Loevinsohn 1993), supplemented by a measure of the diversity of innovations, to assess the net effect of these factors on the spread and adaptation of practices within and beyond the communities.

In addition to the individual questionnaires, we conducted group interviews with each of the four FFS groups. In total, these involved 44 of the 65 group members. Typically, these interviews lasted 2.5 hours and used open-ended questions exclusively. These pursued in greater depth issues that had been broached in the individual interviews and explored issues of group and community-level processes.

objective 2

Assess the capacity in pest management that has been built at the farm and community levels.

Capacity to manage resources was defined as the ability to make better decisions on a continuing basis, in situations beyond that in which the FFS took place. This was assessed in several ways:

- In addition to innovation on coffee and vegetables, the crops targeted in the FFS, we asked during the individual interviews about innovation (i.e. "planned changes") in one of two other major crops, either potato or maize, depending on which was more important locally. This provides an indication of the extent to which farmers have been able to adapt what they learned to other crops and pests.

- In both individual and group interviews, we asked farmers what they had done where practices learned in the FFS did not perform adequately in their own fields, and, specifically, about the modifications and alternatives they had tried.

- During the individual interviews, we posed several hypothetical but realistic questions designed to assess graduates' and control farmers' ability to apply IPM principles independently.

In terms of capacity at the community level:

- We assessed the impact of active diffusion by FFS graduates on the spread of IPM principles and practices (see also under obj. 1).

- In both group and individual interviews, we asked about the role the FFS groups are playing in stimulating technical evolution and in tackling common problems, such as marketing.

objective 3

Evaluate the social (gender), environmental and economic impact of the project at the farm and community levels.

With respect to environmental impact, questions on the effects of pesticides on human health (days of work lost) and on changes in soil productivity were put to FFS and non-FFS farmers during the individual interviews. With respect to economic impact, in-depth interviews were conducted in Githunguri with seven FFS graduates and five non-FFS farmers. These focused on production costs (e.g. for labour, chemical fertilisers, insecticides and fungicides), yields, input and sale prices. Data on chemical input (but not labour) use were also gathered from the individual questionnaires in all 4 villages. The annual reports of the Ministry of Agriculture, Livestock Development and Marketing of Maragwa and Kiambu Districts were also consulted.

In considering the social implications of FFS, the evaluation team focused mainly on gender and to a lesser extent age. We examined the composition of the FFSs as well as the extent to which graduates diffuse what they learn either along or across lines of gender or age. In addition, five FFS farmers and four non-FFS farmers in Githunguri were interviewed on gender issues.

Questions pertained to income generating activities, property rights, division of labour within the household and decision-making between wife and husband. Decision-making within households was also examined, in less detail, in the other villages during the individual interviews.

objective 4

Evaluate the impact of the project within the partner organisations and assess the capacity that has been built there.

Discussions were held with 27 people at different levels within the partner institutions.

1. Trainers - Seven in total
   - six from Ministry of Agriculture
   - one from KIOF

2. Ministry of Agriculture staff
   - Divisional Agricultural Extension Officers - One
   - District Agricultural Officers - Four from the four districts
   - Subject Matter Specialists - Two from two of the districts
   - Provincial Directors of Agriculture - one
   - Ministry Headquarters - Three people
     - Two head of Divisions
     - one Assistant Director

3. Kenya Agricultural Research Institute
   KARI Thika - Two Research Officers
   KARI NARL - One Programme coordinator
   KARI Headquarters - Three Assistant Directors

4. Coffee Research Foundation - Two officers
   - One deputy director
   - One research officer

5. Kenya Institute of Organic Farming - One Director

The project's impact at the institutional level can be assessed in relation to three broad features:

1. Institutional capacity
2. Institutional motivation
3. Institutional performance

(Lusthaus et al., 1995)

Capacity The project was brief and its capacity-building efforts directed at building skills for participatory approaches among extension personnel. These efforts were aimed at the operational level of MOALD and KIOF, primarily through the Training of Trainers course and on-the-job support during the FFSs. (The decision not to do more in terms of building awareness and ownership is considered in relation to objective 5.) We used cross-cutting interviews (at trainer, farmer and supervisor levels) as the main tool to assess the effectiveness of training in building capacity at the operational level.

The restricted focus of the project in this pilot phase precluded assessment of impact on other aspects of institutional capacity. However, we did consider the prospects for an expanded FFS-based program within the partner and collaborating institutions. The issues we examined related then to the "fit" of a program in terms of existing institutional arrangements. Among these are inter-institutional linkages and the ease with which new ones that participatory integrated pest and crop management will require are established and maintained. Another, related component of institutional capacity that we examined is program management and especially the flow of information within and between organisations.

Motivation Institutional motivation includes such elements as an organisation's mission, culture, leadership and the incentives it promotes. One very pertinent aspect of motivation with respect to a novel mode of operation, such as participatory R&D, are the "mixed signals" that individuals receive. In the interviews, particularly with Farmer Trainers, we tried to get a sense of how they experienced this dissonance and coped with it. The emergence and growth in recent years of other participatory programs in the partner organizations is a major influence on institutional culture.

Performance Institutional performance was examined in relation to the efficiency of resource use. This was done by estimating the benefit:cost ratio of the project in this pilot phase under different assumptions about the impacts at the community level and about the expansion of training effort. We also tried to assess the factors that may affect performance under more "normal" conditions.

objective 5

Make recommendations about how the initial effort should be followed up and possibly expanded.

We took up the issue of follow-up with farmers in the individual and particularly the group interviews. Opinions of key actors in the institutions also provided input to our recommendations.

4. Evolution of crop and pest management practices

4.1 Characteristics of the FFS and control groups

The FFS graduates and non-FFS (control) farmers were found to be similar in terms of the major characteristics that were assessed (Table 1). No statistically significant differences were found in age, sex ratio or a wealth proxy. This latter was the quality of house construction, as judged by the type and age of roofing material, and the permanence of floor and walls.

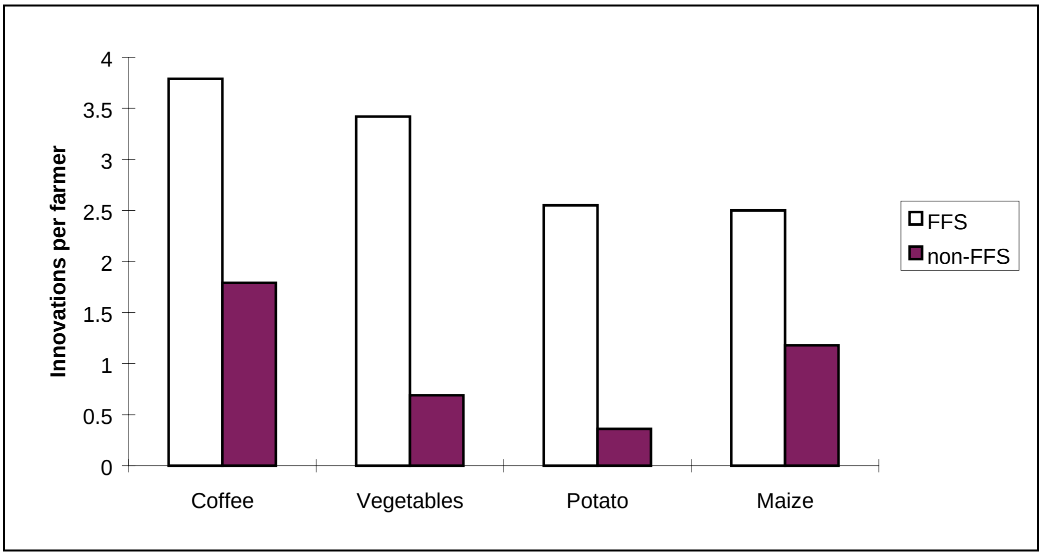
Table 1 : Characteristics of FFS graduates and control farmers

	Non FFs farmers	FFs graduates
n	22	20
Women (%)	55	55
Age (mean years ± st.error)	50.0 ± 3.84	48.0 ± 2.08
Poorer households (%)	31	42

4.2 Innovation by FFS graduates

Figure 1 illustrates the number of planned innovations per farmer in the years 1996 and 1997. FFS graduates have made substantially more conscious changes in their farming practices than have control farmers. Importantly, the differences are apparent on crops that were not discussed or experimented on in the FFSs, such as potato and maize, suggesting that graduates are doing more than merely applying blindly what they learned.

Figure 1. Planned innovations by FFS graduates and control farmers on crops treated in the Field School (coffee and vegetables) and two other major crops (maize and potato). 1996 and 1997 combined.



Tables 2 and 3 show the kinds of innovations farmers say they have made on coffee and vegetables. The FFS appears to have had its most marked effect on the use of non-chemical pest management practices, particularly in vegetables. Farmers report using a range of botanical, physical and cultural controls. However, only one in three say that they practise agroecosystem analysis, or regular monitoring of their fields, a central feature of IPM. We return to this issue below.

Table 2 Planned innovations on coffee, 1996-97. (Number/farmer)

type	Non-FFS Farmers (n=18)	FFS Graduates (n=15)
Agroecosystem analysis	0	0.33
Cultural/physical pest control	0	0.33
Botanical pesticides	0	0.27
Manipulating natural enemies	0	0.07
Intercropping	0.11	0.27
Land shaping	0.11	0.13
Compost	0	0.33
Manure	0.44	0.87
Mulch	0	0.07
Fertilizer	0.17	0.07
Insecticide	0.22	0.07
Variety	0	0.13
Pruning	0.39	0.80

Changes in crop and nutrient management practices, such as increased use, improved preparation and more focused application of manure and compost are also apparent. Several of these practices, such as double-dug beds and the "9-hole" planting system in which organic material is placed in pits which also serve to retain moisture, received no more than a mention in the FFS sessions. However, farmers, particularly in the Wundanyi and Githunguri groups, say that they were introduced to these organic agriculture practices during their visit to the Karigu'ini group, which had been practising them for some time. Improved pruning practices on coffee, which were explored in the FFSs, have also been taken up widely and are contributing to renewed interest in a crop that many farmers had practically abandoned.

Table 3 **Planned innovations on vegetables (kale and cabbage), 1996-97. (Number/farmer)**

type	**Non-FFS Farmers** (n=16)	**FFS Graduates** (n= 19)
Agroecosystem analysis	0	0.32
Cultural/physical pest control	0	0.74
Botanical pesticides	0.06	0.63
Intercropping	0	0.16
Land shaping	0	0.26
Compost	0	0.21
Manure	0.12	0.53
Mulch	0	0.05
Fertilizer	0.12	0.21
Insecticide	0.18	0.16
Variety	0	0
Nursery management	0.06	0.21
Timing	0	0.05
Rotation	0.12	0

No differences were evident between men and women in the number or in the type of innovations taken up.

4.3 Modification and abandonment of practices

For the most part, and particularly on coffee, farmers appear to have taken up these practices without further experimentation. As Table 4 indicates, they implemented more than 80% of the coffee innovations on their whole crop area, rather than first trying them on a small part, suggesting that they were confident of their value. They have also tended to apply what they have learned without modification, again suggesting that they are satisfied with the performance of the practices. Only three farmers report having abandoned innovations on coffee (including two pest control practices), reinforcing the impression that the options they learned in the FFSs are generally appreciated. It must of course be remembered that these results pertain to the first 1.5 years of farmers' experience with these practices. Problems may take some time to appear, especially with a perennial crop like coffee.

Table 4. Features of the innovation process among FFS graduates

	Innovations on:	
	Coffee	**Vegetables**
	n = 61	n = 69
Proportion of innovations (%)		
Tried first on a small area	18	39
Source : FFS	89	72
of these, modified by farmer	6	16
Source : farmer's idea	7	16
Abandoned	5	14

The situation is somewhat different with vegetables. Here farmers appear to be less confident in the practices tested in the field school and they have encountered significant problems with them in their own fields. Four in ten innovations were first tried on a small area and more than a fifth of the options picked up from the FFSs have since been modified. (As detailed below, there is reason to believe that particularly this latter figure may be underestimated). Alternatives to synthetic pesticides, especially botanical pesticides and cultural and physical pest control measures, have shown themselves particularly problematic. Some farmers complain about the time needed to prepare and implement a number of these measures, and the efficacy of some physical and botanical control measures is judged inadequate in certain conditions (the failure of milk powder solutions to control blight on tomato and potato in heavy rain, is frequently mentioned). While alternative pest control measures represented 52% of the innovations made on vegetables, they accounted for 82% of the practices farmers modified and 90% of those they abandoned.

The degree of satisfaction with the technical options available is perhaps overstated by the above analysis. Two factors likely contribute to this. The first is that some graduates appeared reluctant to admit that they had modified practices learned in the FFS, feeling that to do so was somehow wrong or disloyal. The second factor relates to confidence in experimentation: a number of other farmers expressed freely the problems they had encountered with technical options, but said they did not know how to go about modifying them. Both factors reflect on the success of the FFSs in reinforcing skills and confidence in experimentation, an issue we return to below. The ability to modify and experiment is critical to the capacity to manage resources under varying conditions. Individual capacities in these terms must be understood within a social context in which farmers are, to differing degrees, able to access the innovations of their neighbours and fellow group members and are stimulated by them to experiment through example and discussion. This is taken up further below.

4.4 Changes in input use

The uptake of IPM practices and the greater reliance on organic sources of plant nutrients are reflected in reduced use of both synthetic fertilizer and pesticides (insecticides and fungicides). The changes are apparent in both the number of users and the average dose users apply. It is striking that the trend is similar for the crops targeted in the FFS - coffee and vegetables - and those not discussed - maize and potato. In most cases, input use by graduates has declined between the 1996 crops, which were in the ground during or just after the FFS, and the 1997 crops. No consistent trend is apparent for the control farmers.

Table 5. Input use on coffee

Coffee	1996			1997		
	Non-FFS	**FFS**	*signif*	**Non-FFS**	**FFS**	*signif*
N	18	16		18	15	
Fertilizer						
Dose g/tree	353	225	*ns*	305	113	*
SE	75.6	119		57.9	12.5	
Users %	78	25	**	56	13	*
Insecticide						
Dose ml/tree	0.0048	0.02	*ns*	0.0031	0.005	*ns*
SE	0.0027	0.01		0.00068	-	
Users %	44	13	*	28	7	*ns*
Fungicide						
Dose ml/tree	0.076	0.055	*ns*	0.062	0.005	-
SE	0.019	0.045		0.023	-	
Users %	22	13	*ns*	22	7	*ns*
Number of trees	521.9	321.4	*ns*	521.9	321.4	*ns*

Significance of differences between control and FFS farmers in a year:
* p = 0.05
** p = 0.01
- not relevant
SE standard error

In coffee the use of fertiliser by FFS-farmers in 1997 was substantially lower than by non-FFS farmers. This is due to the lesser number of FFS farmers that use fertiliser as well as to lower dosages. As Table 2 showed, many FFS farmers now use composted manure and some employ compost from plant sources. The trends are less clear in the case of insecticide and fungicide due to the lower number of users.

Table 6. Input use on vegetables (cabbage and kale)

	1996			1997		
	Non-FFS	**FFS**	***signif***	**Non-FFS**	**FFS**	***signif***
N	14	19		17	19	
Fertilizer						
Dose g/m2	27.4	281	*ns*	40	29.6	*ns*
SE	7.14	222.7		10.07	5.42	
Users %	71	32	*	76	26	**
Insecticide						
Dose ml/m2	4.64	2.65	*ns*	1.76	0.26	*ns*
SE	1.89	2.13		1.38	0.14	
Users %	50	26	*ns*	47	16	*ns*
Fungicide						
Dose ml/tree	14.09	5.35	*ns*	13.97	1.89	*ns*
SE	11.59	4.30		13.02	0.84	
Users %	29	16	*ns*	29	16	*ns*
Area (m^2)	587.1	352.6	*ns*	665.8	354.7	*ns*

See Table 5 for key to symbols

In vegetables, FFS farmers have decreased their fertiliser use considerably since 1996, primarily in terms of the number of users. The difference between them and the control farmers is significant in both 1996 and 1997. There is a great deal of variation among farmers in the size of their vegetable plots. Some are essentially kitchen gardens of only a few square meters. Others are larger and intended for both household consumption and sale. Together with the relatively small number of users, this variation makes it difficult to assess changes in the doses of inputs.

Table 7. Input use on maize

	1996			1997		
	Non-FFS	**FFS**	***signif***	**Non-FFS**	**FFS**	***signif***
N	6	8		7	8	
Fertilizer						
Dose kg/ac	120	84.4	*ns*	83.8	10	*ns*
SE	80	58.3		43.5	5.29	
Users %	50	38	*ns*	71	25	*ns*
Insecticide						
Dose L/ac	0	0.8	-	0.4	0	-
SE	-	-		-	-	
Users %	0	25	-	14	0	-
Fungicide						
Dose L/ac	0	0	-	0	0	-
SE	-	-		-	-	
Users %	0	0	-	0	0	-
Area (m^2)	3035	3035	-	3469	2457	-

See Table 5 for key to symbols

On maize, FFS graduates have decreased their use of fertiliser considerably since 1996, although the difference with non-FFS farmers is not significant. Few farmers employ either insecticide or fungicide on this largely subsistence crop.

Table 8. Input use on potato

	1996			1997		
	Non-FFS	**FFS**	***signif***	**Non-FFS**	**FFS**	***signif***
N	11	11		11	11	
Fertilizer						
Dose g/m2	5.57	0.012	*ns*	3.93	0.008	-
SE	2.9	0.0067		1.17		
Users %	82	27	*	82	9	**
Insecticide						
Dose l/m2	-	-		-	-	
SE						
Users %	0	0		0	0	
Fungicide						
Dose l/m2	0.142	9E-05	*	0.179	3E-04	*
SE	0.041	7E-05		0.085	9E-05	
Users %	73	36	*ns*	82	73	*ns*
Area (m^2)	1200	1163.6	-	1580	954.5	-

See Table 5 for key to symbols

The difference in fertiliser use on potato by non-FFS and FFS farmers is considerable and again reflects greater reliance on organic sources by the graduates. Few farmers use insecticide on this crop, but fungicide use is generally high, particularly to control blight. Many FFS graduates now use milk powder solutions, a practice that farmers in Wundanyi apparently introduced, in preference to fungicides like Ridomil. Several farmers claim the practice works adequately when disease pressure is low. Under heavy rain, as in the second season of 1997, many graduates say they had to supplement the milk solutions with fungicides. Hence, the number of fungicide users was comparable to that among non-FFS farmers, but the dose used was substantially lower.

Evaluations of FFSs in Asia have often found substantial reductions in the use of agrochemicals, sometimes of comparable magnitude, and sometimes in terms of several inputs (e.g. Rola at al. 1997 in the Central Philippines). What is unusual here is that farmers appear to be achieving substantial reductions in these inputs on several crops at once. Other explanations must be considered, the most plausible being that graduates were reporting what they felt they were “supposed” to. While this cannot be ruled out, it seems unlikely to account for all the effect. The reduction in input use from 1996 to 1997, which is what one would expect as graduates gain confidence in their new practices, would not likely be so clear were farmers consistently underreporting. Partial corroboration is also provided by farmers’ testimony in group discussions where the evaluation team voiced scepticism about the efficacy of some of the alternative pest control practices. The consensus among the graduates was that, while there were problems, on the whole they now had measures which allowed them to control pests when these were serious enough to warrant it.

4.5 Community level effects

4.5.1 Group processes

Over the 1.5 years since the FFS, the groups have succeeding to varying extents in influencing the management of resources and securing other benefits for their members and the wider community. First, they have served, to different degrees, as fora for discussion of management problems and options that members are considering. As Table 9 indicates, the newly-formed groups at Githunguri and Wundanyi appear to be the most effective in this respect. Members of both report that, through their groups, they have accessed new management ideas, often generated by members, which they have or would like to put into practice. The Othaya group, in contrast, no longer meets at all. It appears to have ceased functioning after the death of its charismatic leader in 1996. As will be seen below, this inability to generate new options has contributed to the apparent failure of Othaya farmers to meet technical challenges.

Table 9. Status of FFS groups in the four villages

	Othaya	**Karigu'ini**	**Githunguri**	**Wundanyi**
Still meeting?	No	Yes	Yes	Yes
How often?	--	Weekly	Weekly	Monthly
Non-graduates participate?	--	Yes	No	No
Gained new ideas to try from group?	--	75% no 25% yes	100% yes	100% yes
n (graduates interviewed)	5	4	6	5

There has been discussion in the Karigu'ini group about the need to involve more of the village in pest management: graduates there perceive that several of the pest, weed and disease problems they have to contend with originate in the mismanagement of their neighbours. Till now, however, none of the groups have yet attempted to organize collective action on any issue. We return to this point below.

Nevertheless, the groups have affected resource management practices over a wider area by serving as a source of ideas and options for other farmers. Two of the three groups still functioning report that their meetings are closed to non-members. However, diffusion from members to other farmers within the village and beyond appears to be an important means of influence. In the individual interviews, we asked farmers with whom had they discussed their experiences in the FFS and in the months following who showed genuine interest. Table 10 indicates that, on average, they shared what they had learned with 4.1 other farmers. Farmers from Othaya and Karigu'ini reported less than half as many such contacts as in Githunguri and

Wundanyi. This appears to be due to the fact that the former groups have been working with KIOF for some years. A number of FFS farmers there remarked on the resistance of some neighbours and relatives to organic practices that they perceive as being onerous and labour demanding. IPM practices were apparently seen in this light.

We followed up on a sample (21/82) of the farmers with whom the graduates had discussed their experiences (the "diffused" farmers). As Table 10 indicates, the diffused farmers reported (through free recall) more ideas that they had heard and seen than that they actually employed. Some farmers told us that they have not yet had time to put some of the ideas into practice. Farmers who had been in contact with graduates from Othaya and Karigu'ini picked up and used fewer ideas than did those in contact with Githunguri and Wundanyi graduates, but these differences are not statistically significant.

Table 10. Diffusion of IPM ideas (principles and practices) by Farmer Field School graduates

From graduates in :	**No. of farmers who showed real interest (*diffused* farmers)**	**No. of ideas *diffused* farmers picked up**	**No. of ideas *diffused* farmers implemented**
Othaya and Karigui'ini (former KIOF groups) (n=9)	2.44 ± 0.38	2.60 ± 0.22	1.20 ± 0.36
Wundanyi and Githunguri (new groups) (n=11)	5.45 ± 0.31 **	3.55 ± 0.58 ns	1.54 ± 0.34 ns

Significance of differences in a column:
** $P<0.01$
ns $P>0.05$

An aspect of some concern is the extent to which IPM principles, as distinct from specific management practices, diffuse from graduates to other farmers. IPM principles include agroecosystem analysis and examining whether an organism is a friend (predator or parasite of pests) or an enemy (plant feeder) through the use of an "insect zoo". The information available is ambiguous. The diffused farmers employ agroecosystem analysis less frequently than do the graduates on their coffee or vegetables. On the other hand, they appear to make greater use of the "zoo". However, neither of these differences is statistically significant.

In a later section, we return to consider social aspects of the diffusion process, notably the degree to which ideas pass between men and women, and between age classes.

4.6 The dynamics of IPM practices

The preceding sections have indicated that different practices are being taken up and used by graduates, then modified, abandoned and diffused to varying extents in different situations. What is the overall effect of these actions? To analyse the dynamics of IPM practices, we employ a simple demographic model (for an application of this approach in the context of varietal innovation, see Sperling and Loevinsohn 1993). We treat each FFS graduate who implements a given practice as one individual in a population. That individual may "die", because at some point the farmer decides the practice is no better than what he or she had before, or than some alternative, and abandons it. Individuals also "give birth" by diffusing the practice to other farmers, near or far. Birth and death rates can then be calculated on a seasonal or yearly basis and entered into a projection matrix. From this, we can extrapolate the number of farmers using the practice at some point in the future. At the moment, we have information on only the first 1.5 years after the FFS and our projections must be interpreted with caution: they assume that practitioners continue to be born and die at the same, initial rates. Clearly, this cannot be true indefinitely, if only because diffusion must eventually saturate the pool of potential practitioners. Follow-up visits will be needed to get an accurate idea of longer term trends in the use of practices. Nevertheless, the demographic approach provides a useful picture of the early fate of practices, whether they are likely to expand in the near future, or whether they are headed for local extinction.

For a practice to survive in a farmer's hands, she may have to modify it to meet her specific and changing needs and conditions. As suggested earlier, farmers' ability to modify practices and select better performing alternatives, is at the heart of agricultural adaptation. To assess the extent of modification of a practice, one has to step outside the birth-death demographic framework, to consider the diversity of types in which it is found (when a modification should be considered a novel practice in its own right is to some extent an arbitrary decision). One can attempt to classify the practices that farmers use and then apply one of the common diversity indices. In the current context, however, we used a simpler approach, relying on the diversity of sources that farmers cited for the practices they use.

Figure 2A illustrates the projected use pattern of improved coffee pruning, one of the most popular of the crop management practices that farmers were exposed to in the FFS. There has been as yet limited abandonment of the practice and slow but significant diffusion. On the basis of these initial results, the practice is expected to spread.

Figure 2. Dynamics of improved coffee pruning practices in the FFS communities. A. Projected use based on birth and death rates calculated from interviews with FFS graduates. B. Sources of innovation in coffee pruning cited by the graduates.

A. **B.**

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When we asked farmers the origin of their innovation, we found little variation (Figure 2B). All responded that the idea originated in the FFS, or in one case from extension. On the face of it, improved pruning appears ready to follow a classic adoption process (Rogers 1983). The practice, developed elsewhere, is being taken up with little evidence of modification or further experimentation (although farmers did have a chance to examine the practice in the FFS plot in 1996).

A number of other soil and crop management practices appear to be following similar patterns. The use of manure and plant compost is popular and shows little evidence of modification and only a limited amount of innovation coming from sources other than the FFS, such as farmers' own ideas. The caveat noted earlier should be remembered: some farmers are reticent to admit that they modify or replace practices learned in the FFS. Cross-cutting questions and close observations of field practices sometimes reveal further innovation.

The pattern is different for many of the non-chemical pest management practices. As mentioned earlier, farmers have encountered a number of problems, including lack of efficacy under some field conditions and labour constraints. Figure 3A indicates that botanical pesticide practices are, on current trends, likely to evolve differently in the tea and non-tea growing areas. In the latter (Githunguri, Wundanyi and Karigu'ini), diffusion is outstripping abandonment and the practice (more accurately suite of practices) is set to spread. The sources of farmers' innovations are diverse (Figure 3B): some use what they tried in the FFS, others have modified these options (a few significantly), some use their own ideas, while others have taken up ideas of other farmers.

Figure 3. Dynamics of botanical pesticide innovations on vegetables in the FFS communities. A. Projected use based on birth and death rates calculated from interviews with FFS graduates. B. Sources of innovation in botanical pesticides cited by the graduates.

A. **B.**

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The situation in the tea growing area (Othaya) contrasts starkly. Here, the demands on family and especially women's labor are much greater. Several women told us that they don't have time to collect plants and prepare the pesticides, largely because of the time needed for harvesting tea. This is reflected in a high rate of abandonment of the practice. As the model shows, the practice is set to die out if present trends continue. We see from the source of innovation analysis that there are fewer graduates who innovate with botanical pesticides than in the non-tea areas and that all of these take their ideas unmodified from what they learned in the field school.

There are other differences between the tea and non-tea areas. An important one is that, as mentioned earlier, the FFS group is no longer meeting in Othaya and does not serve as a forum to discuss ideas and practices, as it does elsewhere. Even were different farmers trying different variants, an important point of exchange of information on their performance is absent, slowing the technical evolution that the graduates, and those in contact with them can realize.

Farmers, particularly women farmers, in the tea zone, do not appear to have ideas and options within their reach that meet their needs in terms of vegetable pest management. Other households that experience labour scarcity for other reasons may find themselves in a similar situation. Biological control practices, using natural enemy release and augmentation, which are less onerous in the time needed for preparation and use, might help to overcome the labor scarcity. So possibly might extraction and formulation techniques for botanical pesticides that extend their shelf life, thus permitting farmers to prepare them when they have time. Extension workers are not able to suggest or provide access to such options. Farmers in this situation need to be in direct contact with researchers, and researchers working on such problems would benefit greatly from working with these farmers.

5. Impact on capacity at household and community levels

The forgoing discussion has revealed a good deal about the effect of the FFS on graduates' ability to "make better decisions on a continuing basis, and to do so in situations beyond that in which the FFS took place":

- Graduates have applied principles and practices to crops (e.g. maize and potato) other than those which had been treated in the FFS (some report that they have also tried them against tics on their livestock);

- Graduates have, in at least in some of the sites, modified practices they learned in the FFS which were not performing well (e.g. botanical and cultural/physical pest control measures);

- Graduates have shown and explained practices and principles to a substantial number of other farmers.

It would be a mistake to hold the FFS responsible for all these effects. Farmers were by no means "blank slates". The trainers, for example, could have done no more than encourage graduates to discuss their experiences with others. The dedication with which some have evidently gone about this task (e.g. the Wundanyi farmer who actively taught three others in his field; the Githunguri farmers who, together, organized a training session for another women's group) springs from deeper sources. Likewise the curiosity that impels farmers to generalize what they learn to other crops and to livestock. The most that can be said is that the FFS provided new material and ideas that farmers found useful, that it encouraged wider use and that, by working through groups, it buttressed farmers' continuing adaptation of practices and principles.

The ability of the groups to continue to serve as a support to farmers is unclear. In the time available, we were not able to get a clear idea of their dynamics. It seems unlikely that functioning as a forum for exchange of farming ideas will be enough to maintain active participation for long, if there is not a continuing input of new material to work on, from whatever source. The extension system has yet to provide that: till now, there has been no systematic follow-up to the FFS. Some of the groups have branched out in new directions, for example running a rotating credit scheme that draws on members' own savings, in Githunguri (the Wundanyi group is considering something similar). Such multiple functions may be critical to their survival.

Several members of the Othaya group had very clear ideas about what they need to do together. They can get nowhere, they said, at their present level of exploitation. Through the group, they saw possibilities of accessing water pumping technology that would help them produce vegetables out of season when they can sell at a higher price. Farmers in Karigu'ini and Wundanyi expressed similar ideas. The Othaya graduates also thought that if enough farmers collaborated in marketing, they could negotiate arrangements with merchants in the larger urban markets. Local consumers recognize the quality of their produce (taste and appearance were said to be more important than the reduced risk from pesticide residues), but they are not prepared to pay a higher price.

The master trainers put the Othaya farmers in touch with NGOs that are extending simple pump technology. As yet, there has been no substantive result from these contacts. As regards marketing issues, it appears that in general these have not figured in the FFSs' curriculum. Arguably, the reputation of the groups' produce for quality can be thought of as a common property that can be managed intelligently for the benefit of its members. There are as yet few ready made opportunities for Kenyan farmers to do so, but the ability to recognize and act on them is a capacity that future FFSs should not neglect. In developed country agriculture, the premium that organic markets have paid has been an important incentive for farmers thinking about switching from conventional to IPM techniques.

5.1 Farmer experimentation and farmers' ideas

In considering the project's impact on farmers' capacity to manage their resources, an area of concern is the extent to which the FFSs succeeded in encouraging experimentation. Some farmers told us that they found it difficult to use botanical pesticides because they did not know the effective dose and the trainers could not tell them. Other farmers saw this as something they themselves could easily overcome. A dosage trial could readily be organized, they said. There is clearly a range of competence and confidence in experimentation among farmers. The same could be said of the trainers. Some told us (see further below) in almost identical words to the farmers that they did not know what the effective dose is and that they should have been told by the master trainers or researchers. Clearly, the message-based extension approach is still well entrenched, as is the expectation among some farmers that someone else can provide them the answer to their farming problems.

Related to the capacity to experiment is the value given, by farmers and those who work with them, to farmers' own ideas and the technical options they envisage. In principle, the experiments conducted in the FFSs included treatments suggested by both the trainers, based on the wider experience they were exposed to in the Training of Trainers course, and the farmers. Testing and trying options, taking nothing on faith, is one of the values that the FFS attempts to convey. In practice, it is not evident that all options, local and exotic, are implicitly or explicitly accorded equal weight.

Table 11 provides some tentative evidence that farmers' ideas may be devalued in the FFSs and that farmers may have internalized this. It will be remembered that innovation was, in all crops considered, much greater among FFS graduates than the control farmers (Figure 1). However, if one considers only the innovations that farmers said came from their own ideas, the situation is reversed.

Table 11. Innovations by FFS graduates and control farmers that were said to originate from their own ideas, 1996-97. (Number/farmer)

	Non-FFS Farmers	FFS Graduates
Coffee	0.83	0.25
Vegetables	0.61	0.58
Maize and Potato	0.76	0.32

There may well be more innovation from local sources than farmers told us about in the interviews. It is commonly noted that farmers do not share readily all their inventions, neither with each other nor with outsiders. But that the graduates appear to be less willing to speak of them than the control farmers is cause for concern. That said, at least one alternative explanation must be considered, namely that graduates were already occupied in 1996-97 with so many new ideas coming from the outside that they did not have time to work on their own. Further evaluation, after farmers have had a chance to work through the new ideas, will be needed to clarify whether the FFSs have had any real and lasting effect on farmers' inventiveness.

5.2 Other indicators of change in farmers' capacity

As noted earlier, we posed two hypothetical but realistic questions during the individual questionnaires:

1. A company salesman was recently in [a nearby village] promoting a new pesticide which he says kills [local name for the diamond-back moth] better than Karate. What would be your reaction if he brings the same message here?

2. What would you do if, next season, you found an insect you hadn't seen before eating the leaves of your maize crop?

The answers to these open-ended questions were assessed in terms of the extent to which they indicated (i) a reliance on farmers' own resources, (ii) the application of IPM principles, and (iii) a reliance on group members or other farmers. As Figure 4 illustrates, the FFS graduates scored much higher than the control farmers on the first two indices (both differences are statistically significant). Hardly any difference was found between the two groups in relation to the third index (not illustrated). To an extent, the result in relation to (i) suggests that devaluation of farmers' ideas if it occurred, has had limited effect.

Figure 4. Scores of FFS graduates and control farmers on hypothetical questions designed to test capacity to apply IPM principles independently.
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On balance, and taking note of the above concerns, we believe there is evidence that the FFSs have had a real and positive effect on farmers' capacity to manage their resources.

6. Social, environmental and economic impacts at the household and community levels

6.1 Impact on intra-household dynamics

In Kenya, men and women have different tasks within the household - although traditional divisions appear to be eroding[1]. Often husbands and wives will sit down together and plan, but usually it is the man who has greater say in the decisions made. Women can take decisions, but usually need the approval of their husbands. But while the traditional divisions of tasks and decision-making may be changing, rights are not. The family of the husband (especially in the case of young farmers) or the husband himself usually has title to the land. Cows are also often the property of men - although women may sometimes decide on their management and on how income from them will be spent. Coffee - another major cash earner - is also usually in the man's hands (or his family in case of young farmers) although the woman will often work in the crop (e.g. in weeding). In contrast, the income from vegetables and maize are usually in the hands of women - who will also do most of the work.

In Githunguri, gender aspects were studied in greater in-depth than in the other sites. Githunguri is a very densely populated area near Nairobi, where the men often work off-farm. Children are usually in school and help out on the farm during weekends. This leaves the women in charge of day-to-day farm operations.

Joining a farmers' group may have several advantages, although men and women join different farmer groups and for different reasons. The women who joined *Thayu* (the FFS group in Githunguri) say they wanted to learn new things, but being in a women's group also had other benefits. As one women remarked "Being in a group will assist me in doing things" or as another put it: "Being alone I cannot do things". One advantage that many point to are the financial opportunities. An example of this is the rotating credit fund ("merry-go-round") from which the women can buy utensils. Some women also mentioned that they can seek support from other members in times of need.

Men usually join the coffee co-operative, and sometimes the dairy co-operative as well. Women, who generally do not own coffee are therefore usually not members of the coffee co-operative - unless widowed. They are sometimes members of the dairy co-operative. The important benefit of membership in these co-operatives is that the income (i.e. from coffee or milk) is in one's hands. Most co-operatives also have a credit facility, for which only members are eligible.

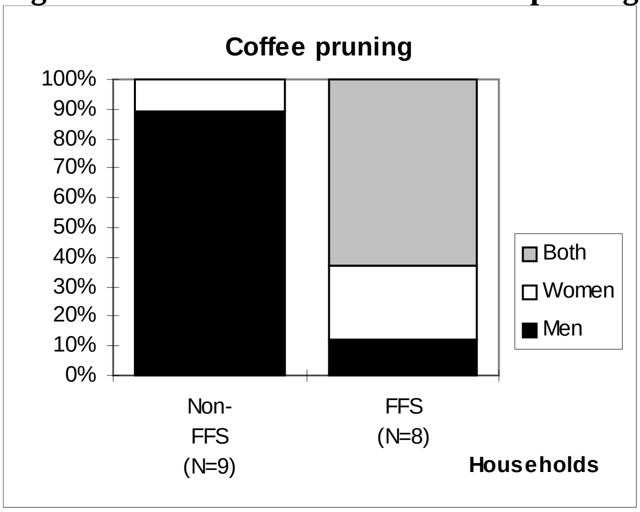
[1] In Wundanyi, one (woman) farmer commented on the notion of "men's" and "women's" crops: "That was so before. The division of tasks is more equal now. Anyone can do anything."

The fact that most men are members of the coffee co-operative, means that they generally have greater financial means and say in financial decisions. However, men do consult their wives on how to spend the money. Often, the largest part is spent on the children's education.

When FFS graduates were asked why women should be trained in coffee, considering that it is a man's crop, one woman replied indignantly that: "Coffee is also mine - because I work in it". However, when asked who decides on the income from coffee, she admitted it was her husband. The fact that women do the work in coffee while the husbands get the money is not necessarily a problem. Another female farmer said that "I am the one who does the work [in coffee], but for me there is no difference who officially gets the money - we decide together on how to spend it".

Women taught in IPM and other crop management practices for coffee have gained in knowledge and skills (Figure 5). This has given them more leverage in decision making in the management of the crop. However, the ownership of coffee (title deeds to the land, membership of the coffee co-operative and therefore income from coffee) remains firmly in the hands of their husbands.

Figure 5. Gender division of labour in pruning coffee in Githunguri



NB includes family labour as well as hired labour

6.1.1 Evenness of diffusion

Diffusion of IPM principles and practices by FFS graduates outside the household appears to be fairly gender specific. Although male and female graduates reported roughly equal numbers of interactions in which the other farmer showed "real interest" (Figure 6), men were found to diffuse primarily to men and women to women. In theory, this could lead to very unequal benefits going to men and women farmers unless care is taken to ensure equal representation in the FFSs. In practice, much will depend on the extent to which knowledge is shared within the household. If, as some farmers claim, this process is efficient, in both directions, then it will not matter so much whether it is the husband or the wife who participates in the FFS, at least as far as the application of management practices is concerned. Not all concur on this and we heard of cases where new ideas met resistance within the household. Furthermore, as suggested above, women's contribution to decision making and their standing within the household may well be affected by their attending the

Field School. And of course women heads of households will need to be involved directly if they are to be reached.

Figure 6. Number of farmers contacted by FFS graduates who showed "real interest" in their innovations

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The spread of knowledge may be more problematic in terms of another social dimension: age. Younger farmers were not well represented in the FFSs. Our sample of 20 graduates included only one under 30 years. Furthermore, neither men nor women graduates reached out much to the young: farmers under 30 years comprised only 10% of the "diffused" group. Again the ease with which knowledge flows within households and families will determine the extent to which young farmers indeed lose out. When interviewed, the women graduates of Githunguri did not cite their children as persons they had diffused to. However, in subsequent informal conversation it came out that many in fact had, especially to their sons who were to take over the farm or who had started their own farm.

Follow-up evaluations should pay attention to the efficiency of these intra-household flows of information.

6.2 Environmental impacts

Reduced health risks A single indicator of pesticide-related health effects was assessed. In the individual interviews, farmers were asked about the number of days of work they had lost due to illness that they attributed to pesticide poisoning. Although many reported days lost in previous years, only two non-FFS farmers reported a total of 5 days lost in 1996-97, compared to one FFS graduate (2 days). The difference is of course not statistically significant. However, over a wider area and a longer time, reductions in pesticide use of the magnitude found here (Tables 5-8) would be expected to yield substantial benefits in terms of chronic and acute illness (Rola and Pingali 1993; Kishi et al. 1995).

Improved soil productivity All FFS graduates (20/20) reported that their soils had improved in quality over the past two years. In support, they cited a range of indicators, including increased abundance of certain indicator plants and improved soil texture. In comparison, only 45% (10/22) of control farmers thought their soils had improved. Some graduates cited specific benefits e.g. better tolerance of mid-season droughts from improved moisture retention. We did not attempt to assign a value to these benefits.

6.3 Economic impact

6.3.1 Savings on agrochemicals

At all sites, the clearest benefit that FFS graduates realized relative to control farmers was the savings from reduced use of fertilizers and pesticides. These are presented by crop in Table 12.

Table 12. Savings on agrochemicals by FFS graduates, 1997. All villages.

Crop	Ksh saved	
	Per tree or m^2	Per household
Coffee	14.43	4803
Kales or cabbage	4.19	1052
Maize	0.27	951
Potato	1.86	1830

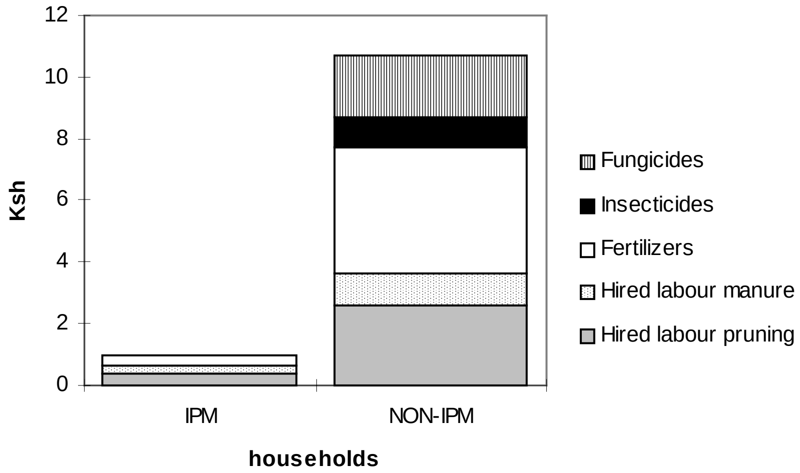
6.3.2 Changes in labour use

In-depth interviews in Githunguri suggested that FFS graduates hired less labour for pruning and other crop management tasks on coffee than did non-FFS farmers. FSS farmers spent on average 0.66 Ksh per tree on hired labour and non-FFS farmers 3.62 Ksh per tree. The explanation given by the graduates was that they wanted the IPM techniques to be implemented well, and did not trust hired labour to do so. Hired labour on vegetables was difficult to compare in Githunguri because the FFS farmers in the sample had considerably smaller vegetable plots than non-FFS farmers (18 m^2 against 404 m^2).

In general IPM seems to require more labour than conventional practices. Making compost manure (reportedly around 2 hours per week or 4 days per season), doing an AESA (typically every day, but usually integrated with other farming activities), preparing and spraying IPM pesticides (usually 1-2 hours) all require more time and closer attention than usual. It seems that many non-FFS farmers are unwilling to practise IPM because they perceive it to be "too much work". However, the farmers in Githunguri do not seem to mind that extra burden. They say it brings them benefits as well, and the extra time invested in IPM is not at the expense of any other activity. They claim that the FFS has made them better at time management, that they've become more efficient. If this is true then there is good reason to assume that for these farmers the opportunity cost of the extra work involved in IPM is low. Similar sentiments were expressed in Karigu'ini and Wundanyi in individual and group discussions. However, the situation is different in Othaya. As noted above, many farmers there are involved in tea cultivation, which requires constant attention (especially in plucking), leaving little flexibility in organising activities. IPM techniques therefore will be at the expense of some other activity and in this case, the opportunity costs may be substantial.

Although hired labour does constitute a considerable cash expense (Figure 6 for coffee in Githunguri), it has not been included in the financial analysis. One reason is the lack of data for all four villages. Another is that FFS farmers appear to be substituting their own labour for hired labour, and may be putting more of their time into crop management than non FFS farmers. The value attached to this extra time depends, as we have seen, on site and likely household-specific factors. The testimony of Othaya farmers suggests that the costs farmers attach to this time may in some cases be substantial and that it may influence their decisions on the use of IPM practices.

Figure 6. Cash expenses per coffee tree (in Ksh) for IPM and non-IPM farm households in Githunguri



number of trees per household: FFS 420, non FFS: 490.

6.3.3 Purchase of vegetable seeds

Although graduates spent less on chemical inputs than non-FFS farmers, at least in Githunguri, they spent more on vegetable seeds, on an area basis. However, because of the big difference in plot sizes, they ended up spending less in total. Graduates on average spent 2.43 Ksh per m^2 and 48 Ksh per household on seeds, while non-FFS farmers spent around 0.63 Ksh per m^2 and Ksh 115 per household. FFS farmers used better quality and higher priced seeds than non-FFS farmers. Some Githunguri farmers reported that cash for buying improved seeds was already a constraint; it would evidently be even more so were graduates to increase their plot sizes. We did not include seed expense in the financial analysis because comparable data were not available for the other villages and because the absolute value of the expense was on average quite small.

6.3.4 Effect on crop yields

There is evidence that FFS graduates had higher coffee yields than non FFS farmers. In 1997, across the four villages, the harvest up to the time of the interviews in November/ December was on average 2.4 times higher for FFS farmers, although the difference is not statistically significant (Table 13). More detailed results from Githunguri, including farmers' expectation of additional harvest in 1997 and their reported yield for 1996, the year of the FFS, confirm the pattern (Table 14).

Table13. Coffee yields in 1997 (until interview in December) for FFS and non FFS farmers in four villages. Standard errors in parentheses.

	Harvested (kg/tree)
Non-FFS farmers (N=9)	0.43 *(0.13)*
FFS farmers (N=11)	1.05 *(0.35)*

Table 14. Coffee yields for FFS and non FFS farmers in Githunguri: 1996 (complete) and 1997 (harvested until interview and farmers' expectation for rest of harvest)

Yields coffee (kg)	**1997**		**1996**
	Kg per tree		**Kg per tree**
	actual until interview	**actual + expected**	**Actual**
FFS farmers (N=6)	0.73 *(0.12)*	1.45 *(0.29)*	5.22 *(1.04)*
Non-FFS farmers (N=4)	0.50 (0.17)	1.13 *(0.31)*	3.20 *(1.40)*

Certainly, farmers perceive that they are getting higher yields with IPM. It is this perception that is behind the renewed interest shown by many in a crop that they had practically abandoned. This sense is confirmed by the results from the FFS trials. Yields for the IPM plot were 0.34 kg/tree, compared to 0.17 kg/tree for the farmer's plot (pers. comm. IIBC, 1997).

For vegetables it was difficult to assess the yields, as farmers harvest throughout the season and do not keep records. However, several farmers mentioned that they were convinced yields had increased due to improved management practices (e.g. the use of improved seeds). In Githunguri for instance, many farmers are now able to sell vegetables which they were not able to do before the FFS.

6.3.5 Other benefits

Among the benefits that we have not included in the financial analysis are:

- Savings from reduced pesticide use in other crops, e.g. tomatoes.

- Yield increase in crops other than coffee. Several farmers mentioned higher yields from improved use and preparation of compost and manure. As already mentioned, a number noted better tolerance of mid-season droughts.

6.2.6 Financial analysis

A conservative or pessimistic estimate of the financial benefit to each FFS graduate takes into account only the savings realized from reduced application of agrochemicals. It assumes that these benefits last for only three years - i.e. that farmers will then go back to their former reliance on chemical inputs. A more optimistic, but still plausible estimate assumes that benefits will last 7 years and that these include a coffee yield increase of 0.61 kg per tree (the difference in actual coffee harvests in 1997, up until the interviews, between control farmers and graduates). The annual benefits and NPV (net present value), using a discount rate of 12% and the crop areas given in Table A1, are shown in Table 15.

Table 15. Financial benefits and NPV of IPM per household (Ksh)

Pessimistic scenario		**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 6**	**Year 7**
Input savings coffee		3602	3602	3602				
Yield increase coffee		0	0	0	0	0	0	0
Input savings kales		999	999	999	0	0	0	0
Input savings maize		523	523	523	0	0	0	0
Input savings potatoes		732	732	732	0	0	0	0
Total Yearly Net benefits		**5857**	**5857**	**5857**	**0**	**0**	**0**	**0**
NPV	**14,067**							
Optimistic scenario		**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 6**	**Year 7**
Input savings coffee		3602	3602	3602	3602	3602	3602	3602
Yield increase coffee		3058	3058	3058	3058	3058	3058	3058
Input savings kales		999	999	999	999	999	999	999
Input savings maize		523	523	523	523	523	523	523
Input savings potatoes		732	732	732	732	732	732	732
Total Yearly Net benefits		**8915**	**8915**	**8915**	**8915**	**8915**	**8915**	**8915**
NPV	**40,684**							

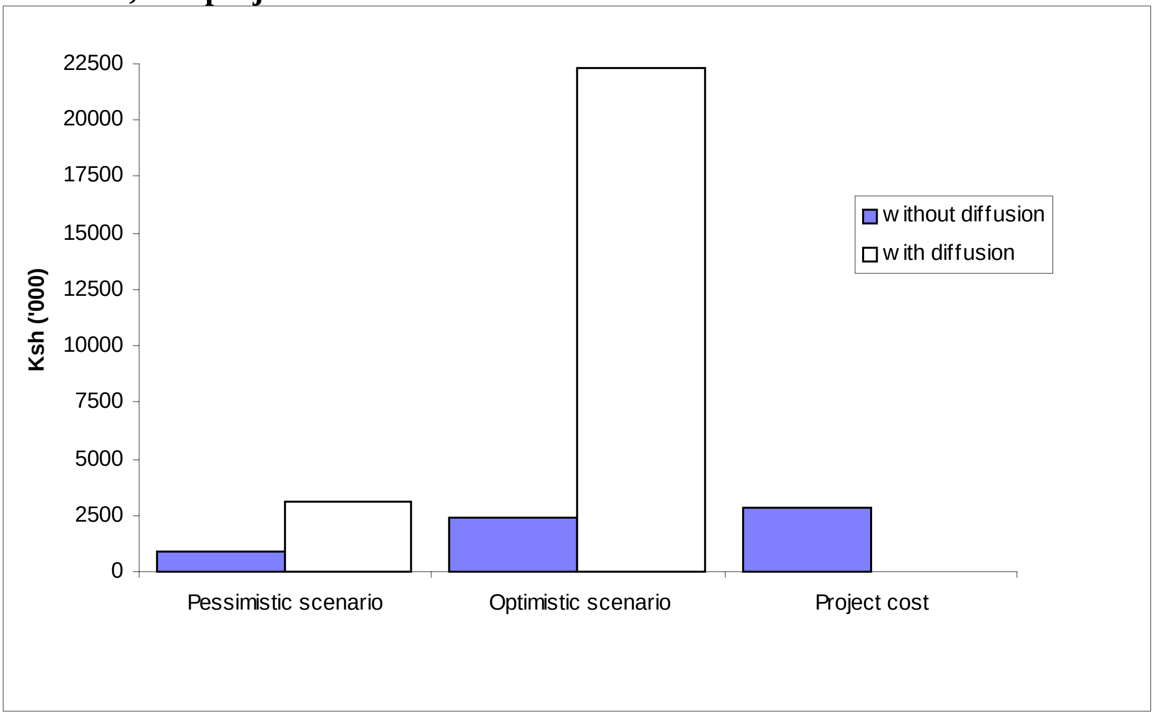
7. Economic impacts at the project level

To estimate benefits at the project level, we take the household level benefits and multiply by the number of graduates (65). We also take account of the active diffusion of principles and practices by the graduates. In the pessimistic scenario, we assume that in the absence of the prior intervention by KIOF, all farmers would diffuse at the rate of the newly formed groups in Wundanyi and Githunguri (i.e. to 5.5 farmers in 1.5 years), to only this number and no more. Further it is assumed that the "diffused" farmers realize benefits only 43% as great as the graduates. This figure is derived from the ratio of ideas diffused farmers reported they had actually used to the average number of planned innovations in coffee and vegetables by graduates. Thus, with the effect of diffusion included, benefits are increased by a further 2.37 times (5.5 x 0.43) above the without-diffusion case.

The optimistic scenario assumes that graduates have diffused to 2/3 of those they will eventually reach, i.e. that they will in total contact 8.25 (5.5/0.67) farmers. Further, it assumes that diffused farmers will implement all the ideas they have picked up from the graduates (3.55), which is almost exactly equal to the average number of planned innovations in coffee and vegetables by graduates, so that their benefits will equal those realized by the graduates. Thus, in the optimistic scenario, diffusion raises benefits by a further 8.25 times. Note that neither scenario assumes that there will be any secondary diffusion, nor that diffusion can happen other than through farmers who talked with the graduates and showed "real interest" in their innovations. These are conservative assumptions.

Figures 7 illustrates the net present value of the benefits estimated under the pessimistic and optimistic scenarios. When diffusion is included, these benefits total KSh 3.1 million and 22.4 million respectively. Detailed calculations are shown in the Annexe.

Figure 7. Net present value of the IPM project under pessimistic and optimistic scenarios, and project cost.



7.1 Cost-effectiveness projections

There were three major activities which incurred costs during the IPM/FFS Pilot Project. They are the Participatory Rural Appraisal (PRA), the Training of Trainers (TOT) course which was held in two sessions, and the FFSs, which were also in two parts. The total cost for these activities, including overhead on IIBC staff, was Ksh 2.81 million (Figure 13). The details of these calculations are given in the Annexe.

With these costs, the pessimistic scenario including diffusion would produce a cost-effectiveness ratio of 1.1 (Ksh 3.08 million / Ksh 2.81 million). The optimistic scenario would yield 8.0 (Ksh 22.36 million / Ksh 2.81 million).

In the Philippines and other Asian countries with national rice IPM programs, it is common that a trainer facilitates two FFSs per year, working generally in teams of two. If the 11 trainers trained in the project worked at this rate, and if the costs and benefits of these FFSs were the same as those done within the project, the cost-effectiveness ratio for the project plus one additional year would be 2.2 and 15.8 under the pessimistic and optimistic scenarios respectively, with diffusion. Were they to do only one FFS in the following year, the cost-effectiveness ratios would then be 1.9 and 14.0 respectively.

The detailed calculations are presented in the Annexe. In assessing these calculations a number of caveats need to be borne in mind. Among these are that the trainers worked during the Field

Schools under the regular supervision of the Master Trainers. This supervision would of necessity be less intensive as the number of Field Schools underway is multiplied. The as yet untested assumptions about the benefits "diffused" farmers realize are also critical to the calculated C:E ratios. Taking these cautions into account, the analyses suggest that, on fairly conservative assumptions, the project's investment would be justified on private benefits alone and in a relatively brief time frame.

8. IMPACT AND PROSPECTS WITHIN PARTNER INSTITUTIONS

8.1 Impact and Prospects within the Ministry of Agriculture

8.1.1 Impact and Prospects at the trainer level

a) Training and its impact on Farmer Trainer capacity

The general view among the Farmer Trainers we interviewed was that the Training of Trainers (TOT) course was too short. As a result, the time allowed for practical training in FFSs was insufficient and the Trainers did not feel confident enough to run similar FFS on coffee and vegetables on their own, without support. Further training, they felt, would be required to deal with other crops which were not covered. A particular gap that was highlighted was the need for additional tools to help make concepts come alive to farmers, as do the insect zoo and Agroecosystem Analysis.

Several trainers remarked on the dissonance between the concepts they were expected to employ in the Farmer Field School and those they used in their extension service. In terms of content, trainers noted that synthetic pesticides had been the first and in most cases the only solution put forward for pest problems, but in the IPM project they were generally considered the last option. In terms of approach, rather than passing messages, as in the normal extension model, the IPM approach obliged them to listen to farmers first and solicit their ideas. The concept of farmer experimentation was new to all the trainers interviewed. In the FFSs, farmers experimented, for example, on a variety of methods for nursery bed preparation. Different groups used different methods.

It was clear that some trainers found this move easier to make than others. As mentioned earlier, finding an effective dose for various botanical pesticide preparations was a problem for some farmers. One trainer threw up his hands when we asked about this. "We weren't told by the Master Trainers. How can we respond to the farmers?". Others seemed to have a more intuitive feel for how to go about encouraging farmer experimentation. One described what happened in the FFS when a chili-based extract failed to perform adequately against aphids.
"Did it affect your standing with the farmers?" we asked.
"No", he replied. "We hadn't told them to use it, only to test it. 'How can we improve on it?' I asked them. The farmers suggested a <u>Tethonia</u> extract, which they then tried. It did better."

Some of the testimony from farmers during the individual and group interviews bears on these issues of trainer confidence and how they resolved the dissonance of conventional and IPM concepts. In one village, the trainer was said to have insisted that the FFS include a tomato trial, as in the TOT, even though farmers tried to tell him it was not the season for

planting tomato. In another village, graduates told us the options to be tested in the FFS experiments, those suggested by the farmers and those by the technicians, got less than an equal hearing. "How could they teach organic methods when they had for so long promoted chemicals?" one woman asked.
"But was it a question of teaching you the methods?" we replied. "Didn't the trainers lay them out and allow you to test them, and then choose"?
"No, they didn't".

But there have also been more positive outcomes. A number of the Farmer Trainers have tried to use elements of the FFS approach, on their own initiative and without encouragement, in their extension work since the FFS. They have been limited in how far they can go by the lack of time (the current extension approach requires Front-line Extension Workers (FEWs) to meet 3-4 groups in a day) and by the lack of material (transport and allowances) and technical support.

Deep-seated attitudes and behaviours cannot be expected to change as a result of a single TOT and one season's FFS. Yet the Farmer Trainers appeared to be genuinely impressed by the FFS approach and by the enthusiasm it generated among the farmers. They appreciated the closer relationship it fosters between extension staff and farmers, and, through the FFS, appear to have gained a greater respect for farmer knowledge and what they can learn from it. Several of the Farmer Trainers say that, since the FFS, they cannot pass an insect without looking more closely to see whether it is a pest or a natural enemy.

b) Institutional support

All the Farmer Trainers report that they received good supervision and support from the IPM Master Trainers during the FFSs. The Farmer Trainers found this very helpful, because any pressing questions they might have could be discussed during these regular visits. The supervision was an encouragement not only to the trainers but also to the farmers.

Support and supervision from the Farmer Trainers' superiors in the MOALDM varied by individual and was in some cases problematic. At least to a certain extent, this is a result of the manner in which the project sought to involve institutional actors above the field level.

8.1.2 Impact and prospects at the divisional and district levels

The trainers' superiors within MOALDM included the Divisional Agricultural Extension Officer (DAEO), and the District Agricultural Officer (DAO). The IPM project had requested their assistance in selecting and making available Front-line Extension Workers (FEWs) to serve as Farmer Trainers and it attempted to keep them informed of its activities. But DAOs and DAEOs had little direct role in organizing, running or evaluating the FFSs. It is perhaps not surprising then that some of the Farmer Trainers told us that their superiors did not understand the project and that some had quite negative feelings about what they were doing. However, this was by no means always the case. One DAEO in particular made a concerted effort to attend the FFS and brought along other FEWs. Some Farmer Trainers said they had been requested by their DAO to teach the FFS approach to other staff in the district, despite their limited experience. And in one case, a FEW who was having trouble in his relations with farmers was told by the DAO to talk with one of the IPM Farmer Trainers.

Our interviews of the Farmer Trainers' immediate superiors at the divisional and district levels confirmed that understanding of the IPM project and the FFS approach was spotty. The most informed were the district Monitoring and Evaluation Officers who had taken part in the internal evaluation in early 1997. However, from the limited knowledge district and the divisional staff had of the project, they generally thought it a good approach. One aspect frequently mentioned was the FFS's focus on solving problems as they appear in the field. The notion of farmer experimentation was less understood and appreciated, but several officers thought it possible to integrate this within the extension program if there is adequate support from research. The group-based approach of the FFS was also seen to be consistent with trends in extension practice in Kenya, which have up to now been largely based on the T&V approach. Recent changes have put less emphasis on passing messages through progressive "contact farmers" and more on working with groups. However, downsizing in the Extension Division has obliged FEWs to work with several groups each day. Without a rethinking of how extension personnel are deployed and their efforts focused, it is hard to see how an intensive group-based approach like the FFS can be generalized.

In discussing the "fit" of the FFS approach with evolving extension practice and philosophy, one example that was brought up several times was the Soil and Water Conservation (SWC) Program. Like the FFS, it is participatory in nature and works with groups, in this case organized on a catchment basis. Extension staff say that they cannot meet the demand from new groups that want to work with them on soil and water conservation. They feel the main reason for the apparent success of this program is that farmers can readily see both the need for and the fruits of collaboration. They say it is important that farmers identify their felt needs through a Participatory Rural Appraisal (PRA) or similar means. KARI is supporting the SWC project through research aimed at the development of sustainable land use systems which broadly includes productive land use and conservation of natural resources.

The staff we interviewed suggested several measures to improve the involvement of district and divisional personnel in an expanded program. Among these was a one day seminar at the launch of activities in a district which would bring together the DAO and the district Subject Matter Specialists, giving them a chance to discuss the program in detail. At the end of the seminar, one or two district staff should be made responsible for regular monitoring and supervision of the Framer Trainers. During the Training of Trainers, the DAEO should be involved to some extent, so that he/she can provide more effective supervision. Where possible, some topics taken up in the TOTs should be handled by the district staff, acting as resource persons.

Contrary to what is indicated in some of the project reports i.e. that there was lack of interest among supervisory personnel in MOALDM, our impression is that staff, at both district and division levels, were generally very interested when they learned what the project was attempting. Most, however, had been kept in the dark. We support the sentiment several officers expressed that the Farmer Trainers will take their work more seriously if their immediate seniors are well informed and directly involved. Certainly, contradictory signals from Master Trainers and local supervisors would then be minimized. Fostering the skills and attitudes within the extension bureaucracy that are needed in order to make effective use of participatory approaches will require a concerted effort.

8.1.3 Impact and prospects at provincial and national levels

Most staff at the province and at Ministry headquarters had little direct knowledge of the project. The Provincial Director of Agriculture (PDA) Central only received a copy of the evaluation done at the end of the project. None of the officers we spoke with in Nairobi had visited the project, although some had heard of it in meetings. There was a greater awareness of the KAFPROD FFS project in Western Kenya. However, no one had had direct experience of a FFS.

When we explained to those who did not know much about the IPM project what it had done and how it had worked, there was generally interest and a recognition of the importance of the approach. One officer told us that little of the knowledge on IPM for crops other than coffee and vegetables has been tested yet with farmers. There was a need for similar efforts as had been mounted in the FFS for other problem topics, such as Striga management. Another senior officer thought it important that the approach be extended beyond the high potential zones of the highlands.

The question of the scope and priorities for an eventually expanded IPM program, building on the experience of the pilot project, was discussed with several officers. The consensus was that a program that focuses only on the cash crops that a limited number of wealthier farmers grow is unlikely to be viable. While coffee and vegetables were seen to be important, particularly because of the relative intensity of pesticide use (which the Ministry would like to see come down), the need to tackle pest problems on subsistence crops like maize was stressed by the officers. It was also agreed that the priorities for such a program need to be established locally.

The issue of NGO involvement in the design and execution of programs was discussed. KIOF, a key partner in the IPM project, was well known to many of the Ministry officers for its work in promoting organic agriculture. Some officers expressed concern that the NGO might exert undue influence on the technical content of the project, particularly by discouraging the use of synthetic fertilizer. The Ministry considers increased use of fertilizer essential to boosting agricultural production. Other officers saw the promotion of unregistered botanical pesticides as a greater worry. They expressed concern over the widespread use of highly toxic nicotine-based formulations derived from tobacco, and about the unknown active ingredients of many pesticidal plants. (The officers confirmed that registration is not required for formulations that farmers produce for themselves and do not commercialize.)

More generally, concern was expressed about the proliferation of NGOs active in agricultural development whose activities are not always congruent with national policy. However, there was also recognition of the contribution that these organizations can make to rural development, and instances of successful collaboration between NGOs and government programs were cited, for example in the field of small-scale irrigation. One officer suggested that some sort of forum was needed where the different organizations working in a field could meet to discuss methods and objectives. This would help to avoid overlap and ensure coordination of the actions of research, extension and NGOs.

The officers interviewed felt that it is important for a project that explores new approaches to extension to seek support initially at the headquarters level, usually in the Division of Development Planning, in order to ensure that policy concerns are addressed. A project that skirts headquarters, they said, is likely to die off after the experimental or pilot phase. The Director of Agricultural is answerable for any results of the project involving his staff and therefore needs to be well informed of what is going on. A one day's meeting both at the province and at headquarters may be all that is needed.

8.2 Impact and Prospects in other Partner Institutions

8.2.1 Kenya Institute of Organic farming (KIOF)

KIOF was one of the institutions involved from the very beginning of the IPM project. A KIOF officer became one of the project's master trainers and three of the Farmer Trainers were provided by the NGO. We interviewed one of these Farmer Trainers and the director of the organization during the evaluation.

8.2.1.1. Impact of training on Farmer Trainer capacity

Like the Farmer Trainers from the Ministry, the KIOF trainer we interviewed felt that both the TOTs and the time for field practical (running the FFS) had been too short. He would have liked to go deeper into the identification of pests and their natural enemies, to cover more crops, and to be exposed to more IPM options. But he was enthusiastic about the FFS approach and explained how the experience has influenced his work since. In terms of technical options and specific control measures, there was a good deal in common between the FFS and KIOF's earlier organic farming extension, he explained. KIOF had long been working with cultural and physical controls and botanical pesticides, although biological control was novel. However, it was the pedagogical approach of the FFS that represented the greatest innovation. "We asked people what they thought would work [to control a particular insect]. If they suggested ash, we'd say, 'Well, let's try it and see'. Before we would have told them what to do... Experimentation was new to us. Training had been our concern, not experimentation."

The trainer has not been able to set up additional FFSs in the year since the project ended. However, he employs techniques he learned there in his work with organic farming groups, and in soil and nutrient management as well as in pest management. "Farmers can learn to recognize specific nutrient deficiencies and try different organic amendments to find what will alleviate them. The project really opened my mind", he said.

Like the farmer trainers seconded by the Ministry, KIOF personnel working in the IPM project experienced a dissonance between the concepts they had long used in their work with farmers and those they were expected to employ in the FFSs. Both had to adapt to a different pedagogical approach, in essence, learning to respond to a farmer's question with a question, not with an answer. In terms of technical options, however, the adaptations were very different. Whereas Ministry staff had to shift from presenting pesticides as the first choice in pest control to the last, KIOF trainers had to digest that pesticides might have any place at all in farmers' practice. Allowing a role for synthetic fertilizer was also a marked change for them.

Some farmers saw this also, though in different terms. In the group discussions in Othaya, FFS graduates who had known the KIOF trainers from the days when they taught organic farming, described the loss of credibility these trainers suffered in their eyes when they now admitted a place for agrochemicals. Some farmers, who had evidently internalized organic farming philosophy, spoke of "betrayal". How did the KIOF trainers see this conflict?

The trainer we spoke with saw it essentially as a question of pragmatism. If botanical or other locally available controls were not adequate, a synthetic pesticide of low toxicity might be necessary. "I leave it open, explain the choices. That's my point of view, anyway. It's bad for our reputation if farmers lose their crops".

KIOF's director appeared to agree. "Pest problems are more severe in tropical than in northern countries. Less toxic chemicals need to be considered, but as a last resort".

8.2.1.2 Impact and Prospects at the Management Level

The Director was actively involved in the IPM project from the beginning, seeing the collaboration as an important step for the organization. He had visited the trainers in the field and encouraged them to apply the lessons in their own work. KIOF's training efforts, particularly in Ecological Pest Management are benefiting, and a training module has been developed. Two extension workers are currently employing the approach, one in a high, the other in a lower potential area.

The partnerships developed during the project have been important for KIOF. From IIBC, KIOF learned about the Asian experience in IPM. The Director described this as an "eye-opener". Working side-by-side with CRF and KARI had also been valuable. KIOF is deepening its collaboration with CRF in the area of organic coffee. Relations with the Ministry have improved greatly since the beginning of the project. There was a good deal of suspicion at first, he said, but staff from the two organizations worked together in the field and learned from each other. There is still hesitation, and new staff must learn afresh, but one indicator of change is that KIOF has been invited by the Ministry to exhibit at an important agricultural show in Central Province.

The Director was in favour of a renewed and expanded IPM initiative. The coffee-vegetable combination was a good first choice, but it is important to focus on locally important cropping systems and to adapt the approach to local needs. This is possible, he said, if the Farmer Trainers have a good grasp of underlying principles.

8.2.2 Coffee Research Foundation (CRF)

Like KIOF, CRF staff were involved very early in the project. They played a major role as resource persons during the TOTs and the FFSs. They were very positive about the project. Although they had not previously worked with farmer groups or participatory approaches, their experience in the project led them to believe the FFS approach will yield good results. CRF itself is not well placed to play a leading role in implementing FFSs, given the organization's limited staff. However, they felt CRF could play an important supportive role if the Ministry were to take on this task. The officers saw CRF's role in such a collaboration as providing information, particularly on IPM aspects in coffee, and picking up the options farmers had and refining them.

According to these officers, the FFS approach is much superior to the conventional extension approach because in the latter information does not reach farmers in a timely fashion. They indicated that there is need to prepare extension officers, particularly at the district, division and location levels so that they understand the approach. This preparation could be done through induction courses, they suggested. They were concerned, however, that the FFS approach might not work with resource rich farmers who usually don't buy into group approaches, preferring to call extension officers to their farms. As did other project partners, the CRF officers commented on the high cost of the FFS approach compared to the conventional approach. They also felt the approach will put strain on the research institutions, particularly in supporting the use of diverse botanicals pesticides. They saw the need for constant exchange of information between collaborating institutions and recognized the potential for strengthening the links between research and development organizations.

8.2.3 Kenya Agricultural Research Institute (KARI)

The Kenya Agricultural Research Institute (KARI) was involved rather late in the project, during the Training of Trainers stage, its staff serving mainly as resource persons. The KARI scientists interviewed felt that to ensure more effective collaboration, they should have been involved at the beginning of the project. If possible they should have taken part in deciding on the key elements of the project so that there would be no "surprises" during implementation. For example, some of them thought that there was too many KIOF ideas in the project. While there were indeed similarities with KIOF's organic approaches, there were also major differences. Had these officers been involved in the project early on, they would have understood this better. The officers recognized that some of these problems resulted from the project having been started in a hurry.

The officers saw KARI's role in the project first and foremost as providing new technological options. The officers felt it important that the Institute constantly carry out research on the various themes addressed by the project, so that there be a stream of new options available. If the same ideas are continually put forward, farmers will lose interest. KARI can also play a role in investigating and testing the various options coming from farmers, the officers said, both on farm and in the laboratory, to find out if they really work, and how they can be refined and improved. Research can also identify active ingredients in botanical pesticides and establish the required dosages for them, which, as noted earlier, was an important issue for some farmers.

According to KARI management, this project fits within the Institute's Farming Systems and participatory research thrusts, which are mainly implemented at the Regional Research Centres (RRCs). The appropriate level of collaboration is therefore the RRC situated in the area where the project is being implemented. On-farm collaboration was seen to be important because the kind of observations KARI scientists make will likely differ from those made by farmers, and the two can enrich each other. An annual cycle of planning exists at the Regional Research Centre level, and new projects are usually presented to the Centre Research Advisory Committee, which confirms the relevance of the project to the area where it is being implemented.

In the area of farmer experimentation, KARI is carrying out participatory research where farmers compare the different options developed by research with their own practices. The IPM project is somewhat different in that many of the options farmers test do not originate with KARI and many more options are tested. But the project's fits with KARI's evolving priorities and collaboration was deemed to be useful. It was felt that research should strongly support farmer experimentation in a renewed project by ensuring that other options are available should farmers' ideas not work. Resource persons backstopping the project should have some options in mind for testing to add to what the farmers have.

Another role for KARI was seen in carrying out project reviews, adoption and impact assessments.

8.3 Information flow and reporting within the project

The project managers did a commendable job in terms of reporting. The Farmer Trainers prepared monthly reports on the progress of the FFSs. These reports were directed to the IIBC Project Managers. The Project Managers also reported on each major activity, such as the PRA, the TOTs and the technical backups to the FFS. At the project's end, quite detailed final and evaluation reports were prepared. However, distribution was problematic. Only the latter two reports were sent to project partners. Partners felt they would have been better informed and better able to collaborate had they received the others as well. This is particularly so for the immediate supervisors of the trainers. Had the DAEO received the monthly reports, it would then have been his/her responsibility to report the same to the District Agricultural Officer. The DAO, would in turn report to the PDA and eventually the report would reach the Director of Agriculture. The IPM project would then have been better known and the information task that now faces those who would like to see it deepened and extended would have been reduced.

9. Conclusions and recommendations

Our evaluation suggests the project has had significant impacts at the farm and community levels with respect to the use of integrated pest and crop management practices and the concepts that underlie them. There is evidence that farmers are making their crop management decisions differently as a result of the FFSs, for example, assessing crop health and natural enemy activity before employing insecticides. Graduates now rely more on and make more efficient use of local sources of compost, manure and botanical pesticides. At least some farmers have also reduced their reliance on hired labour. The cash savings from these changed practices are significant at the household level. They are likely complemented by other economic and environmental benefits that we were not able to measure satisfactorily.

Farmer management capacity, assessed as the ability to make better decisions independently and under different conditions, has also been positively affected by the FFSs. These effects appear to have reached men and women in roughly equal measure. Women graduates appear to have increased their role in managing coffee, a cash crop that has generally been controlled by men, though it is not clear that this has translated into greater influence in deciding how proceeds will be spent. Graduates employ what they have learned on crops and enterprises other than those targeted in the FFS. In many cases, they have modified practices and innovated where initial results were not satisfactory. They also explain what they have achieved to other farmers, who then go on to test and implement at least some of the new practices. The FFS groups have continued to meet in most cases and, depending on the village, play roles of varying importance in the further development and spread of management practices. Some of the groups are also taking on other functions, such as mobilizing savings for a revolving credit scheme for members.

A financial analysis that takes account only of the savings graduates realize on agrochemical inputs and that makes conservative assumptions about the durability of benefits and the rate at which IPM practices are taken up by neighbouring farmers, suggests that the project would repay the initial investment within a year or two. The greater intensity of supervisory involvement in this pilot phase is among the factors that need to be weighed in projecting these results to a wider scale.

These are the broad, overall impacts of the project. Though based on conservative assumptions, they draw on observations at only one time, 1 ½ years after the project's end. Further follow-up would help buttress our conclusions. In drawing lessons from the project's experience, particularly in terms of the design of follow-on efforts in Kenya, it is essential to take account of several additional points.

9.1 Technology needs and the involvement of research institutions

In both individual and group interviews, graduates expressed overall satisfaction with the pest and crop management options they now have at their disposal. However, several are proving problematic in certain situations. Farmer experimentation appears to be active in some of these. The testimony and actions of graduates suggest a number of areas where research support from KARI, CRF and possibly other organizations would be helpful.

- Labour-scarce households, notably in the tea zone, appear to be abandoning knowledge and labour-intensive practices. There are also indications that farmers in these areas are using IPM approaches for vegetables on small, kitchen-garden scale plots, but are finding it difficult to scale them up to larger fields, intended for the market. A range of less labour intensive options is needed in such cases. Biological control, through release of non-native predators or parasites, is one promising area. Another is techniques that enable farmers to prepare botanical pesticide formulations when they have time and then store them.

- The use of milk powder against blight on potato and tomato is a farmer practice that arouses skepticism among many scientists. However, its use has spread among farmers in the four groups and from them to the wider farming community. Farmers affirm that it works, but that it must be supplemented by fungicide under strong disease pressure, notably in heavy rain. There certainly appears to be scope to improve the practice's effectiveness. How it works is still unclear. It has been suggested that the milk may provide a medium for fungal antagonists of the pathogen. Possibly milk's calcium content is responsible. In Central America, calcium carbonate from lime was found to exert a degree of control over "ojo de gallo" disease of coffee, by relieving the effect of calcium sequestration by the oxalic acid which the pathogen produces (Prof. Oscar Arias, pers. comm.). The emergence of the milk-based treatment for blight provides an example of the benefits of wide participation in the search for solutions to common problems.

- Research support is also needed in relation to botanical pesticides. In addition to work on preparation techniques referred to above, assistance in determining effective doses, assessing the range of applicability of farmer-developed formulations, and providing better information on the human toxicity of these plant extracts would be helpful. A good deal of what is needed may already be available. Plants such as chili pepper, garlic, neem, and tobacco are used by farmers in many countries and preparation techniques and toxicology have long been studied. There are several research and information networks in existence.

- Graduates were able to realize significant savings in their use of fertilizers by employing more manure and compost, improving the preparation of these materials, and concentrating their application. Most graduates relied on on-farm sources, though a few purchased organic materials from neighbours. These free or low-cost resources are likely to become increasingly scarce and valuable as use expands at the farm and village levels. Options to increase the availability of biomass and to improve farmers' ability to manage both organic and inorganic nutrient sources are of growing importance. This echoes the conclusions of several recent reviews, for example Neefjes et al. (1997).

- In other countries, particularly in the North, the adoption of low external input practices, including IPM, has been aided by the existence of organic markets that offer farmers a price premium. Such markets are only emerging in developing countries like Kenya, but aiding farmers to link up with them may be important in sustaining the spread of integrated pest and crop management techniques, which are also just emerging. Reliable links to markets in industrialized countries, which are becoming increasingly exigent in terms of quality standards, may also help propel farmer innovation. Developing viable options in marketing linkages may be an area where NGOs can play an important role.

Research organizations will have to determine how far their priorities should be influenced by an expanded IPM program, taking into account the other calls on their energies. Much will depend on the scope and extent of such an expanded program (see further below).

Researchers taking on the above mentioned issues will likely choose to work both on-station and on-farm. As a venue for focused on-farm research, the FFS is not necessarily the most appropriate. Returning to the distinction put forward in the Introduction, the FFS is designed to enhance resource "literacy", not "discovery". The experimentation that is conducted there touches on several themes and tests a limited number of options for each, generally without replication in either space or time. More focused research that brings to bear the best options available from both the institution's and farmers' sides is likely to make more headway on any given theme. Researchers should hence consider conducting participatory research with FFS graduates who have confronted the issues directly in their farming and are experimenting independently on them. The results of such research should then be available to future FFSs.

9.2 Effectiveness of specific participatory methods

It is clear from the testimony of graduates and Farmer Trainers that certain elements of the FFS approach were more successful than others. Among the more successful were the efforts to stimulate farmer-farmer diffusion through group visits. Githunguri and Wundanyi farmers who visited the Karigu'ini group picked up a number of options that had not been broached in their own FFSs, particularly related to land shaping and preparation and the concentration of organic matter application. They are now using these and communicating them to others. The testimony of farmers actually using the practices appears to have been particularly influential. This confirms results from other participatory R&D efforts (e.g. Loevinsohn et al. 1994; Kingsley and Musante 1996; Dilts and Hate 1996).

The encouragement given by Farmer Trainers to farmer experimentation appears to have been uneven. Some evidently were not effective in stimulating the testing of ideas on a level playing field, farmers' own alongside those from outside. More than one trainer appears to have replicated in lockstep the experiments he/she had carried out in the TOT, ignoring farmers' protests that conditions were not the same. This is an area that has proven problematic in other participatory IPM programs. An expanded project should pay particular attention to improving trainers' skills in encouraging experimentation and ensuring quality control in this area.

9.3 Equity in the distribution of benefits

Men and women were approximately equally represented in the FFSs. Analysis suggests that they have innovated in similar fashion, in terms of both numbers and types of practices. However, diffusion of knowledge by graduates is found to be strongly divided by gender, men diffusing mostly to men and women mostly to women. It was pointed out that this fact heightens the importance of gender balance in the FFSs' composition, if the benefits are to flow in roughly equal measure to men and women. A critical factor in this regard is the degree to which knowledge is shared within the household.

Age was found to be another critical dimension. Younger farmers were not well represented in the FFSs and older graduates did not generally pass on what they had learned to them. Again, the extent to which knowledge is shared within households will determine how far younger farmers are effectively excluded from access to new ideas and technical options. Follow-up studies should pay careful attention to this key factor.

We were unable to assess the extent to which diffusion of knowledge is affected by differences in wealth. Work elsewhere in the East African highlands suggests that the poor are often excluded from local seed networks (Sperling and Loevinsohn 1993). How far this is true in the present case merits following-up. Sharing of knowledge within households would be of little help because poverty is largely a household characteristic. Ensuring adequate representation of poorer farmers in the FFSs is hence likely of even greater importance than for women and the young.

9.4 Planning with partners

A shortcoming of the project's first phase was that key partners, notably KARI and MOALDM, were involved only at the operational level. While the objectives and methods of the project were of interest to many people at the provincial level of the Ministry and at the national levels of both it and KARI, no real effort was made to draw them in. In a small-scale experiment, this may be understandable. But if the next phase is to truly function as a pilot, it is important that key national institutions determine what it is to pilot them toward.

A key issue that needs to be considered is the scope of the initiative. Will it continue to focus on IPM for coffee and vegetables, or will it develop a broader approach to integrated pest and crop management, across commodities and responsive to local priorities? As many officers noted, it is difficult to imagine how a participatory IPM program with a very restricted area and commodity mandate could survive within the Ministry, surrounded by programs oriented differently. On the other hand, a program that takes on all crops would require very strong organizational and research support. A more realistic approach may be to allow Farmer Trainers to improve their competence by leading a few more FFSs in coffee/vegetable farming systems, then gradually bring in other crops on which farmers are facing important problems and the program feels it has some helpful ideas to offer.

The Ministry is already operating several participatory programs, notably the national Soil and Water Conservation Program, in which KARI collaborates. This also employs a group approach and, like the IPM project, employs PRAs to determine priorities at the catchment level. There are clear complementarities between the two approaches which should be capitalized on in the future.

Finally, the project has benefited from the inputs of diverse institutions, governmental, non-governmental and international. This collaboration has made it possible to bring to bear skills and experience that no one organization could muster. While there have been frictions, the arrangement appears to have been successful and mutually advantageous. This foundation should be built on in any future phase. Program structures that draw in diverse actors, including NGOs, have played a role in the spread of IPM in Asia (Kingsley and Musante 1996; Dilts and Hate 1996). That experience should stimulate reflection on how similar benefits can be achieved in the East African context.

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ANNEXE

Assumptions and calculations of financial benefits

Table A1. Proportion of farmers growing coffee, kale/cabbage, potatoes and maize.

Number of farmers:	***65***
% of farmers with coffee	***80***
% of farmers with kale or cabbage	***100***
% of farmers with potatoes	***60***
% of farmers with maize	***40***

Table A2. Net benefits of the project to the graduates (n=65) under pessimistic and optimistic scenarios. No diffusion.

Pessimistic scenario		**Year 1**	**2**	**3**	**4**	**5**	**6**	**7**
Net benefits coffee		234153.87	234153.9	234153.9	0	0	0	0
Yield increase coffee		0	0	0	0	0	0	0
Net benefits kale/cabbage		64948.668	64948.67	64948.67	0	0	0	0
Net benefits maize		34015.031	34015.03	34015.03	0	0	0	0
Net benefits potatoes		47586.64	47586.64	47586.64	0	0	0	0
Total Yearly Net benefits		**380704.2**	**380704.2**	**380704.2**	**0**	**0**	**0**	**0**
NPV	**914387.3**							
US Dollars	**15239.8**							
Optimistic scenario		**Year 1**	**2**	**3**	**4**	**5**	**6**	
Net benefits coffee		234153.87	234153.9	234153.9	234153.9	234153.9	234153.87	234153.87
Yield increase coffee		284863.91	284863.9	284863.9	284863.9	284863.9	284863.91	284863.91
Net benefits kale/cabbage		64948.668	64948.67	64948.67	64948.67	64948.67	64948.668	64948.668
Net benefits maize		34015.031	34015.03	34015.03	34015.03	34015.03	34015.031	34015.031
Net benefits potatoes		47586.64	47586.64	47586.64	47586.64	47586.64	47586.64	47586.64
Total Yearly Net benefits		**665568.12**	**665568.1**	**665568.1**	**665568.1**	**665568.1**	**665568.12**	**665568.12**
NPV	**3037490.8**							
US Dollars	**50624.8**							

Table A3. Benefits of the project, taking diffusion into account, under pessimistic and optimistic scenarios.

Pessimistic scenario		**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 6**	**Year 7**
Total Net benefits (Ksh)		1281069.6	1281070	1281070	0	0	0	0
NPV	**3076913.1**							
US Dollars	**51281.9**							
Optimistic scenario		**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 6**	**Year 7**
Total Net benefits (Ksh)		6156505	6156505	6156505	6156505	6156505	6156505	6156505
NPV	**28096790.3**							
US Dollars	**468279.8**							

Cost : Effectiveness Calculations

Project Costs

1) Participatory rural Appraisal (Dec 1995 - Feb 1996

Item	Cost in Ksh.
Mileage	54,621.00
Consultancies	12,000.00
Sub-allowances	37,750.00
Consumable	215.00
Scientists Charges	142,025.78
Total	**246,611.78**

2) First TOT course at Maragwa (5 weeks)

Item	Cost in Ksh.
Mileage	52,062.81
Consultancies	36,729.00
Sub Allowances	150,200.00
Consumable	80,539.00
Accommodation	21,745.50
Stationery	225,200.00
Communication	15,850.50
Local Travel	58,400.00
Photocopying	2,084.00
Driver	68,000.00
Scientists charges	66,278.70
Total	**777,089.51**

Second TOT course (17th June to 5th July, 1996) 3 weeks

Item	Cost in Ksh.
Mileage	40,768.05
Consultancies	65,200.00
Sub-allowances	42,769.00
Consumable	7,254.00
Accommodation	145,500.00
Stationery	5,285.00
Local travel	31,790.00
Scientists charges	65,496.22
Total	**404,062.32**

Total for the TOTS = 404,062.32 +777,089.51 = 1,181,151.80
cost per participant = 1,181,151.80 ¸11 = 107,377.44

Field Practical (FFS) April to June 15

Item	Cost in Ksh.
Mileage	52,062.81
Consultancies	18,250.00
Sub-allowances	22,344.00
Consumable	2,754.00
Stationery	20,007.00
Communications	7,629.87
Local travel	18,190.00
Photocopying	556.94
Driver	120,000.00
Scientists charges	132,557.40
Total	**394,352.00**

Field Practical for July to September, 1996

Item	Cost in Ksh.
Mileage	110,696.18
Consultancies	55,200.00
Casual staff	6,250.00
Communication	5,572.51
Photocopying	628.32
General Office expenses	475.00
Local travel	49,675.00
Meetings/Conf-Trainers/farmers	108,292.00
Consumable	2,918.00
Scientists charges	176,703.59

Total **516,410.60**

Total for the Field practicals = 394,352.00 +516,410.60 = 910,762.60

Total cost for the exercise

PRA	-	246,611.78
TOT	-	1,181,151.80
Field/Practical	-	910,762.60
Overheads for scientists	-	468,720.00

Total **2,807,246.20**

AVERAGE EXPENDITURE PER FFS

Four Farmer Field Schools were operated during the pilot project. The average cost of running each FFS is calculated using total variable costs on the project.

Total variable cost		=	2,807,246.20
Average cost per FFS	2,807,246.20 /4 FFS	=	701,811.55

COST EFFECTIVENESS

Pessimistic Scenario (in Ksh.)

Total Net Benefits 3,076,913.13
(see above: "**Pessimistic with diffusion"**)

Total Cost of the Project 2,807,246.20

Cost Effectiveness 1.1

Optimistic Scenario (in Ksh.)

Total Net Benefits 22,363,600
(see above: **"Optimistic with diffusion"**)

Total Cost of the Project 2,807,246.20

Cost Effectiveness 7.96

Budget notes

Ksh. to Sterling Pound 90

Mileage: Transport cost (charges) for IIBC vehicles.

Local travel: Bus fare within the country.

Consultancies: Money paid to resource persons as facilitation fee.

Sub allowance: Money paid for bed and breakfast and lunch where applicable.

Consumable: This was money spent on snacks and tea during the practical sessions e.g during the FFS meetings.

Accommodation: Full board accommodation for trainers during the TOTs.

Comparisons

The eleven trainers were distributed among the four FFS, giving an average of three trainers per FFS. However, on Asian experience, it is possible for one trainer to run two FFSs in a year, though a more conservative assumption is that one trainer will run one FFS a year. Both cases are considered in the analysis.

Scenario 1

Assuming that one trainer manages one FFS in a year. In this case the 11 trainers should be able to run 15 FFS (4 during the TOT and eleven in the next one year).

If that is the case the expenditures will be as shown below;

PRA (246,611.78*15) /4	-	924,794.18
TOT	-	1,181,151.80
F/Practical (910,762.6*15)/4	-	3,415,359.80
Overheads for scientists	-	468,720.00
Total		**5,990,025.80**

Average cost per FFS will be 5,990,025.80 /15 =399.335.05

Scenario 2

Here it is assumed That one trainer manages two FFS in a year. This implies that a TOT will yield 11 trainers who will go on to implement 26 FFS (4 during the training session and 22 in the next one year. The analysis then is as shown below;

PRA (246,611.78*26) /4	-	1,602,976.6
TOT	-	1,181,151.80
F/Practical (910,762.6*26)/4	-	5,919,956.90
Overheads for scientists	-	468,720.00
Total		**9,172,805.30**

Average cost per FFS will be **9,172,805.30** /26 =352,800.2

COST EFFECTIVENESS

PESSIMISTIC SCENARIO

Scenario 1 (eleven trainers running 15 FFS)

Total Net Benefits	11,538,424.00
Total Cost of the Project	5,990,025.80
Cost Effectiveness	1.93

Scenario 2 (eleven trainers running 26 FFS)

Total Net Benefits	19,999,935.00
Total Cost of the Project	9,172,805.30
Cost Effectiveness	2.18

OPTIMISTIC SCENARIO

Scenario 1 (eleven trainers running 15 FFS)

Total Net Benefits	[105,362,960.00] no
Total Cost of the Project	5,990,025.80
Cost Effectiveness	[17.59] no

Scenario 2 (eleven trainers running 26 FFS)

Total Net Benefits	[182,629,140.00] no
Total Cost of the Project	9,172,805.30
Cost Effectiveness	[19.91] no

Assumptions

1. The cost of the field practicals are equal for all the FFS
2. The Scientists overhead charges remain constant irrespective of the number of FFS
3. PRAs will be carried out for all the groups to collect background information before staring the FFS activities.
4. The benefits are similar for all FFS

OTHER CONSIDERATIONS

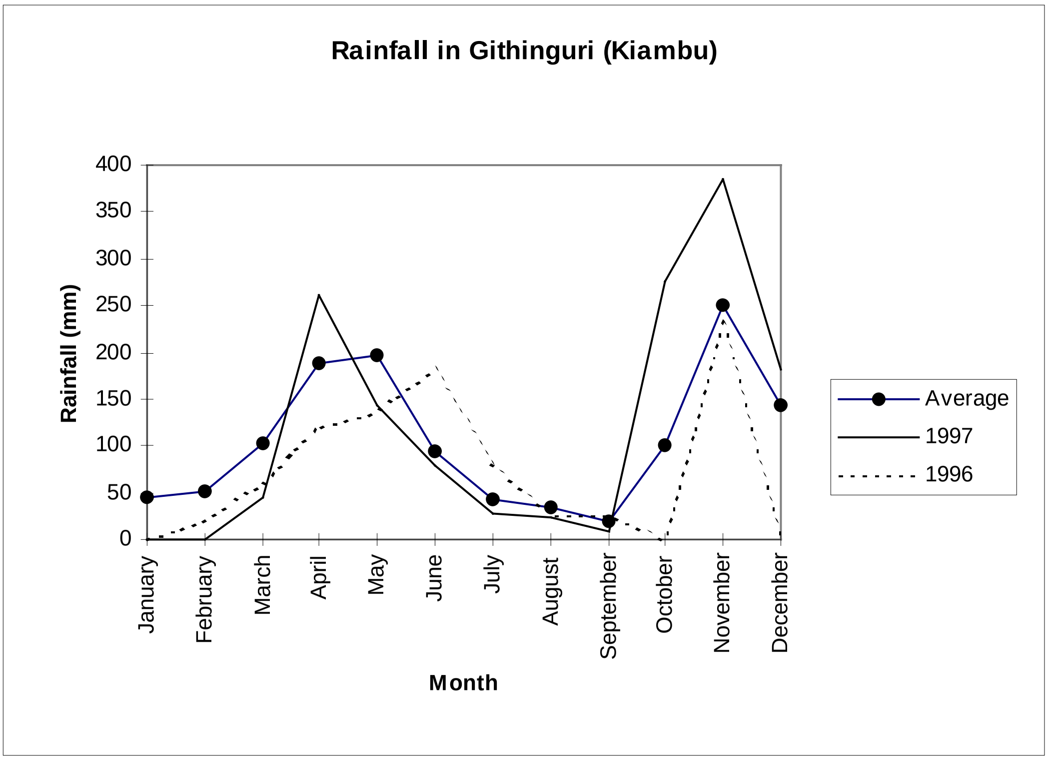
There are other considerations to be put into account when looking at the cost effectiveness. They include the following;

Extra Costs

The analysis excluded the following costs;

1. Trainers salary
2. Salary of the collaborating scientists
3. Costs incurred by IIBC in UK
4. Farmers' opportunity cost for attending the FFS

These were considered as fixed costs which will have been incurred even in the absence of the project. However considering that these personnel would have been doing something else it can be considered an added cost.


Rainfall in Githinguri (Kiambu)
Rainfall (mm)
0
50
100
150
200
250
300
350
400
January
February
March
April
May
June
July
August
September
October
November
December
Month
Average
1997
1996