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Dissertation

IMPACT EVALUATION OF FARMER FIELD SCHOOL: The case of Integrated Potato Late Blight Management in the Central Highland of Ethiopia

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SUMMERY

This dissertation is based on a data collected during the period June-July 2005 from Dendi and Jeldu Districts in Ethiopia. It is an ex-post evaluation of a project focusing on improving farmers understanding on potato late blight using Farmers Field School approach. Impact of this project is measured here on changes in improvement in the number of late blight control methods farmers use in the study area, income from potato and impact on the household status measured by changes on family food situation and ox ownership. In this study, participants and the control group are compared after the intervention. Moreover, changes in the differences of the impact indicators in each group before and after the intervention is measured. Therefore, it is documented here that participating farmers gained more knowledge on potato late blight and increased the number of controlling methods against the disease. Moreover, significant difference is also observed in income from potato, family food situation and ox ownership between the participating and control groups. Three years after the completion of the intervention, this study demonstrates that if farmers get the chance to participate in developing solutions of their own serious problems, they would adopt the result sustainably. What follows is the documentation on how the study was organized and the result analyzed.

Key words: Farmer Field School, Integrated potato late blight management,

CONTENTS

LIST OF ABREVATIONS

CIP	The International Potato Center (Centro International de la Papa)
EARO	Ethiopian Agricultural Research Organization
FDRE	Federal Democratic Republic of Ethiopia
FFS	Farmer Field School
GDP	Gross Domestic Product
HARC	Holeta Agricultural Research Center
IAR	Institute of Agricultural Research
IDM	Integrated Disease Management
IFAD	International Fund for Agricultural Development
KAP	Knowledge, Attitude and Practice
LB	(Potato) Late Blight
MOA	Ministry of Agriculture
MoFED	Ministry of Finance and Economic Development
PA	Peasant Association
PDTES	Participatory Demonstration & Training Extension System
SHDI	Self Help Development International
SSA	Sub-Saharan Africa
T & V	Training & Visit

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CHAPTER I BACKGROUND

1.1 Introduction

Ethiopia is one of the least developed countries in the world with poverty-stricken economy, mainly based on agriculture which accounts for half of GDP, 60% of exports, and 80% of total employment. Eighty five percent of the total population of the country lives in the rural area and eighty percent of the labor force is on agriculture and animal husbandry while industry and construction constitutes 8% and government and services account for 12% (CIA, 2005).

The prevalence of poverty in Ethiopia is associated with low growth and low productivity of subsistence agriculture as a result of this, one of the serious consequences of the structure of the economy is the problem of food insecurity; in any one-year, more than 4 million people on average face food shortage and need relief assistance (MoFED, 2002). Consequently, the country remained the largest food aid beneficiary in the world. The main causes of the low productivity of agriculture in SSA countries in general, according to Cleaver and Donovan 2002, '[c]ontinue to be poor economic and agricultural policy, and inadequate public investment in infrastructure, rural education and agricultural services such as extension'. Therefore, 'agricultural extension and farmer education programs are key policy instruments for governments seeking to improve the productivity of agriculture' (Feder et al, 2003).

However, in Ethiopia, since early 1950s' the MoA attempted to transform the traditional agriculture and implemented various extension systems which focus on community development, development of commercial farming, package program approach and training & visit system (Habtemariam, 1996). Following the T & V system, a new agricultural extension system known as PDTES is under implementation since 2003. Despite the large extent of public investment over the agricultural history of the country, let alone improvement of the agricultural sector, level of food production itself is still far behind the size of the population growth.

The main reason for the failure of the various agricultural extension systems to transform the agricultural sector include poor institutional linkage among agricultural research, education and extension systems (Habtemariam, 1996), limited participation of farmers in design of extension systems and poor focus on organization and empowerment of farmers. As a result of this a highly participatory approach is needed to ensure better adoption of technologies and increased productivity of the sector.

In recent years a number of development agencies, including the FAO, have promoted Farmer Field Schools (FFS) as a more effective approach to extend science-based knowledge and practices to farmers (Feder et al. 2003).

A pilot project on Integrated Management of Potato Late Blight through FFS, which is referred as FFS-IDM intervention in this document, was implemented in Ethiopia during 1999-2002 through a collaborative effort of EARO, SHDI and CIP and financed by IFAD. It mainly focused on increasing potato production through the development and implementation of integrated management techniques for late blight, a disease responsible for the Irish potato famine in the 1940s', to increase farmers understanding about the disease and enable them make better management decisions.

However, since the completion of the project in 2002, the impact of the FFS-IDM approach on knowledge, attitude and practice of the farmers towards LB, income from potato and household status was not adequately investigated and evaluated. Since the FFS approach is more expensive than other methodologies (Feder et al 2004), its impact should be investigated before expanding its application to other areas. This calls for an urgent need to assess and evaluate the impact of the approach. This research, therefore, focuses on ex-post impact evaluation of FFS-IDM intervention on changes in knowledge, attitude and practice towards late blight control, income from potato and impact on the household of participants as measured by change in ox ownership and food supply from potato.

Data for this study was collected from Dendi and Jeldu Districts in the central highlands of Ethiopia (See figures 1 & 2 for map of the study area) during the period June-July 2005 using focus group discussion and survey questionnaire, See Annexes 1 & 2 for topic guide and survey questionnaire used. The design of this evaluation is quasi-experimental design, which compares participants and non-participants after the project and also compares changes in participants before and after the project with similar changes in the control group. Due to lack of baseline data especially on income from potato sale before the intervention and also over time during and after the intervention, recall interview was used to determine the level of potato income over the years. Since such method of data collection can bias participants to over estimate the impact of the project, other indicators of income from potato like size of potato farm over the years and quantity of potato sold in each year were collected to validate the data.

The purpose of this paper is, therefore, to document the impact of FFS-IDM approach so that the findings can help to understand farmer's participation in problem identification, research planning, technology generation and evaluation processes. The beneficiaries of this output will be policy makers, research organizations, agricultural extension departments, farmers development organizations, community based organizations and other governmental and non-governmental organizations. The outputs of this study could be disseminated to the beneficiaries mainly through published reports, seminars, and websites. Leaflets will be prepared in local languages to be distributed for the farmers and CBOs.

1.2. Potato Production in Ethiopia

According to Horton (1987) and Scott et al (2000), the potato is the most important crop in developing countries and its production is expanding more rapidly than that of most other crops. As a result of this, it is becoming an increasingly important source of rural employment, income and food for growing populations.

Originating in the Andes, Latin America, potato was introduced to Ethiopia in the 19th century by a German Botanist Schimper (Pankhrust, 1964 & Horton 1987). Though it has been under cultivation for almost 200 years in the country, its production was not wide spread and it contributed little to food security in the country. According to Yilma (1991) about 70% of cultivated agricultural land is suitable for potato production. However, currently only 80,000 hectares is under potato cultivation. The main reason associated to this under utilization of potato is the narrow genetic base of the early introductions and the traditional view towards potato as poor man's food and also most of the people use cereals as stable food. In addition to this, lack of high yielding and disease resistant improved potato varieties, problems of pests and disease especially potato late blight (Gebre Medhin et al, 2001), are also the causes of under utilization of potato in Ethiopia. Moreover, lack of sufficient quantity of good quality seed, poor agronomic techniques, lack of storage facilities, inefficient marketing and transportation system and shortage of skilled man power and facilities also contribute to the under utilization (EARO, unpublished).

To promote potato production in the country, EARO has established a National Potato and Root Crops Program, which coordinates and leads potato research in the country. The main objective of the program is to coordinate the generation and promotion of appropriate technologies to promote production of potato and other root crops in the country.

CHAPTER 2 THE INTERVENTION THEORY

2.1. Managing Potato Late Blight Disease through FFS

In the 1940s' an outbreak of late blight ravaged potatoes. ... “The ensuing 'potato famine' (in Ireland) was the worst European disaster since the Black Death 500 years before. One million people died and 1.5 million emigrated, out of a total population of around 8 million”.

Horton, 1987:11

In spite of the fact that Ethiopia is one of the food deficient countries in the world, the food potential of potato has not been adequately exploited despite its enormous contribution to food availability (Gebre Medhin et al, 2001). The main reasons for this under exploitation of potato are indicated under section 1.4 above.

However, studies on the extent of potato destruction in the study area due to potato late blight disease, caused by *Phytophthora infestans*, on the local potato variety estimated an average of 91.3 % loss (IFAD-FFS Ethiopia Project Annual Report 2002). Other research indicates that, in some conditions, late blight can cause 100% loss of potato crop on an improved local cultivar (Bekele and Yaynu, 1996).

As a result of this, management of late blight (LB), the single most important potato disease worldwide (Horton 1987: pp 41), presents special problems for resource-poor farmers because the pathogen is essentially invisible, farmers cannot easily understand the phenomenon of the disease and the damage can be rapid and devastating, as a result of this it is hard for farmers to fine-tune their management strategies (CIP, a). Though some farmers in the pilot site are generally aware of fungicides, they often lack sufficient information to use them effectively (IFAD-FFS Ethiopia Project Annual Report 2002).

In response to the problem of late blight, CIP has been developing potato genotypes with strong levels of partial resistance, which slow rather than prevent the epidemic, resulting in less disease and higher yields with fewer fungicide sprays, to get the most out of these

genotypes, however, farmers need to understand the disease better and integrate resistant cultivars with improved fungicide use and other practices (Torrez, R. et al). Though the availability of, and access to, disease-resistant potato cultivars provides an opportunity for farmers to reduce LB risk, they also need considerable knowledge about the disease, resistance of the potato crop, fungicide use, seed health, and the various agronomic practices that affect LB, as well as knowledge about other aspects of pest and crop management (CIP, a).

As a result of these, development and implementation of integrated management techniques for potato late blight disease becomes fundamental to increase potato production and income from potato to make the peasant food self-sufficient. To locally develop these knowledge intensive integrated disease management techniques together with the farmers, the FFS approach was applied.

With the financial support of IFAD, EARO, SHDI and CIP designed a pilot scale project entitled "Integrated Management of Potato Late Blight: Refining and Implementing through FFS". The project was implemented from 1999- 2002 in three districts in the central highlands of Ethiopia.

The overall objectives of the project, according to the project document, were,

- To increase potato production through the development and implementation of integrated management techniques for late blight and other major potato diseases and insect pest to enable farmers make better management decisions
- To develop methods for participatory research and farmer training on management of potato late blight and other key constraints faced by resource-poor potato growers.

The FFS approach was used because it is believed to ensure high participation of the farmers'.

2.2. FFS-IDM Approach

Initiated by the Food and Agriculture Organization (FAO) in late 1980s' in East Asia, the FFS approach has since been implemented in many developing countries in Asia, Africa and Latin America. Its application has also been diversified from Integrated Pest Management (IPM) to Integrated Disease Management (IDM) and Natural Resource Management (NRM).

FFS-IDM approach as developed by CIP is a season long training of farmers involving participatory activities based on a session as outlined in Annex 4. It follows participatory training and research methodology using the techniques of adult education and learning by doing which was mainly designed to promote IDM of potato late blight.

FFS-IDM was implemented using a group of 25 farmers on 1 communal farmland, which was used as a learning and experimentation ground to try out the different potato technologies and compare various late blight resistant improved potato varieties. An experiment comprised of fungicides by varieties (trial) was the corner stone for the FFS-IDM field session activities (Bekele et al, 2002). FFS-IDM applies the principles of Agro-Eco System Analysis, dealing on farmers regular observation and continuous experimentation on the field, which are the main tool for gathering useful information for farmers decision making on their experimental plot.

In this project, farmers participated from problem identification up to evaluation of the outputs of the experiment. The project was based on the FFS principles of adult learning and learning by doing. In average a group of 22 farmers from each of the FFS gathered regularly throughout the cropping season, and conducted one or more field experiment in each contact. With the support of a facilitator, the farmers undertook various hands-on learning exercises focusing on seed quality, concepts of basic experimental design, the source and cause of late blight, testing a set of promising potato varieties under their local conditions and correct calibration of sprayers and understand safe use of fungicides. The experiments and learning activities were designed to allow the farmers to learn about

agro ecological principles and to test and adapt disease control and crop management methods.

Generally, FFS-IDM was formed on 14 different sessions each with 1.5 - 2 hours (sometimes up to 3 or more hours) once a week or a fortnight during the potato-cropping season. The timing of each session was designed to coincide with the different development stage of the potato crop so that farmers can experiment based on what is practically happening on the crop in the field. The sessions were conducted by a trained facilitator (not instructor), who helps the group of 25 farmers in each school in their self-learning and discovery process.

During all the sessions, the farmers observed their field, analyzed their observation, and conducted experiment based on the findings of their observation and analysis. Each observation and experiment was documented for future reference. Moreover, farmers also compared the result of the different Integrated Diseases Management techniques they experimented with their own practice.

2.3. The Different Phases of the Project

The different phases of the project include problem identification, customize FFS-IDM sessions, training of facilitators, understanding farmers practice to produce potato, implementation of FFS-IDM sessions and participatory evaluation of the field school.

The problem identification phase of the project was implemented by EARO-HARC in 1998 especially in Dendi district. The result of this study was used as a base line to select the district for the intervention, in 1999. Following the selection of the intervention area, a regional workshop was conducted in Ethiopia to customize the FFS-IDM curriculum developed by CIP in the local context of the country. Two field facilitators were hired and trained mainly on the implementation of the curriculum customized.

The next phase of the project, understanding farmers practice to produce potato, was implemented after the establishment of FFS-IDM. This phase is part of the FFS-IDM curriculum where Knowledge, Attitude and Practice /KAP/ survey of participating

farmers were documented. The result of the KAP survey is used in this research to compare KAP of farmers before and after the intervention.

Participatory evaluation of FFS-IDM was conducted at the end of each session and also during the completion of the FFS-IDM cycle at the end of the season. The purpose of this evaluation was to improve the implementation of the next field school session and also to make the implementation of the school as a whole better during the coming season.

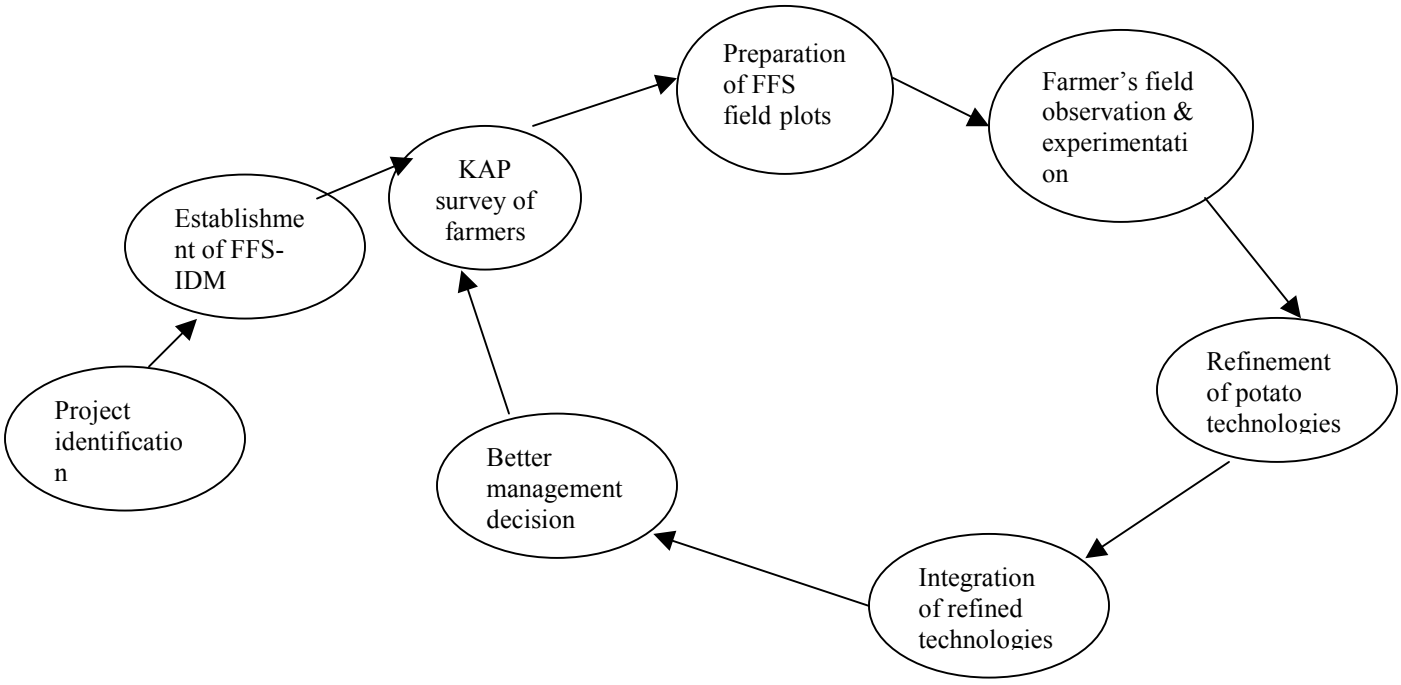


Figure 1 The Different Phases of the Project

2.4. Implementation

2.4.1. Organization

The project was part of 6 similar projects in 6 countries[1] on the Globe, which was financed by IFAD, and Globally coordinated by CIP-Lima. This project in Ethiopia was

[1] Bangladesh, Bolivia, China, Ethiopia, Peru and Uganda

regionally coordinated by CIP-SSA office in Nairobi with joint national coordination from EARO and SHDI. It had two employed full time facilitators working on the field.

The institutions involved in the implementation of the project were EARO, SHDI, CIP and the respective districts of Agriculture.

2.4.2. Implementing Organizations

Ethiopian Agricultural Research Organization

According to the Web Site of the organization, EARO, formerly known as IAR, was established in February 1966, with a mandate to formulate a national policy for agricultural research and to implement the policy through coordinated research centers and programs. With a mandate to nationally coordinate agricultural research in the country, the mission of EARO is to conduct innovative research on priority food and tree crops, livestock, and natural resources in the 18 major agro-ecologies of Ethiopia and provide national scientific leadership in agricultural research by nationally coordinating the research. Currently EARO coordinates research through its 18 agricultural research centers and also research by agricultural academic institution in the country.

Recently EARO has developed a national research strategy based on the following approaches:

- Stakeholders' participation,
- Agro ecological coverage,
- Farming systems and
- Multi-disciplinary and balance of research.

As a result of this, the Organization is making its research result client oriented by participating stakeholders in priority problem identification and the research process. It has also recently undertaken a drive to consolidate and intensify the linkages among research, extension and farmers in technology generation and transfer.

(Web Site of EARO)

The IFAD-FFS-Ethiopia project is undertaken in the context of this larger effort.

According to the project document, EARO was responsible in the project for: -

- Initial site selection and characterization
- Conducting a base line survey, to be used as a basis for focus and refinement of the FFS program, and as a basis for impact analysis;
- Production and provision of potato seed for the FFS, to include both released and promising breeding lines;
- Technical support for the preparation of the FFS curriculum for Ethiopia;
- Provision of technical input and support for the FFS, particularly in design and implementation of field experiments;
- Coordination of the IFAD-FFS-Ethiopia project
- Preparation of technical reports

Self Help Development International

SHDI is an Irish based development NGO founded in 1984 in response to the Ethiopian famine of that year (Web Site of SHDI). The vision of SHDI is to see flourishing rural communities in the developing world where every citizen has an access to adequate food, shelter, health care, and education, the means to generate a livelihood, and the right to respect, dignity and equality.

According to the web site of the organization, currently Self Help Development International operates in 5 East African countries[2]. Self Help Development International-Ethiopia is one of the stakeholders of the IFAD-FFS-Ethiopia project. Currently, the organization is now implementing 4 IRDPs', 2 CBPs' and 1 FFS project in the country. The main working principle of Self Help is helping people to help themselves.

Based on IFAD-FFS Ethiopia project document, the roles and responsibilities of SHDI in the project were: -

- Participation in the preparation of FFS Curriculum for Ethiopia;
- Participate in conducting baseline survey;

[2] Ethiopia, Eritrea, Kenya, Uganda and Malawi.

- Preparation and conduct weekly FFS sessions;

The International Potato Center – CIP

CIP is part of the global agricultural research network known as the Consultative Group on International Agricultural Research with a mission to reduce poverty and achieve food security on a sustained basis in developing countries through scientific research and related activities on potato, sweet potato, other root and tuber crops, and on the improved management of natural resources in the Andes and other mountain areas.

CIP as part of the Global Initiative on Late Blight (GILB), CIP encourages collaboration among research and extension partners to develop and implement farmer-based strategies for integrated management of late blight. It globally coordinated IFAD funded FFS projects aimed at developing and implementing farmer-participatory research and extension through FFS focusing on integrated management of potato late blight in 6 countries in the world.

It has internationally recruited staffs that undertake research in more than 30 countries on the globe in partnership with national agricultural research systems, universities and NGOs. The Center has regional offices in Kenya, which works for Sub-Saharan African Countries and regionally coordinated the IFAD-FFS projects in Uganda and Ethiopia.

(Web Site of CIP)

The roles and responsibilities of CIP in the IFAD-FFS Ethiopia project were: -

- Provision of draft FFS curriculum and other background material, to serve as a basis for development of the FFS curriculum for Ethiopia;
- Organization and implementation of a curriculum development workshop, and assistance with planning for training of the FFS facilitators;
- Scientific collaboration on design and evaluation of field experiments;
- Coordination of regional and overall project activities;

- Preparation of final reports to be submitted to IFADs

Dendi and Jeldu Woreda offices of Agriculture

Dendi and Jeldu district offices of agriculture are local level offices of the Oromia Region Agricultural Bureau in Ethiopia. The offices have Development Agents locally stationed on the IFAD-FFS-Ethiopia Project sites who actively participated on the field level implementation of the project.

2.5. Project Location and Budget

IFAD-FFS-Ethiopia project was located in Dendi, Jeldu and Wolmera districts of the Oromia Regional State in Ethiopia. The districts are located in West Shoa Zone of Oromia Region in the central highlands of the Country. In this impact evaluation research, however, Wolmera District is not included for the reason that the project was not implemented well enough to produce an impact.

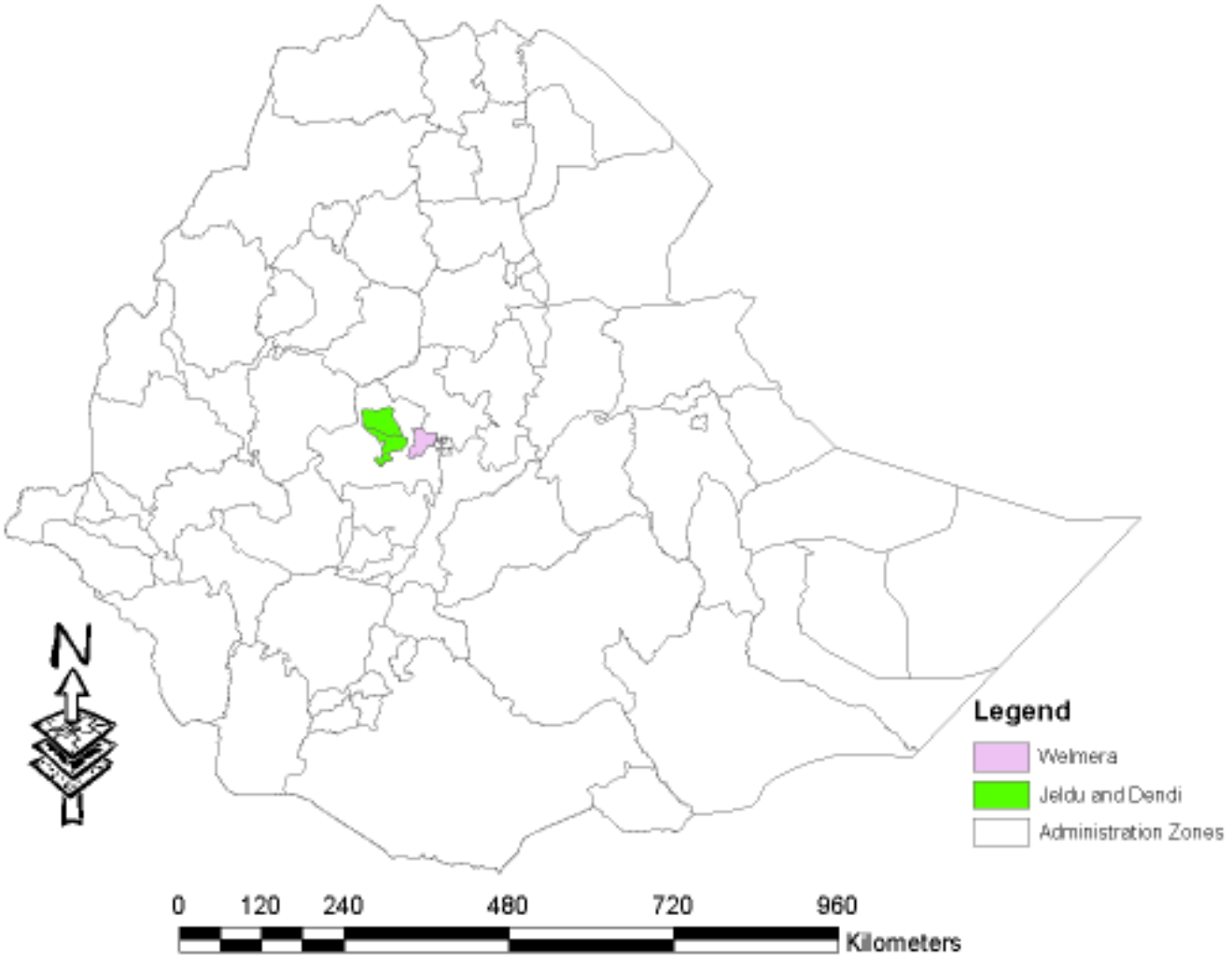
Dendi and Jeldu districts are characterized by high altitude, ranging from 2,400- 3,054 m.a.s.l. Rainfall pattern is bimodal with the main rainy season from June to September and short rainy season from February to March. Mean annual rainfall is ranging from 1,007 to 1,551. The maximum and minimum temperature ranges from 18 to 26.5 ^{0}C and 1^{0}C to 10 ^{0}C (IFAD-FFS Ethiopia project Final Report 2002).

On-farm activities are the main economic activities in the two districts with very little number of farmers working in off-farm activities. Source of cash income in the area includes sales of crops such as barley, wheat, live animals, animal products and potato.

According to respective districts Office of Agriculture, the population size of Jeldu and Dendi districts are 5,000 and 2,000 respectively.

IFAD-FFS Ethiopia project had a total budget of 104,000 USD, which was allocated by IFAD. The time frame for the implementation of the project was from 1999 to 2002.

Figure 2 Location of Dendi and Jeldu districts in Ethiopia



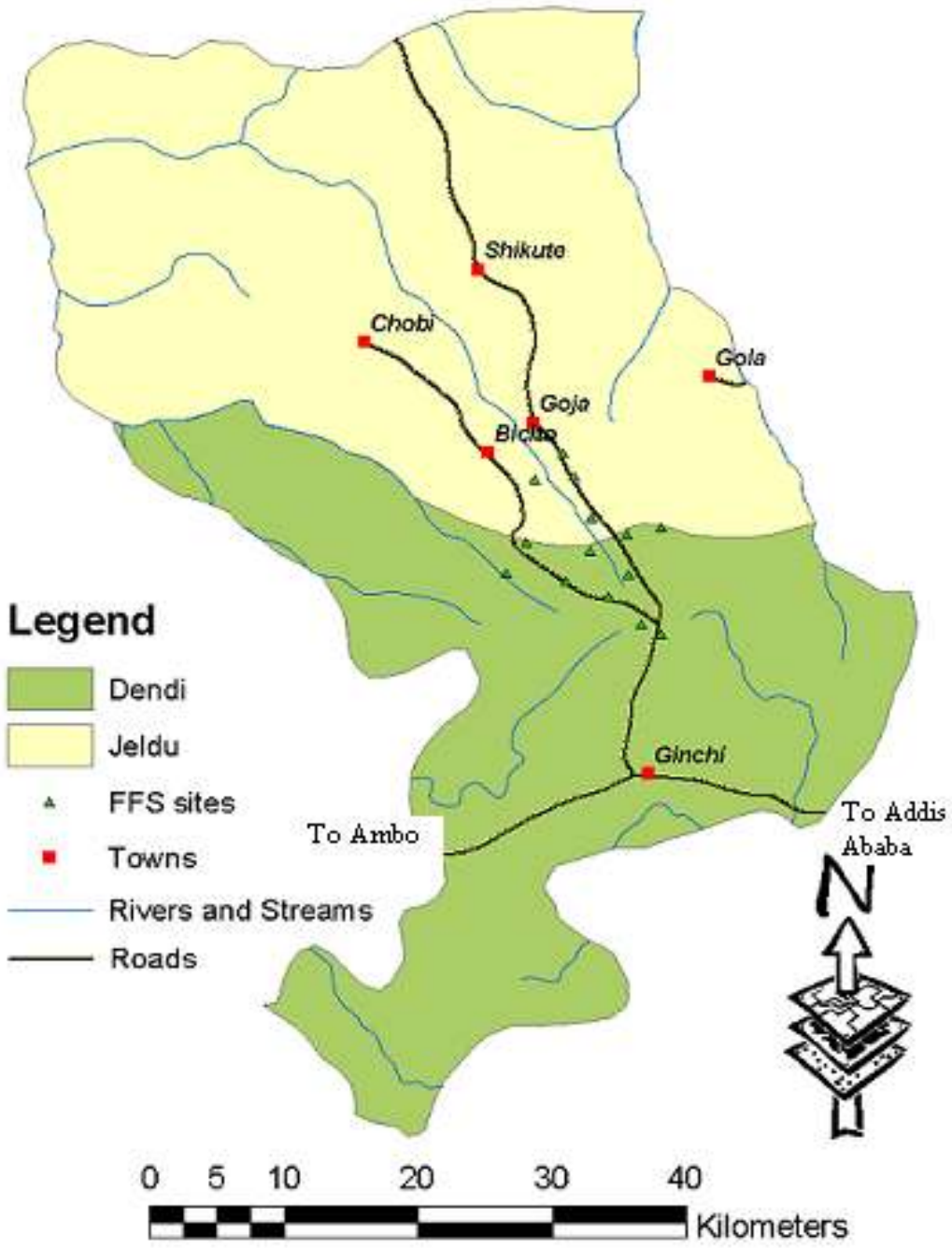


Figure 3 FFS sites in Dendi and Jeldu Districts, Ethiopia

2.6. Achieved Intervention

During the project period (1999-2002), 17 FFS were implemented in the pilot site, Dendi, Jeldu and Wolmera districts, with total number of participating farmers of 375. In addition to this a guideline was also prepared to assist FFS facilitators in implementing potato FFS-IDM in Ethiopia.

CHAPTER 3 EVALUATION METHODOLOGY

3.1.Delineation of the Research

This research is limited to evaluating the impact of FFS-IDM project on potato late blight management in the central highlands of Ethiopia. It specifically tries to measure the impact of the project on farmer's knowledge about late blight disease and potato production and storage techniques, and impact on income from potato and the household. It doesn't involve economic impact and cost-benefit analysis of the project.

3.2.Assumptions of the Impact Study

This impact evaluation study is based on the following assumptions:

- IDM FFS intervention was well implemented to produce an impact on farmer's knowledge, attitude and practice about late blight and potato production in the study area.
- The impact in potato production influenced the household status of small scale farmers in the area
- Small scale potato growing farmers can perceive the benefits from the FFS

3.3.Relevant Evaluation Questions

The problem to be investigated in this study is the impact of FFS-IDM on knowledge, attitude and practice of farmers about late blight disease and potato production techniques, impact on income from potato and the household of small-scale potato growers in Dendi and Jeldu districts. It is stated with the following research question:

'**Does FFS-IDM approach impacted knowledge, attitude and practice on late blight control and potato production, income from potato and household status, as measured by ox ownership and food supply from potato, of small scale potato growers in Dendi and Jeldu districts?'**

Research Sub-Questions

- Does FFS-IDM impacted late blight control and potato production knowledge and practice of potato growing farmers in the pilot area?
- Does FFS-IDM impacted income from potato of potato growing farmers in the study area?
- Does FFS-IDM approach impacted household status of potato growers in the study area?

3.4.The Study Objectives

The general objective of this research is to evaluate impact of the FFS-IDM approach in Dendi and Jeldu districts in the Central Highlands of Ethiopia through the consideration of its impact on the farmers' knowledge, attitude and practice about late blight control and potato production, income from potato and household status.

Specific objectives of the study are to: -

- Identify the impact of FFS-IDM approach on knowledge, attitude and practice about late blight control and potato production of farmers in the study area;
- Identify the impact of FFS-IDM approach on income from potato of farmers in the study area;
- Determine the impact of FFS-IDM approach on the farmers household status in the study area;
- Determine the difference in the level of potato production and late blight control knowledge, potato yield and income from potato of farmers who participated in FFS-IDM approach and farmers who did not;

3.5.Choice of Evaluation Method

Since FFS-IDM intervention was designed to improve farmers' knowledge on potato late blight disease in particular and improved potato cultivation in general. It was assumed in this intervention that the improvement in farmers knowledge will enhance potato cultivation and reduce the effect of the disease as a result of which farmers would improve their potato yield thus improve their food supply and income from potato (Section 2.3). The general effect of the change in knowledge of farmers is also assumed to positively influence their income from potato and their household status. This research, therefore, tries to identify the impact of the FFS-IDM approach on the participating and non-participating farmers in the pilot area.

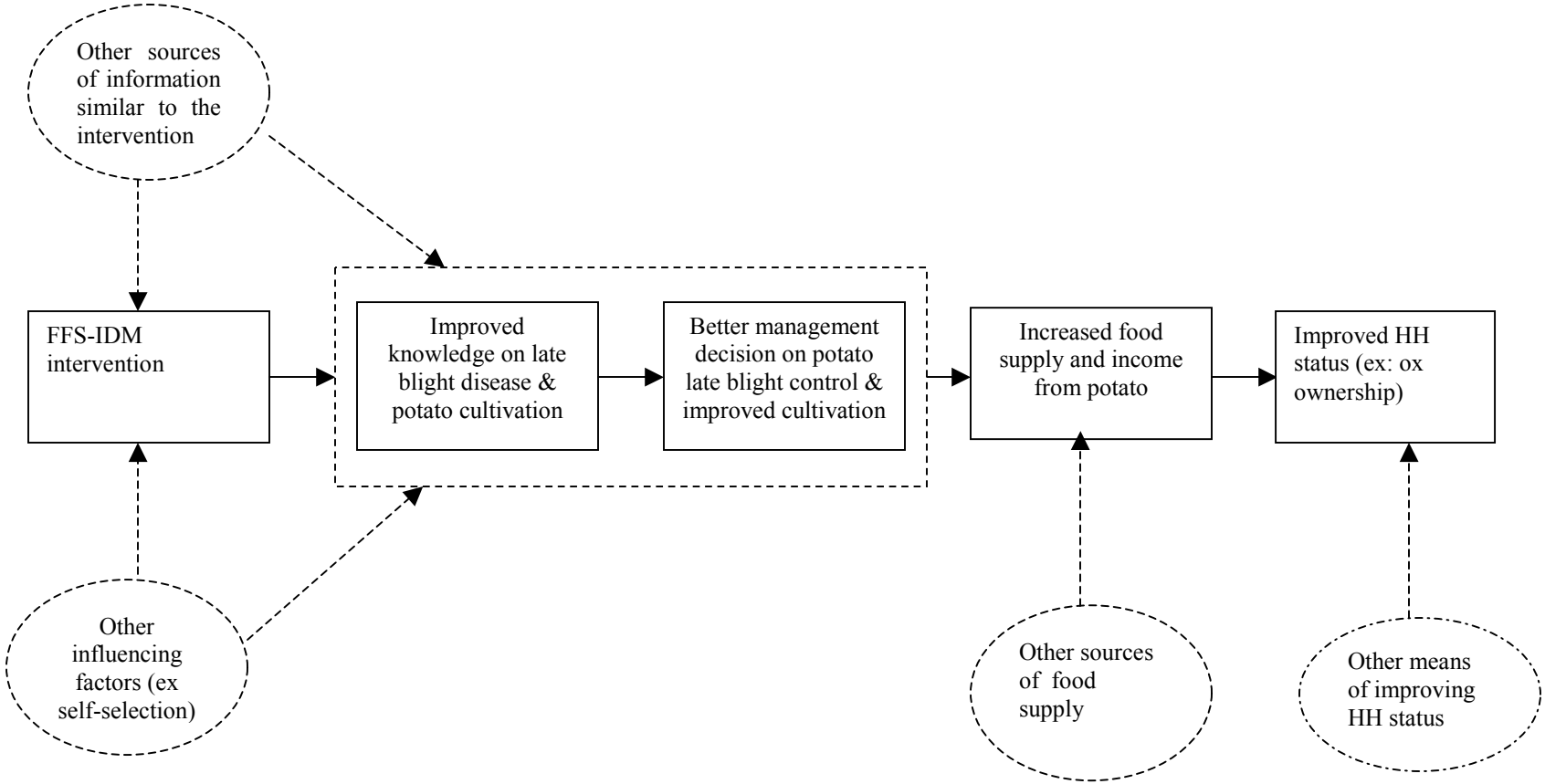


Figure 4 Diagrammatic Representation of the Impact Assessment Study

Since all impact assessments are comparative (Rossi, 1999), simple comparison of differences in knowledge about late blight and changes in mean potato yield or income among participants and non-participants may not indicate the exact impact of the project. This could be due to: -

- **Farmers diversified sources of information with impact similar to the project**

As shown in Figure 4, both participating and non-participating farmers can have different source of information to enhance their knowledge about potato late blight disease and improved potato cultivation as a consequence this can influence both the intervention and its final outcome. For this reason this evaluation uses a methodology suitable to identify and capture such sources of impact and separate from the impact of the project by using

a) Systematic random sampling technique to give equal chance for all farmers in the sampling frame to be included in the study with the assumption that if there are effects of other information sources, it will be represented in the sampling and will be identified and controlled during the analysis,
b) The questionnaire is designed in such a way that farmers can indicate their sources of information separately for each knowledge they get which might have similar effect like the intervention
c) Categorize farmers based on their information source to simplify analysis and identify the impact of the different information sources

Therefore, as indicated under a) above, a sample of 154 individuals was taken from 4 PAs' in the two districts using systematic random sampling technique. All the PAs where the FFS-IDM intervention was located were selected for data collection. Prior to sampling, individuals familiar with each PA were asked to draw map of their PA indicating each village and also the location of each FFS-IDM with in the PA. Following this, two types of villages were identified in each PA, those villages with and without FFS-IDM. Therefore, the sampling frame was determined based on availability of FFS-IDM in the PA. This technique was used to disperse the observation across the study area

and provide equal chance for all the farmers to be selected for the data collection in order to increase the external validity of the research out put.

During sampling, list of individuals living in the PA was used as a sampling frame. Based on this, a total of 154 individuals (82 from Dendi and 72 from Jeldu Districts), as shown in Table 1, were selected for quantitative data collection. This sample size was considered taking the time and other resources available for the research into consideration.

Table 1 Size of the Sampling Frame & Number of Observations in the Study

District	Name of PA	No of House Holds[3]	No of observation
Dendi	Galesa Kota Gisher	335	41
	Galesa Koftu	325	41
Jeldu	Seriti Denku	563	40
	Chilanko	234	32
TOTAL		**1457**	**154**

Following the sampling, enumerators were recruited and trained/ oriented with the pre-designed questionnaire. This step was also used to pre-test the questionnaire and adjust it based on observation.

Data for this research was gathered using focus group discussion, by the help of a topic guide, and a survey technique using a pre-designed questionnaire (See Annex 2). As indicated in this section, under b) above, data was also collected specifically on sources of knowledge for each late blight control and improved potato production technique the farmers use.

During analysis, the individuals were categorized in to 2 different groups, which are participants' and non-participants.

[3] Information retrieved from records of the respective PA

This methodology was used to simplify the data analysis based on different knowledge sources, to see the spill over effect of the FFS-IDM approach to non-participating individuals and also to single out the impact of other information sources from the impact of the desired intervention, FFS-IDM.

However, even in this case the non-participating farmers can get information from participating farmers (obviously knowledge from FFS-IDM intervention) and increase their potato yield and income. Though this can be considered as secondary impact of the intervention, it actually reduces the impact of the project if only simple comparison is made between participants and non-participants after the intervention. Therefore, it is important to judge the differences between participants and non-participants with and without the project as well as before and after the project so that the changes on non-participating farmers before and after the project would be compared with the changes in participants before and after the project. Since other information sources are assumed to have more or less similar effect on both participants and non-participants, any improvement on non-participants would be attributed to spill over effect or secondary impact of the project. As indicated earlier in this section, the data collection format of this research is also designed in such a way that non-participants can indicate their source of information regarding any improved LB control practice or improved potato production technique.

- **Self-selection of participants into the program**

The other key element in this evaluation is the initial selection procedure of participants into the FFS-IDM project, which was done in two major steps. Prior to selection of individuals to participate in the intervention, EARO-HARC selected the villages based on prior information about late blight problem and potato production in the area. Following selection of the villages, farmers in each village were assembled in their respective village and informed about the working modalities of the FFS-IDM and voluntarily recruited into the intervention. In villages where number of volunteers was in excess of the required, 25 farmers among the volunteers were selected in a random lottery drawing. Therefore, it is possible that this voluntary selection of participants might have affected

the impact of the FFS-IDM intervention. According to Rossi, 1999 '… there is always a possibility that those who choose to participate will be the ones most likely to improve whether or not they receive the services of the program'. For this reason, it could be possible that the farmers volunteered to the intervention are better off with some characteristics which can affect the out come of the intervention and any change observed during this research can easily be mis-interpreted as impact of the project.

In order to minimize the effects of such problems of self-selection, the evaluation first compared the participating and non-participating farmers in their underlying characteristics like level of education, family size, farm size, family food situation before the intervention, potato farm size before, no of ox before, size of farm land before, potato sale 1999/2000 and potato sale 2000/2001[4]. Independent samples t-test was employed for all the variables except level of education and family food situation before the project, which was compared using Mann-Whitney U test which is the '…non-parametric equivalent of the independent samples t-test' (Kinnear and Gray, 2000).

Table 2 Independent Samples Test to compare participant and non-participant groups before the intervention

Variable	T-test for Equality of Means	
	t	Sig. (2-tailed)
Family size	-.768	.444
Farm Size	-.270	.788
Potato farm size before	-2.148	.033
No of Ox before	-1.516	.132
Size of farm land before	-.352	.725
Potato sale 1999/2000	-1.006	.316
Potato sale 2000/2001	-1.711	.089

Table 2 shows the result of the independent samples t-test for the participating and control groups. Accordingly, the two groups had no significant difference (α=0.5, 2-

[4] Potato sale during the two years is considered here as before situation for the reason that farmers didn't yet start to change their potato production practice, including the use of improved potato varieties

tailed test) on these characteristics prior to the intervention. However, as depicted in Table 3, the U test has indicated significant difference in the level of education while family food situation was similar for the two groups.

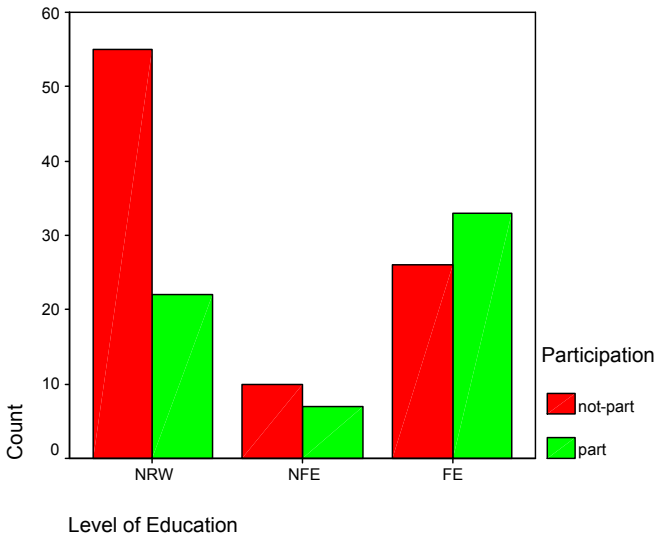
Table 3Comparison of level of education and family food situation between participant and non-participants, Dendi and Jeldu districts, Ethiopia, 2005 (n=154)

Variables	Ranks			Test Statistics		
	Participation	N	Mean rank	Mann-Whitney U	Z	Sig (2-tailed)
Level of education	Not-part	91	**68.45**	2043.000	-3.205	.001
	Participated	62	89.55			
Family food situation	Not-part	91	78.15	2668.000	-.900	.368
	Participated	61	75.26			

There are two assumptions here based on the difference in the level of education between the two groups. The first assumption is that the difference is due to large sample size of non-participants, 92, as compared to participants, 62, and the proportionally big number of farmers in the population not reading and writing (Figure 5). This resulted in higher frequency of farmers not reading and writing in the sample of the control groups, artificially reporting their low participation; though in reality 35% of participants can not read and write.

The second assumption is that, level of education affects participation in FFS-IDM intervention. Accordingly, there are two ways to proceed. The first one is to randomly select cases based on participation and level of education and create proportional samples using pseudo-random techniques and compare these two groups. This method has shown non-significant difference in the level of education between the two groups. While the second option is to statistically control for level of education and compare the effect of the intervention at each education level of the treated and the control group and separate the effect of the treatment from the effect of education. It is also necessary here to check if there is possible interaction effect between participation and level of education.

Figure 5 Distribution of Participating and Control Group Based on Level of Education[5], Dendi & Jeldu Districts, Ethiopia, 2005 (n=153)



Based on the second assumption, he data is analyzed by statistically controlling for level of education. For sake convenience the farmers were categorized into three groups based on their education level as Not Reading and Writing (NRW), Non Formal Education (NFE) and Formal Education (FE).

Therefore, Chapter 4 presents the results of the analysis, using the second assumption in this section above.

[5] NRW, Not Reading & Writing; NFE, Non Formal Education; FE, Formal Education;

CHAPTER 4 EVALUATION RESULT

4.1.Introduction

This chapter is organized in such a way that the effect of the intervention is analyzed separately on

- farmers knowledge, attitude and practice about potato late blight disease,
- farmers income from potato and
- impact on the farmers house hold which measures changes in ox ownership and improvement in house hold food supply,

Accordingly, the chapter constitutes three parts. Part 1 deals on impact of the intervention on farmer's knowledge, attitude and practice about potato late blight disease, while part 2 deals on impact on income from potato and part 3 shows the impact of the intervention on the household.

4.2.Uncovering the Reality: Impact of FFS-IDM on Farmers Knowledge, Attitude and Practice about potato late blight disease

"*Farmers do not know the sources, causes and factors favoring or affecting late blight and believe that fog and rain are the causes of the disease*."

(Bekele et al 2002)

The knowledge, attitude and practice of farmers documented prior to project implementation indicated that fog and rainfall were known to be the cause of potato late blight in the area. As a result of this perception, the farmers in the intervention area thought that controlling late blight during the rainy season is something impossible and they shifted their planting date from June to February so that the potato can mature and escape the disease before the onset of the rainy season in June. However, this gives the farmers '… very low yields because they plant potatoes in the dry season to avoid late blight and without sufficient water, potatoes yield poorly' (CIP, b). In addition to low productivity of the potato crop, this change in planting time also created a food shortage

period from September to February, which was originally filled with potato planted during the rainy season.

It was also documented, prior to the project, that farmers had incomplete information about fungicides to control the disease by consulting the District Ministry of Agricultural Office and farmers to farmers exchange of information and they apply Ridomil MZ 63.5 % WP and Mancozeb below the recommended rate for various reasons (IFAD-FFS Ethiopia Project Final Report 2002). In addition to this, farmers handling and application practices of the fungicide were highly risky to human and animal health in the area. Therefore, farmers had no other late blight controlling practice except the 2 methods of late blight control which were shifting their planting date and mild application of fungicide, though both cannot effectively control the disease.

Data collected during the focus group discussion and survey questionnaire with participating and non-participating farmers indicated that most of the participating farmers understand fungus as the cause of late blight and rainy and foggy conditions as environmental factors favoring the disease. While non-participating farmers still attribute rainfall and fog as the cause of LB. This indicates the shift in knowledge of participants related to the cause of the disease. However, since one of the objectives of this study is to determine the impact of the FFS-IDM intervention on knowledge of potato production and late blight control practice of small-scale potato growing farmers of the study area, it is necessary to identify the changes in LB control practices beyond the changes in knowledge about the cause. In addition to this, this research is designed to investigate the changes in LB control practices for the reason that changes in practice is related to changes in knowledge. Therefore, determining the level of changes in LB control practices will also indicate the level of knowledge about the disease.

This section, therefore, compares the numbers of late blight control methods employed by both participating and non-participating farmers and measure the impact of the intervention in change of farmers practices to control the disease. Baseline information

collected prior to the intervention and data collected form the field for this study was used in this comparison.

As indicated earlier in this section, farmers in the study area had only two late blight controlling methods before the project. Theses methods were shifting the planting date from June to February so that the potato can be harvested before the main rainy season in June and mild application of fungicides. However, it is also explained in this section that these methods cannot help the farmers to effectively control the disease and improve their potato yield. Accordingly, FFS-IDM intervention was implemented in the area to promote integrated late blight control methods, IDM-LB. The components of the IDM-LB technique include using improved disease resistant potato varieties, using late blight free healthy seeds, proper use of fungicides, hilling, crop rotation, crop residue destruction and destruction of volunteer crops (IFAD-FFS Ethiopia Project Final Report 2002).

Table 4 Comparison of Number of Late Blight Control Methods between Participants and Control based on Level of Education, Dendi and Jeldu Districts, Ethiopia, 2005 (n=153)

Variables		Participation		Cramer's V[6]	Sign.
Level of Education	**Late Blight Control**	**Not-part**	**Part**		
NRW	1-2 Methods	53	12	.521	.000
	>3 Methods	2	10		
NFE	1-2 Methods	10	4	.553	.023
	>3 Methods		3		
FE	1-2 Methods	23	16	.408	.002
	>3 Methods	3	16		

Table 4 depicts the relationship between participation in FFS-IDM intervention and the number of late blight control practices used in the study area after the intervention for the different education level of the farmers using Cramer's V test employed to test

[6] Pearson's Chi-square can not be used here for some cells have expected count of less than 5; Phi test and Pearson correlation gives the same result.

association between participation and number of late blight control methods under each educational level of the farmers. Based on this, it is discovered in this evaluation that there is significant difference between the participants and the control group in the number of late blight control methods under their respective level of education. In all the three level of education, farmers participated in FFS-IDM intervention practice more number of late blight control methods than their counterparts in the control group. Therefore, the above analysis gives the idea that there is association between participation in the FFS-IDM intervention and the practice of integrated late blight management techniques.

Further analysis of the data on number of late blight control methods as per level of farmers education shows that among the farmers not-reading and writing, 45% of the participants improved their knowledge on late blight and changed their controlling practice towards the disease. While only 3.7% of non-participating farmers in the same education level has changed their practice, which can also be attributed as secondary impact of the intervention. Among the farmers attending non-formal education, 42% has improved their practice against none of the control groups with non-formal education. Since there is lack of statistical power at this level of education category, it is difficult to conclude that the spill over effect of the project is better with farmers not reading and writing than those in this category. Half of participating farmers with formal education has improved their controlling practices against 13% of the non-participants.

Cross sectional analysis of the proportion of participating farmers changing their practices shows that, all groups of farmers can benefit proportionally from FFS-IDM without regard to their difference in the level of education. Based on this it is possible to conclude here that the FFS approach can help farmers to improve their knowledge and improve their decision in employing different late blight control techniques regardless of their education level. The data also shows that farmers without formal educational skill can also benefit from the techniques of knowledge transfer through FFS approach. This could probably be due to the adult education element of FFS approach, which mainly focuses on practical learning using hands on exercises. Though it is difficult to conclude

with small number of farmers in the non-formal educational level, secondary impact of FFS-IDM seems to increase with increasing educational level. This however needs further investigation.

The analysis of the data on number of late blight control methods has shown that FFS-IDM intervention has significantly increased the number of LB control practice of participating farmers which indicates a change in knowledge, attitude and practice of participants about the cause of LB against their original perception of the disease. Similarly possible changes in knowledge as a result of participation in potato related FFS have also been documented in Peru (Ortiz et al 2004, Godtland et al 2004).

In addition to knowledge about the cause of late blight, farmers in the study area had no knowledge concerning its control using improved potato varieties. Except very few farmers participating in on-farm trial or other interventions of HARC Potato Research Program, most of them in the study area had no knowledge of improved potato varieties. Data collected on year of first use of improved potato variety as a means of controlling late blight estimated that the farmers participated in the interventions of HARC before FFS-IDM intervention were only 1.3%. As a result of this 98.7% of the farmers in the study area couldn't use resistant varieties to control LB disease prior to the intervention.

However, analysis of use of improved variety as per educational level of the farmers shows that, Table 6, currently 100% of participating farmers who are not reading and writing and 52.72% of their counterparts in the control group are using improved potato varieties. This difference has shown to be statistically significant at α=0.01 level. While in the groups with non-formal education, 98.4% of participants are using improved varieties while 99.9% of their counterparts in the control group also use the varieties. As Table 6 reports, the difference between the two groups is also not statistically significant. This is probably due to small number of observations and consequently low statistical power to explain the difference in this category. However, comparison of frequency of improved potato variety use between participating and non-participating farmers before (1.3%) and after the intervention (>98%) shows that the two groups with non-formal

education level have significantly increased the number of potato varieties they use after the intervention.

Table 5 Comparison of Participating & Non-participating Farmers Using Improved Potato Varieties in Dendi & Jeldu Districts, Ethiopia, 2005 (n=154)

Variables		Participation		Cramer's V	Sig.
Level of Education	**Potato Varieties**	**Not-part**	**Part**		
NRW	Local	26	-	.452	.000
	Improved	29	22		
NFE	Local	1	1	.065	.787
	Improved	9	6		
FE	Local	7	-	.413	.001
	Improved	19	33		
	Total	91	62		

Moreover, all of the farmers with formal education who participated in the intervention are planting improved potato while 73% of farmers in their control group also use the varieties.

Cross sectional analysis of use of improved varieties across the different groups shows that >98% of participating farmers in all level of education use improved potato varieties. Moreover, both participating and non-participating farmers changed their attitude about the possibility of growing potato during the main rainy season and 77% of the farmers in the area currently use improved disease resistant potato varieties and able to plant potato in the main rainy season. This change in practice helped the farmers to improve their food situation and income from potato Sections 4.3 and 4.4.2).

Further comparison of this frequency with the 50% maximum proportion of participating farmers changing their number of late blight controlling methods as a result of change in their knowledge about the disease (the same section page 34 above) shows the high degree of diffusion of the varieties. This could be due to the fact that input based technologies (improved varieties in this case) disseminate much faster than knowledge-based technologies.

As the data on the change in the type of improved potato varieties used by both participating and non-participating farmers after the intervention shows, 98% of participating farmers and 62% of non-participants use improved variety. The later figure estimates the level of secondary impact (spill over effect) of the intervention on use of improved potato variety as obtained through farmer-to-farmer exchange and market. In addition to this farmers are also selling seed potato of the improved varieties to different governmental and non-governmental organizations operating in the country. However, availability of such seeds outside the project area is not measured in this study. Only the income from the proceeds is included in the impact analysis under section 4.3 below.

Generally, FFS-IDM intervention impacted the number of potato varieties used by farmers in the study area. This section earlier indicated the effect of changing potato-planting dates on potato productivity and food availability to the household. As discussed above, the use of improved varieties together with integrated late blight management techniques can help to reduce the effect of the disease and allow farmers to grow potato in the rainy season and increase food availability over the year. Therefore, it is possible to conclude here that availability of improved potato varieties and change in the number of late blight control techniques improved the practice of potato growing in the intervention area which in itself impacted food supply and income from potato (Sections 4.3 and 4.4).

The FFS-IDM intervention has enhanced farmer's access to improved potato varieties by multiplying and disseminating the varieties on the FFS-IDM plots while farmers were experimenting in late blight control methods on field plots. These varieties mostly developed by CIP and locally selected by EARO-National Potato Program are high yielding better resistant to late blight disease and with high acceptability on the market, Annex 4 shows list of the varieties used during the intervention.

4.3.Impact on Farmers Income From Potato

According to IFAD-FFS Ethiopia Project Final Report 2002, income source of farmers in the study area include selling barely, wheat, livestock products and horticultural crops.

Following other agricultural crops, selling potato is a good source of income. However, since the price of the local potato variety on the market is lower, the average income of farmers from potato remained lower. Comparison of income from potato between the participating and non-participating farmers shows that there is significant difference in income from potato after the FFS-IDM intervention.

Data on income from potato was collected using pre-designed questionnaire during the survey phase of this study. Farmers participated in the survey were requested to indicate their yearly potato sale in Birr[7] over the six years. In addition to this, farmers were also asked to specify the amount of potato they sold over these years to validate the data on income from potato by estimating average prices over each year. During the analysis, only four years average potato sale (2002-2005) was used as after situation for the reason that during the period 2000 – 2001, all the improved varieties were planted in the communal FFS field plot and not yet distributed for individual plantation and farmers didn't start marketing the varieties.

In this section, the impact of FFS-IDM participation on average potato sale is estimated using regression technique. The dependent variable, average potato sale (2002-2005), was regressed on different independent variables explaining household characteristics and participation in FFS-IDM. Table 10 reports the differential impact of each of the variables on the dependent variable.

It is assumed here that though participants were selected into the program on voluntarily basis, there was no selection bias into the intervention. This has also been indicated in Table 2 and 3 where only level of education was significantly different for participating and control groups. However, as data analysis in section 4.2 shows there is no effect of education level on some impact of the intervention like number of late blight control methods and use of improved potato varieties. Following this observation, the first assumption on page 29 section 3.5 above which says the difference in the level of education between participants and the control group is due to large sample size of the

[7] Birr is the Ethiopian currency with approximate exchange rate between 1 Euro: 10.5 to 11 Birr

control group was considered. Scatter plot of regression standardized predicted value against regression-standardized residual was explored and outliers outside three standard deviations were excluded from the analysis.

Therefore the regression analysis here follows the assumption that there is no selection effect into the intervention.

It is also assumed that the independent variables are linearly independent and there is no multicollinearity. This is checked using collinearity statistics. Table 6 shows tolerance statistics, '... which is the proportion of a variable's variance not accounted for by other independent variables in the equation' (Kinnear and Gray, 2001).

Based on these assumptions, the model in Table 6 shows the differential impact of the variables on average potato sale. The result shows that participation in FFS has significant effect on potato sale.

Table 6 Impact of FFS participation on average potato sale for the years 2002-2005 in Dendi & Jeldu districts, Ethiopia,

Variables	Coefficients	T	Sig.	Collinearity statistics
Participation	193.850	3.011	.003	.755
Level of Education	66.190	1.729	.086	.587
Size of Farm land before	18.768	.996	.321	.887
Age	-23.526	-.594	.554	.564
Gender	35.856	.377	.707	.832
Family Food Situation Before	-36.223	-.354	.724	.891
Family Size	9.882	.253	.801	.876
Other Potato Trainings	-22.068	-.237	.813	.775
No of Ox before	.975	.036	.971	.825
(Constant)	79.225	.329	.742	
N	130			

R^2	**.356**			

4.4.Impact of FFS-IDM on the Household

Impact of FFS-IDM intervention on the household is studied here in the form of impact on livestock ownership and family food situation. The impact of the intervention on livestock ownership specifically focuses on ox ownership for the reason that it is a basic asset for the household and a means of production to improve income from farming.

4.4.1. Impact on ox ownership

Ox ownership is one of the criteria for wealth ranking in rural Ethiopia including the study area. As part of impact evaluation of FFS-IDM intervention on ox ownership, this research uses two approaches. The first approach compares ox ownership between participants and non-participants after the intervention. The second approach, which is based on the first one, compares differences in changes in ox ownership between the two groups i.e. change in ox ownership in participants before and after the intervention, is compared with similar changes in ox ownership in non-participants.

Moreover, to separate the effect of other income sources on ox ownership, the survey questionnaire of this research was designed to document impact specifically related to FFS-IDM intervention. In addition to this, to estimate the differential effect of income from other non-agricultural and agricultural sources except potato sale, of both participating and non-participating farmers, such income was analyzed using t-test for equality of means. The result shows that (Table 7) there is no significant difference (α=0.05) in yearly average income except potato of participating and non-participating farmers.

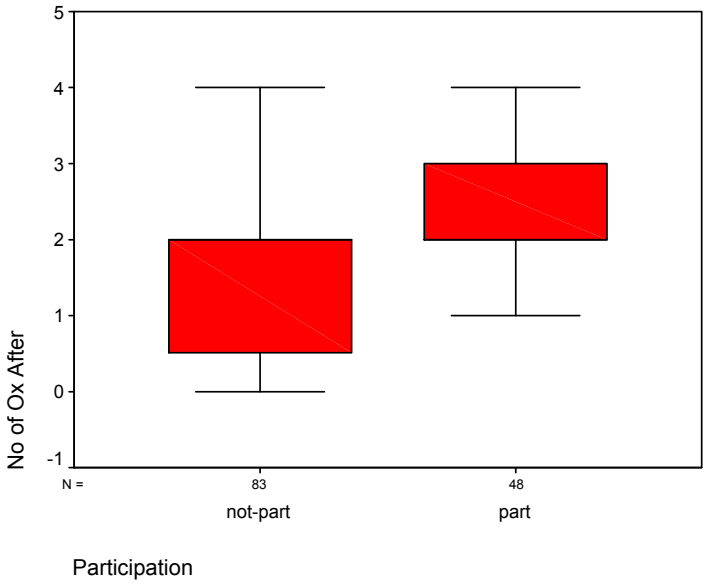
Table 7 Independent Samples Test of Non-Agricultural and Agricultural Income from Potato of Participating and Non-participating farmers in Dendi & Jeldu Districts, Ethiopia, 2005 (n=142)

Non-Agri & Agri income except potato in Birr	t-test for Equality of Means		
	t	Sig. (2-tailed)	Mean Difference
Non Agri-Income 2004/5	-1.175	.242	-124.43

Non Agri-Income 2003/4	-1.021	.309	-76.54
Non Agri-Income 2002/3	-1.217	.226	-85.37
Non Agri-Income 2001/2	.315	.753	16.16
Non Agri-Income 2000/1	.912	.363	37.53
Non Afri-Income 1999/2000	.641	.523	29.09
Agri Inc Expt potato 2004/5	-1.298	.196	-261.89
Agri Inc Expt potato 2003/4	-.931	.354	-178.79
Agri Inc Expt potato 2002/3	-1.181	.240	-201.39
Agri Inc Expt potato 2001/2	-1.117	.266	-122.36
Agri Inc Expt potato 2000/1	-1.632	.105	-97.41
Agri Inc expy potato 1999/2000	-1.496	.137	-88.69

Figure 7 displays the box plot, which indicates association between ox ownership and participation in FFS-IDM intervention. The figure shows that, there is a significant difference in ox ownership between participants and non-participants. Using the first approach to compare ox ownership between the two groups, all most all-participating farmers own at least 1 ox while 25% of the non-participants have no ox at all. Moreover, all most 50% of non-participants do not own a pair of oxen while it is only 25 % of the participants with less than a pair of oxen. Since ox is a means of production in the rural Ethiopia in general and the study are in particular, the higher the number of ox in a house hold the higher the productivity and vice versa. Therefore, it is possible to see here how much the intervention in potato is supporting agricultural productivity in the study area. However, this needs further study to investigate such positive externalities of the intervention.

Figure 6 Ox ownership and participation in FFS-IDM in Dendi & Jeldu districts, Ethiopia, 2005 (n=154)



Using the second approach to compare differences in changes in ox ownership between the two groups, this study employed independent samples t-test on differences of ox ownership of participating and non-participating farmers. The result shows that, Table 8, there is significant difference in difference of ox ownership between participants and non-participants before and after the intervention. The data shows that in average 38% of participants has got one additional ox due to participation in the intervention over the changes in non-participants (see also Figure 6).

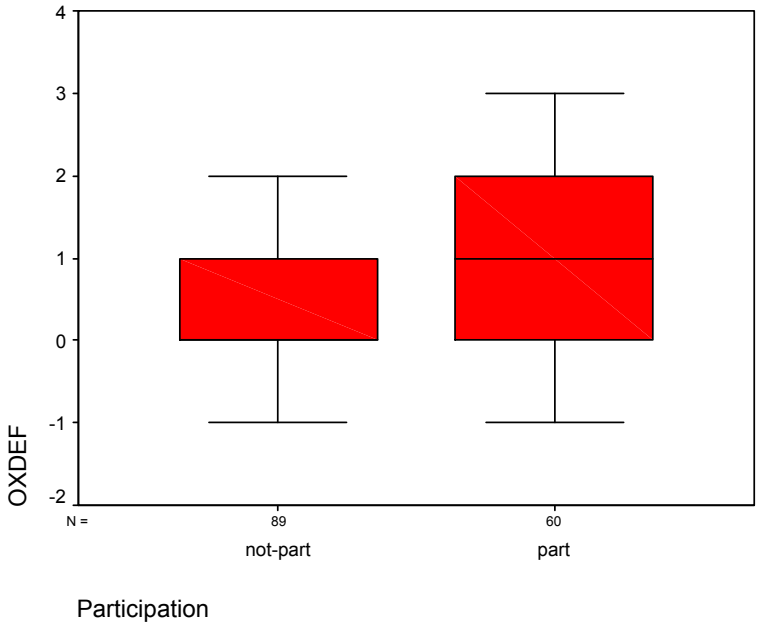
Table 8 Independent Samples t-test on Changes in Ox Ownership Before and After the Intervention between Participants & Non-participants, Dendi & Jeldu districts, Ethiopia, 2005, (n=151)

Participation	N	Mean difference	Standard deviation	t-test for Equality of Means		Mean Difference
				t	Sig. (2-tailed)	
Non-part	89	.5843	.7509	-2.933	.004	-.3824
Part	60	.9667	.8227			

Therefore, based on the above analysis using the two approaches, it is possible to conclude that FFS-IDM intervention has improved ox ownership in the intervention area. Since other factors are assumed similar for both groups, the difference observed in the

changes of ox ownership between participants and non-participants after the intervention are clearly attributable to the difference in potato sale between the two groups.

Figure 7Comparison of Difference in Ox ownership between Participants & Control Group after the Intervention, Dendi & Jeldu Districts, Ethiopia (n=151)



4.4.2. Impact on family food situation

Base line survey conducted prior to project implementation confirmed that the local potato variety is completely wiped out by late blight when planted in the main rainy season from June to September. Data collected during the focus group discussion indicated that farmers with shortage in food supply borrow food in September/October and pay back double in December, or they pay back what they borrow in December and harvest the crop of the borrower as interest.

Analysis of the food situation after the FFS-IDM intervention in Dendi and Jeldu districts shows significant difference between participating and non-participating farmers. Forty six percent of the farmers in the study area observed a change in family food supply due to potato. Table 7 shows cross tab counts of food situation between participating and non-participating farmers and the result of Pearson's chi-square test. Accordingly, the

frequency of food shortage among non-participants is 0.92 while it is 0.24 among participants. Analysis of the frequencies shows that the odds of food shortage among non-participants is 3.8 times higher than the participants. This indicates that there is association between participation and family food situation. Pearson's chi-square test was also used to compare the observed frequencies with their corresponding expected frequencies and observe whether the trend of food situation in both participating and non-participating farmers follow the same pattern or not. The chi-square test confirms that the food situation between participating and non-participating farmers is not similar.

Table 9 Comparison of Family Food Situation between Participants & Non=participants in Dendi & Jeldu Districts, Ethiopia, 2005 (n=153)

Participation	Family Food Situation		Total	Pearson Chi-square	Sig.
	Not enough*	Enough**			
Not-participants	44	48	92	12.529	.000
Participants	12	49	61		
Total	56	97	153		

* Potato produced is not enough for food through the year

** Potato produced is enough for food through out the year

The difference in the food situation shows that more than 75% of participating farmers have improved their food supply and able to fill the food gap they had form September to February before their participation in the intervention. This is mainly due to the integrated LB management techniques through FFS-IDM, which enabled farmers to grow potato in the rainy season.

CHAPTER 5 CONCLUSION

This study has shown how participation in FFS can increase understanding of farmers about potato late blight disease and helped them to improve their controlling practices of the disease. It has also demonstrated that FFS can help to improve farmers knowledge and affect their agricultural practice even on knowledge intensive technologies. Comparison of the impact of the FFS approach using farmers level of education also indicated that farmers can benefit from this approach, with out regard to their level of education. As shown in the result under section 4.2, 45% of farmers who can not read and write have changed their late blight control practices due to their participation in FFS. This shows that FFS can help the uneducated rural farmers to increase their understanding on agricultural knowledge and increase their productivity and efficient use of their natural resources.

Therefore it is concluded here that FFS approach can be an option to extend knowledge intensive technologies to farmers. It can help farmers to get full insight of their production system and help themselves in controlling plant disease like late blight and depend less on external technical assistance in the long run. Once they discover the reality they integrate the new knowledge into their system and change their agricultural practices accordingly. The performance of farmers based on the knowledge they get 3 years after indicates that once they obtain practical information they will maintain and use it for long period of time. This demonstrates the reality that if farmers get the chance to participate in developing solutions of their own serious problems, they get full idea of the process and adopt the result sustainably.

REFERENCES

Bekele Kassa and Yaynu Hiskias. 1994. Research on potato diseases in Ethiopia. pp.226-231.In:Edward H. and Lemma Dessalegne (eds.). Proceeding of the second National Horticultural workshop of Ethiopia. 1-3 Dec., 1992, Addis Ababa. Ethiopia. IAR/FAO, Addis Ababa

Bekele K. et al. (2002) Integrated Potato Late Blight Management: Experience of Farmer Field School (FFS) in Dendi District. IN Gemechu. K et al (eds) (2002) Towards Farmers Participatory Research: Attempts and achievements in the Central Highlands of Ethiopia. Proceedings of Client-Oriented Research Evaluation Workshop, 16-18 October 2001, Holetta Agricultural Research Center, Holetta, Ethiopia.

CIA. The World Fact Book: Ethiopia. Accessed at http://www.cia.gov/cia/publications/factbook/geos/et.html. On 10 August 2005.

CIP, a. Participatory Research and Farmer Training. Accessed at http://www.cipotato.org/potato/Pests_Disease/lateblight/participatory_research.htm Accessed on 15 May 2005.

CIP, b. *Integrated Management of Late Blight.* Accessed at http://www.cipotato.org/potato/Pests_Disease/lateblight/integrated_management_LB.htm Accessed on 15 May 2005.

Cleaver, K. M. and W.G. Donovan. (1995). *Agricultural Poverty and Policy Reform in Sub-Saharan Africa.* World Bank Discussion Paper 280, Africa Technical Department Service. World Bank, Washington D.C.

EARO. Strategies and Priorities for Potato Research. (unpublished).

Feder, Gershon, Rinku Murgai, and Jaime Quizone. 2003. "Sending Farmers Back to School: The Impact of farmer Field Schools in Indinesia." World Bank Policy Research Working Paper 3022.

Final Report of Activities & Achievements of the IFAD Funded Project: Refining and Implementing IDM Late Blight Strategies Through Farmers Field School (FFS). 2002.

Gebre Medhin, W. et al. 2001. Country Profile of Potato Production and Utilization: Ethiopia. Ethiopian Agricultural Research Organization, Holeta Agricultural Research Center, National Potato Program. (Unpublished)

Godtland, E., E. Sadoulet, A. de Janvry, R. Murgai and O. Ortiz. 2004. The Impact of Farmer-Field-Schools on Knowledge and Productivity: A study of Potato Farmers in the Peruvian Andes. Economic Development and Cultural Change. Vol 53 No. 1 October 2004. pp63-92.

Habtemariam K. (1996). Agricultural Education, Research and Extension in Ethiopia: Problems and Linkages. In: Mulatu D. et al (eds). *Proceedings of the Second Conference of the Agricultural Economics Society of Ethiopia. 3-4 October 1996*, Addis Ababa, Ethiopia. Agricultural Economics Society of Ethiopia, pp:161-181.

Horton, D. 1987. Potatoes: Production, Marketing and Programs for Developing Countries. Westview Press. Boulder.

Kinnear., P.R. and Gray C.D. (2000). *SPSS FOR WINDOWS MADE SIMPLE, RELEASE 10.* Department of Psychology, University of Aberdeen. East Sussex, UK.

MoFED FDRE. 2002. *Sustainable Development and Poverty Reduction Strategy Paper.*

Ortiz, O.; Garret, K. A.; Heath, J.J.; Orrego, R.; Nelson, R.J 2004. Management of potato late blight in the Peruvian Highlands: Evaluating the benefits of farmer field schools and farmer participatory research. Plant Disease. Vol. 88 No. 5 pp 565-571.

Pankhrust, R. 1964. Notes on history of Ethiopian Agriculture. Ethiopian Observer 7: 210-240.

Rossi P.H., Freeman H.E. and Lipsey (1999). Strategies for Impact Assessment. In: Evaluation: A systematic Approach. London, Sage. Pp:234-276.

Scott, G.; Rosegrant, M.; Tingler, C.; 2000. Roots and tubers for the 21st century Washington DC, International Food Policy Research Institute and International Potato Center.

Torrez, R. et al. *Implementing IPM for Late Blight in the Andes*. In CIP Program Report 1997-1998. Accessed at http://www.cipotato.org/market/PgmRprts/pr97-98/12ipmlb on 20 August 2005.

Yilma, S. 1991. The potential of true potato seed in potato production in Ethiopia. Actae Hurticultrae. No. 270:389-394.

Zuger, R. (2004) Impact assessment of Farmer Fields schools in Cajamarca, Peru; an economic evaluation . Social Sciences working paper No. 2004-1 Lima, Peru: International Potato Center

ANNEXES

Annex 1: Topic Guide for Focus Group Discussion (qualitative data collection)

1. Why did you involve in FFS-IDM?
2. What did you learn from the school?
3. What did you use/ apply from the FFS in to your potato production system?
    - Regarding seed selection?
    - Planting?
    - Crop management practices?
    - Harvesting?
    - Storage, for seed? for food?
    - Do you practice the following?
        i. Ridging/Hilling
        ii. Organic and inorganic fertilizer application , which ones (including animal manure, compost etc), when and how to apply
        iii. Cultural practices (residue destruction, up-rooting volunteers, Rotation

Knowledge about environmental factors that affect late blight disease and the causal agent of late blight

4. What causes late blight?
5. Do you recognize the symptoms of the disease?
6. How can potato late blight spread?
7. What conditions are favorable for potato late blight?
8. What practice(s) do you use to control late blight?

Farmer's knowledge about fungicide application

9. How do you determine fungicide application for late blight control (correct dose, application timing)
10. What equipment do you use to apply fungicide? how do you calibrate the fungicide application equipment
11. What protective equipment do you use for chemical application?

Farmer's experimentation capacity, concepts of treatments, repetitions, and randomization.

12. Did you conduct any experiment, test or make comparison on different varieties of potato or other crops, or on anything else? How did you conduct it?

Group dynamism

13. How did you work in-group on common problems like late blight, before, and how you do now?

Impact

14. Have you observed any change in your life as a result of participating in FFS? Which ones?

Annex 2: Questionnaire for Quantitative Data Collection

1) Have you participated in FFS

1. Yes
2. No

If yes, which type of FFS

1. organized by FFS project
2. organized by farmer facilitators
3. Other, specify _____

If no, have you heard about FFS-IDM?

1. YES
2. NO

If yes, How?

1. from family member or neighbor participated in FFS-IDM
2. from family member or neighbor not participated in FFS-IDM
3. from some one leaving outside the village, (specify the village)_____
4. other, specify _____

Have you participated on other potato related training (including potato extension services) other than FFS-IDM?

1. YES
2. NO

If yes, by which organization?

1. HARC
2. WoA
3. Other, specify _____

How many potato varieties did you grow so far? _____

s

Varity	**Time of first planting**	**Initial Source of seed**
Tolcha		

Wochecha		
Menagesha		
.2		
.3		
.5		
Genet		
Awash		
Other, specify		

Source of seed

1. Farmers field School
2. HARC
3. Farmer-to-farmer exchange
4. From market
5. Other, specify _____

Do you store potato for seed?

1. YES
2. NO

If yes, how do you store?

1. Diffused Light Store
2. Traditional practice
3. Other specify _____

If you use Diffused Light Store, since when? _____

If you use DLS, how did you know about it?

1. FFS
2. HARC
3. WoA
4. Other, specify _____

Crop Management Practices

How do you practice the following? Why?

Crop management practice	Before FFS	After FFS
Seed bed preparation		
Clean seed selection		
Row planting		
Fertilizer application		
Hilling		
Up-rooting volunteers		
Chemical spraying		
De-haulming		
Potato storage using DLS		
Potato storage using traditional system		

Late blight management

Do you have potato late blight problem?

1. YES
2. NO

If yes, how did you control it? /indicate the answer or the answers/

1. using resistant varieties
2. Hilling
3. Chemical sprays
4. Wide spacing
5. Crop residue destruction
6. Destruction of volunteer potatoes
7. shifting planting time
8. others, specify _____

Agricultural production of the HH in the past year

Changes on crop production pattern over the past 4 years

Crop type	**Do you use improved variety?**	**Since when**
Wheat		
Barley		
Beans		
Peas		
Lentil		
Teff		
Others, specify		

Changes in potato farm size over years (how do you measure your farm size: hectare, *kert*, *timad*)

Varity	2005	2004	2003	2002	2001	2000
Local						
Tolcha						
Wochecha						
Menagesha						
.2						
.3						
.5						
.8						
.13						
Genet						
Awash						
Others						

If potato farm size is increasing why?

1. high productivity
2. increased income
3. good taste for food
4. adaptable to the area

5. resist disease
6. others, specify

Do you use fertilizer for potato production?

1. YES
2. NO

If yes, since when _____?

If no, why?

1. The farm is fertile enough
2. Fertilizer is expensive
3. Using fertilizer not profitable
4. Fertilizer is not available
5. Other, specify _____

Do you use fungicide to control late blight?

1. YES
2. NO

If yes, since when? _____

If no, why?

1. no problem of late blight
2. the variety is resistant to late blight
3. no idea about the fungicide
4. it is not available
5. it is expensive
6. lack of sprayer
7. I use cultural control practices

Do you participate in potato extension services?

1. YES
2. NO

If yes, since when? _____

If yes, from which organization?

1. WoA
2. HARC
3. Other, specify _____

Indicate the size of your potato farm? _____ (please indicate how you measure your farm)

How much potato did you produce during the last season?

Production	**Average production**	**Minimum Production**	**Maximum Production**
Improved variety			
Local variety			

Do you sell potato?

1. YES
2. NO

If yes, how much was the income?

	2005	**2004**	**2003**	**2002**	**2001**
Amount of Money Sold					
Quantity of potato sold (in quintals)					

Did you observe any change in the HH over the past 4 years due to potato?

Type of Change	**Change Observed (yes/no)**	**Before 4 Years**	**Now**
Type of house			
Number of house			
renewing house			
number of ox			
number of cows			
number of hybrid cattle			
number of calves			
number of heifer			
number of sheep			
number of goats			
number of donkey			
number of horses			
number of chickens			
farm size			
HH food supply			
Credit			
input use (fertilizer, pesticides, fungicides)			
labor use			
number of children going to school			
purchasing school materials for children			
HH closing condition			
Saving			
on farm investment for income			

Type of Change	**Change Observed (yes/no)**	**Before 4 Years**	**Now**
source			
off-farm investment for income source			
Access to medical treatment			
HH expenses			
contracting farm land from other farmers/ share cropping			
other, specify			

Do you have other income different from agriculture?

1. YES
2. NO

If yes, please indicate the amount in Birr

2005	2004	2003	2002	2001	2000
_____	_____	_____	_____	_____	_____

Do you have other income from agriculture different from potato?

1. YES
2. NO

If yes, please indicate the amount in Birr

2005	2004	2003	2002	2001	2000
_____	_____	_____	_____	_____	_____

Name _____

Age _____

Sex _____

Level of education: _____

Family size: _____

District _____

PA _____

Village _____

Farm size

land owned _____

total farmland _____

potato farm size _____

Annex 3: Summery of FFS-IDM Facilitators Guide (IFAD-FFS Ethiopia Project Facilitators Guide)

Session title	Objective(s)	Methods
1.Introduction to FFS	Introduce the mode of operations of FFS	Discussion
2.Knowledge, Attitude & practice of farmers on late blight/ bacterial wilt & potato production	Determine knowledge, attitude & practice of farmers Share experience	Group discussion, preference ranking etc.
3.Potato seed quality, sorting, handling potato seed and planting	To assist farmers to recognize late blight in tubers Determine quality of seed & planting	Group discussion, experimentation, planting according to the recommended spacing
4.sssBasic concepts of experimentation	To give farmers idea on basic aspect of experimental design	Group discussion, field exercise
5.Crop management and its application to potato (seedling emergence, weeding, hilling and soil fertility)	To encourage problem identification and make decision at field level.	Observation of the field (agro-ecosystem analysis), field activity, discussion, data collection
6. Role of organic fertilizer, compost preparation and use	To understand the ITK and improved compost preparation	Discussion, Activity and Experimentation
7.Symptom and diagnosis of late blight and other potato diseases such as bacterial wilt and viruses	Differentiate symptoms caused by insect pests and various diseases Learn about the disease in	Discussion, observation, experimentation, data collection (rainfall, temperature and relative humidity)

Session title	Objective(s)	Methods
	their fields	
8 & 9.Late blight development & potato disease in relation to the environment and clonal / varieatal evaluation	Learn the causes and life cycle of late blight pathogen Identify sources of inoculum and means of transmission	Observation, group discussion, presentation, field-lab exercise, data recording on late blight progress.
10.Field insect pests of potato (Cut worm)	Learn the different type of insects (harmful and harmless) and understand the life cycle of the major insect pests Identify type of damage caused	Observation, discussion on representative insect pest specimen.
11.Reaction of potato varieties to late blight under different fungicide management strategies	Test a set of promising potato varieties/ clones under local conditions Monitor disease & environmental conditions through data collection	Field exercise, discussion, data collection on late blight severity, weather etc.
12. Fungicide application: nozzle selection, spray equipment calibration and safety precaution during transportation, storage application, and post application of fungicides	Learn the correct calibration of sprayers Understand safe use of fungicides/ toxic effects Improve fungicide application for late blight	Demonstration, discussion

Session title	Objective(s)	Methods
	control	
13.Harvest considerations: positive / negative selection, sorting (blighted tuber), variety evaluation (yield, test, color, eye depth, stolen length)	To train farmers in producing healthy crop To produce quality /healthy seed high yield per unit area	Discussion, field exercise (card method), observation, selection, test evaluation storage (DLS), visit.
14.Measurement of potato yield (gains and losses) of fungicide by variety trial	To understand how production costs are calculated and cost components to be considered Evaluate varieties/ clones and fungicide protection, based on cost-benefit analysis	Discussion and exercise based on total yield obtained per treatment, cost of fungicide etc.

Annex 4: List of Improved Potato Varieties Evaluated during the Project (IFAD-FFS Ethiopia Project Final Report, 2002)

Local name	CIP code (if available)	Comments
Genet	CIP-800984	Proposed for National Release
Menegesha	CIP-374080.5	Nationally Released
Wochecha	Krolisa	Nationally Released
Tolcha	K-59A-61	Nationally Released
Local	-	Highly Susceptible to late blight
Population A	KP-90108.5	Advanced clones selected by school members in the previous FFS cycle
	KP-90134.5	
	KP-90134.2	
	CIP-386423.13 CIP-389701.3	
Population B		
	CIP-392640.524	
	CIP-392640.539	

Source: IFAD-FFS Ethiopia Project Annual Report 2002.