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The perception of farmers on Farmer Field School (FFS) in Malawi.

A case study of rice FFSs in Bundi

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A case study of rice FFSs in Bundi.

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Preface

This report is a thesis research conducted by a Biology Master student at Wageningen University.

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Summary

In this report rice Farmer Field Schools (FFSs) in Malawi are investigated. The FFS approach is a method in which farmers gain knowledge through participation and self based discovery learning. FFS was originally implemented to stimulate Integrated Pest Management (IPM) to reduced use of pesticide, counter pest resistance and increase yield. In Africa pest are not considered as a mayor part to yield loss and pesticides are hardly used. The main problems contributing to yield loss are degrading soils, erratic rainfall and lack of resources. So FFS needs to be adjusted to the local problems and needs to be effective. In order to confirm if FFS is connected to the problems and needs of Malawi rice farmers, participants of six different rice FFSs and non-participants, in the village Bundi (Malawi) were interviewed. A total of 39 participants, 42 non-participants and 6 drop outs from the same village were asked questions. It is examined whether FFS connects to the needs and problems of the farmers and subsequently improves their livelihood. Through semi structural interviews with local rice farmers, information on: their problems, the FFS curriculum, viewpoint on FFS, and yield were obtained. It turned out that the mayor problem is degrading soil quality and proper availability of artificial fertilizer. Furthermore weeds, pests and diseases and lack of water, resources and little market are considered problems by farmers. The curriculum of the rice FFSs was obtained by asking the extension worker who initiated FFS in the area and participants about the topics given. The FFS curriculum partially connected to the problems and needs of the farmers. Fertilizer use and soil restoring methods was covered in FFS. Also good cropping methods were shown which aided in reducing weeds and increased yield. However participants still considered availability of artificial fertilizer a problem. There should be a bigger focus on making artificial fertilizer and using manure. In one of the sessions, disease resistance of rice varieties is named, however pest and diseases are hardly discussed, so this could also be covered more during FFS sessions. Farmers said that they have a need to learn business skills so they can be stronger in the market. The rice FFSs only focus on rice cropping but it might be wise to include business skills. It should become more multidisciplinary. When looking at the amount of yield produced by participants, it has almost doubled after attending FFS, probably because of good cropping practices. So FFS does aid in increasing the livelihood of farmers. The participants and other local rice farmers are mostly positive about FFS. The only changes named are concerning adding topics in the curriculum. It can be concluded that the farmers are mostly satisfied with how the FFSs are conduced.

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1. Introduction

The Farmer Field School (FFS) approach is a method in which farmers gain knowledge through participation and self based discovery learning (Matteson 2000; Ooi 1996). This method was initially used to implement Integrated Pest Management (IPM). IPM uses variety of biological, cultural, genetic, physical, and chemical techniques to reduce pest incidence and to increase yield. It is often used to reduce chemical control (Malena 1994) though IPM can also mean using chemicals in a judicious way. However in developing countries pesticides are hardly used and the loss due to pests is relatively small (Orr 2003; van Huis et al. 1997). Farmers face different problems which contribute to low yield like poor soil fertility, erratic rainfall and lack of resources (Orr et al. 2004; van Huis et al. 1997). Also institutional issues, like market price, rent seeking by government or private enterprise can be a problem for farmers.

FFSs often have not been properly conducted (Nederlof et al. 2007; Isabukula 2007), and in those cases did not connect to the agenda, problems, needs and opportunities of the farmers. Also FFSs were often used to implement new techniques devised by scientists. Through the years, FFSs have evolved to meet the demands of the farmers. However, the implementation of FFS has mostly been dominated by scientists, not the farmers themselves. A discussion is still going on whether FFSs are really adjusted to the needs, resources and problems of the farmers.

In Malawi several FFSs have been conducted. Agriculture is very important in Malawi. Malawi has about 20% of arable land[1] and agriculture contributes to 36% of the national GDP[2]. The staple crops are Maize, Rice and Cassava. However the country does not produce enough food to supply the entire population. The farmers do not reach maximum attainable yield, because they face problems like erratic rainfall, not enough resources, and lack of knowledge. But the main factor contributing to low yield is decreasing soil fertility. The FFSs were started to help the farmers increase their yield. In order to get an idea about the appreciation of FFSs by farmers a survey among rice farmers in Malawi was conducted.

With the aim of gaining more knowledge on the effectiveness of FFSs and how the farmers perceive FFS, research has been conducted in the province of Chilumba in the north of Malawi. In the Hara Irrigation scheme in the village Bundi six rice FFSs have been conducted in the past six seasons (3 years).

In this report, we look at what the problems of farmers are, whether FFS connect to these problems, how the farmers perceive FFS and if FFS aids in increasing yield. To get an image of these issues a main question and several sub questions are asked.

[1] United Nations Statistics Division 2003
[2] World bank group 2007

1.1 Research questions

Main research question

- Does FFS connect to the needs and problems of the farmers and subsequently improve their livelihood?

This research question is quite extensive. So in order to answer this question several sub research questions are devised.

Sub research questions

- What problems do the Bundi rice farmers encounter in rice production?
- What topics are given at the Bundi Rice FFS?
- Do the problems of the farmers connect to the topics given?
- How do these farmers perceive FFS?
- What kind of impact does the FFS has on yield?

First I made a diagnosis of the main problems of the rice farmers. Then I focused deeper on some of the main problems. Furthermore the curriculum of FFS was determined. Afterwards the curriculum will be compared to the problems. Also the viewpoint and perception of the farmers on FFS will be investigated to detect whether they feel FFS is relevant for them. Lastly the impact of FFS on livelihood will be assessed by examining yield.

1.2 Hypothesis

Before conducting my research certain expectations were set. For the main research questions and sub research questions hypotheses are made. These hypotheses will later be compared with the results to confirm if my assumptions were correct or can be rejected

Main research question

Does FFS connect to the needs and problems of the farmers and subsequently improve their livelihood?

It is expected that FFS will adjust to the needs of the local farmers and is conducted accurately. So it is likely that FFS connects to the needs and problem of the farmers. Because of proper carrying out of FFS the farmers will gain more knowledge, use proper cropping practices, increase yield and therefore improve their livelihood.

Sub research question 1

What problems do the Bundi rice farmers encounter in rice production?

Earlier I mentioned that soil degradation is a major problem in Malawi. I have no reason to expect that this will be any different in my research area. So my hypothesis is that poor soils

will be the main problem which farmers face. Other problems of farmers which I expect are; pests and diseases, lack of water and lack of resources.

Sub research question 2

What topics are given at the Bundi Rice FFS?

FFS is supposed to adjust its curriculum to the needs and problems of the farmers. My expectation is that the problems of the farmers are poor soils, pests and diseases, lack of water and lack of resources. So my hypothesis is that the topics are related to these problems.

Sub research question 3

Do the problems of the farmers connect to the topics given?

If FFS in Bundi is conducted properly I expect that the curriculum connects to the problems of the farmers. So the answer to this question will be yes.

Sub research question 4

How do the farmers perceive FFS?

My assumption is that the Bundi FFSs are conducted properly, therefore it is expected that farmers are satisfied with FFS. Farmers who participated in FFS are content with the way it is conducted. The farmers who have not participated have knowledge of FFS since they live close to the participants and would be willing to join. The overall opinion of FFS is positive.

Sub research question 5

What kind of impact does the FFS has on yield?

FFS is meant to improve the situation of the farmers. This is done by giving the farmers through field trails the tools and knowledge to improve their cropping practices and thus increase their yield. So I expect that FFS participants gained more overall knowledge, have made changes in their crop husbandry, thus have more yield than farmers who have not participated in FFS.

2. Method

In this report both literature research and data sampling was conducted. Literature was researched to gain more insight in FFS, Malawi and the investigated topics. Furthermore data were collected in Malawi at the local sampling site in Bundi.

2.1 Literature research

Literature was investigated to get an extensive overview of FFSs, of Malawi and possible problems of farmers. The information gathered about FFS, Malawi, rice cropping, pests and diseases, and other problems in rice are shown in the next chapters. Furthermore the results found by the collected data will be compared with existing literature.

2.2 Collecting Data

Sample site: the village Bundi at the Hara Irrigation Scheme in the province Chilumba

Data were collected in several ways. First literature research was conducted. Afterwards Eighty-seven semi structured interviews with local farmers, two open interviews with facilitators and one open interview with the water board president were conducted. Also mapping exercises and plant samples were used during the interviews with the farmers. A specialist on the scheme was consulted. One Farmer Field School (FFS) session was attended and its contents and schedule recorded. Lastly insects were collected from three different sampling sites and preserved in alcohol. The data were analyzed using excel and checking significant differences with the chi test.

2.2.1 Semi structured interviews

Eighty-seven semi structured interviews were conducted in the village of Bundi. The questionnaire used can be found in Appendix I. The questionnaire has been updated several times to get the correct information needed for this research. One interview lasted about two hours.

All the people who were interviewed are farmers who grow rice in the Hara Irrigation Scheme, though most also grow other crops. Of the eighty-seven people interviewed thirty nine are participants of FFS, forty-two are non-participants and six farmers are FFS drop-outs.

A list of all the FFS participants was composed by an extension worker. From this list the farmers were randomly selected and partially snowball sampling was used. Snowball sampling means asking the interviewees for other acquaintances who are willing to be interviewed. Random sampling was used because then there is the biggest chance that the data will not be biased. With snowball sampling the data can be biased because a lot of interviews will then be conducted with relatives. This may lead to similar information. However this method was used because of practical reasons. It was not always possible to find people which were selected by random sampling, so with snowball sampling more participants could be found. In the Hara Irrigation Scheme six FFSs were conducted. Participants off all six FFSs were selected for interviews to obtain as much data as possible. Because people from several FFSs were selected it was not entirely random sampling; a small amount also consisted of stratified and clustered sampling. This means selecting persons which have similar characteristics like being graduated from the same FFS year. For selecting non-participants and FFS drop-outs random sampling and snowball sampling were used.

The interviews were conducted in Tumbuca, a local language in the north of Malawi. In order to conduct the interviews a local was hired as an interpreter. The interpreter translated the answers of the farmers in English which were then written down and entered in Excel. Because the answers were first translated and later entered it is possible some of the answers may have been interpreted wrong or the farmer may have misunderstood some of the questions. So it should be noted that the answers written down in Excel might not be exactly what the farmer said or meant

2.2.2 Mapping exercise

During the semi structured interviews mapping exercises were conducted. Farmers were asked to place pictures of their house and field(s) on a white sheet. Then question were asked about those fields. This method was used to make the farmer more active during the interview so more knowledge could be gained and the attention of the farmer would not waver so quickly.

2.2.3 Plant samples

At first the farmers were taken to their field during the interviews and we asked them questions about plant samples we selected. Those samples were all affected by pests, deficiencies or diseases. However this turned out to be very time consuming and not always could suitable samples be found. So it was decided that the farmers would not be taken to their field anymore. Instead, during the morning samples were selected from random fields in the Scheme. Those samples were then used for all the interviews conducted that day. The next day new samples were taken because the old samples were not fresh any more. Between one and four samples were selected, being affected by pests, deficiencies or diseases. Sometimes an

insect was found and that was also shown to the farmer. The samples were used to test the farmers' knowledge on adverse organisms.

2.2.4 Open interviews

Three open interviews were conducted. One was with the water board president to gain more knowledge about the Hara Irrigation scheme and its regulations. This interview was conducted and recorded in English.

The other two interviews were conducted with the FFS facilitators. In the Bundi rice FFSs only two people have been facilitators, not including the extension worker who set up FFS in that area. Both facilitators were interviewed using an open interview. The interview was conducted in Tumbuca by an interpreter. These interviews were recorded and later on translated in English. Those interviews were conducted to gain more knowledge of FFS seen from a different point of view.

2.2.5 Scheme specialist

A specialist on the scheme was consulted. He used to be an extension worker but now he is retired. Because of his activities as extension worker he has much knowledge on the varieties of rice and their characteristics, the problems in the scheme, how these problems are solved and which pests and diseases occur. A question list was given to him so he could make an overview of all that information. Furthermore some fields which contained affected rice were visited to see the symptoms of the problem and to determine the cause.

2.2.6 Following FFS sessions

The rice FFS was being held during my stay in the Hara Irrigation scheme. It was my attention to participate in order to gain more knowledge of the FFS. However the rice FFS had many problems during this season. Very often the participating farmers did not show up. In the end only two sessions were conducted, this was not enough for the farmers to graduate. I only managed to participate in one session. So while I did see how a lesson was conducted it was not enough to get a complete picture of the FFS.

2.2.7 Insect collecting

In order to determine which rice insect pests occurred in the Hara Irrigation scheme, samples were collected. On three different occasions insects were caught. Those insects were found in rice fields and the area surrounding those fields. The locations were randomly selected fields in

the Hara Irrigation scheme. The insects were caught using a butterfly net and sucking tubes. The collected insects were preserved the same day in Ethanol.

2.3 Analysis

The data was entered in excel sheets. Some of the data is analyzed in excel by using a Chi test. Only one answer given per farmer will be used. In a few occasions two things were considered equally important by a farmer, in that case an exception was made and both answers were included. Data is considered weakly significant when the P-value is 0.1, significant when the P-value is 0.05 and extremely significant at 0.01. Other information was analyzed by making tables and using graphs. Also SPSS is used to analyze data and create graphs. Furthermore a SWOT (Strength, Weakness, Opportunity, Threat) matrix was conducted to get an overview of the strengths, weaknesses, opportunities and threats of the FFS in order to devise a strategy. Subsequently the results will be compared with information found in the literature.

3. Malawi

3.1 The country

Figure 1. Map of Malawi

Malawi is a relatively small country in Africa. It has a surface area of 118,484 square kilometers and a population of 13,603,181[1]. The country is situated between Mozambique, Zambia and Tanzania. It lies next to a big sweet water lake called lake Malawi, also known as Lake Nyasa, Lake Nyassa, Lake Niassa and Lago Niassa. The country is also known as the warm heart of Africa, because of its friendly people.

In the 16th century Malawi was first visited by Portuguese. Though at that time the country known as Malawi did not exist yet. Throughout history there had been much slave trading in that area and many tribes fought against each other. The first significant contact of the western world with Malawi was when David Livingstone in 1859 arrived at Lake Malawi. With him many missionaries came and they spread Christianity, build missions and sought to make an end to the slave trading. Malawi became a British colony in 1891 and was called British Central Africa Protectorate. In 1907 the name was changed to Nyasaland and was later joined with the federation of Rhodesia. On the 1st of February 1963 Hastings Banda became the Prime minister and on 6 July 1964 Nyasaland became independent and was renamed to Malawi. Banda declared himself president for life and became a dictator. He relinquished his power at the age of 95. Increasing domestic unrest, pressure from Malawian churches and the international community led to a referendum in which the Malawian people were asked to vote for a new kind of government. The 14th of June 1993 the people of Malawi voted in favor for a multi- party democracy and the next year election were held and Bakili Muluzi became president. In May 2004 Bingu wa Mutharika became president and is still reigning.

The official language is English and the National language is Chichewa. Nevertheless many other languages and dialects are spoken. In the province Chilumba the local language is Tumbuca.

[1] Estimated 2007

The main religion in Malawi is Christianity; this is due to influence of European missionaries which came to the country in the nineteenth century. About 80%[1] of the population is Christian. Another religion in Malawi is Islam, and 12.8% is Muslim[2].

The education level of the population is very low: 37.3%[3] of the Malawians are illiterate. The education structure of Malawi is as follows. Primary school consists of eight standards which range from standard 1 to 8. Although primary school is free, many children do not attend. After that children can continue with middle school. Middle school consists of four forms, ranging from form 1 to 4. After graduating it is possible to attend college. Hardly any Malawian is able to go to college because they have not graduated from form 4 or they cannot pay the school fees. There are a few scholarship but not enough to fill the demand. So the education level remains low. Also high mortality due to AIDS reduces the education level.

AIDS is a major problem in Malawi. It is estimated that the HIV/AIDS prevalence is 14.2%[4] and 900,000[5] people are living with HIV/AIDS. It has increased mortality and morbidity leading to lower production. This resulted in poverty which is still prevalent in the country. It is estimated that 65.3%[6] of the population lives below the poverty line.

Malawi is situated next to a big lake so a lot of fishing is done. There are hardly any big fishing companies; most of the fishing is done by local fishermen. The local people make small boats cut from a log, and uses lines and nets to catch fish. The most common fish occurring in the lake is called Chambo, *Oreochromis* spp (McKaye et al. 1988).

Malawi's GDP is US $ 2,231,531,264[7]. Agriculture is very important; it contributes to 36% of the GDP[8]. A 44,400[9] sq km is agricultural land. Of that agricultural land 55.2 %[10] is arable. So 20 % of the entire surface area of the country is arable. Agriculture accounts for over 80% of the labor force, and represents about 80% of all exports[11]. Nearly 90% of the population engages in subsistence farming. The climate is sub tropical. The rainy season is from November to May and the dry season from May to November. Many of the crops are grown during the rainy season. The main crop is maize. It is not an indigenous crop. It was introduced in the 16th century by the Portuguese. Other staple crops are rice and cassava. Because maize depletes the soil, the quality of the soil has been decreasing leading to a high amount of fertilizer application. Pour soils is a big problem in the Malawi agriculture (Carr 1997).

[1] CIA – the world factbook, 1998 census
[2] CIA – the world factbook, 1998 census
[3] Estimated 2003
[4] Estimated 2003
[5] Estimated 2003
[6] World bank group 2004
[7] World Bank group 2007
[8] World bank group 2007
[9] United Nations Statistics Division 2003
[10] United Nations Statistics Division 2003
[11] http://en.wikipedia.org/wiki/Malawi

3.2 Hara irrigation scheme

The research was conducted in Bundi which is located in the Hara Irrigation Scheme in the province Chilumba. The province Chilumba is situated in the North of Malawi between Karonga and Mzuzu. The biggest town is Uliwa. The Hara Irrigation scheme lies about 10 km from Lake Malawi and 15 km from Uliwa.
So as to gain more information about the scheme an in depth interview was held with the current scheme president, Mr. Chitaya Kanyenda.

Hara Irrigation Scheme was founded in 1968 by the British government. Now it is a Malawian government institution. The Irrigation Scheme is run by a general assembly which consists of farmers who are member of the Hara Water Association. At the head of the assembly is the scheme president. The current scheme president is Mr. Chitaya Kanyenda. He was elected in 2007. All farmers can be a member of the association provided they are 18 years or older and a Malawi citizen. At the moment 531 farmers are members. Farmers rent plots to grow rice; the rent per plot is K 400 (around 2 Euros).

Figure 2. Rice fields at Hara Irrigation Scheme

The scheme consists of a big area of land which is irrigated so rice can be grown. A main channel which connects to a river flowing from the lake provides the scheme with water. The scheme is divided in lines which consist of plots. All those plots are irrigated by small channels connected to the main channel. Through this irrigation the plots are provided with water almost the entire year. The channels are only closed two times a year for one month each. This is done so the channels can be maintained. The channels are closed 6 November and opened 6 December; subsequently they are closed 6 June and opened 6 July.

In the scheme wetland rice is grown, so it needs to be in water constantly. This is possible due to irrigation. Because the land is irrigated it is assumed the farmers are not very depended on rain. The rainy season runs from November to May, which normally is the crop season. But in the scheme there are two seasons in which rice can be grown. The first season is from January to July and the second season is from August to December.

Rice is considered a money crop. Farmers grow rice to sell it so they gain capital. Of the rice grown some it is kept to be eaten by the farmers themselves, but a big part is sold.

The varieties of rice that are grown in the scheme are Pussa 33, TCG 10, Kilombero, Faya MT69 and Zambia. Recently new varieties were received like Wamboja, they will be introduced shortly.

A few years ago the main problem in the scheme was birds that fed from the rice. The locals call them Mpheta; it is a finch species (Quelea group). Special nets were supplied by Chinese and many birds were caught, leading to a decrease of the bird population. So now the reduction of yield due to birds is minimal. Currently the main problem is Kayuwili. It affects the rice leading to low yield. Symptoms named are yellowing of rice, drying of leaves, spots, stunted grains, un-maturing grains (deadheart) or damaged parts. It is not yet clear whether Kayuwili is caused by a disease or pests, or that it is one term used for different kinds of causes. People are investigating this problem to find a solution.

4. Farmer Field School

4.1 FFS general information

First I will explain the start of the Farmer Field School (FFS) approach. Also the relationship between Integrated Pest Management (IPM) with FFS will be highlighted. Then the practical implementation and training of facilitators will be addressed. The bottom-up approach will be explained. Lastly the effectiveness and challenges of FFS will be discussed.

4.1.1 Integrated Pest Management and FFS

The Integrated Pest Management approach started in cotton in the Canete valley in Peru (Smith et al. 1967), and was an alternative for chemical control. This approach uses a variety of biological, cultural, genetic, physical, and chemical techniques to reduce pests and thus decreasing crop loss, making maximum use of natural mortality factors while not affecting the environment and the farming system (Malena 1994).

In Southeast Asia, around 1970 and 1980 widespread outbreaks of pest insects occurred in rice, mainly the Brown Plant Hopper (BPH). It was found that they were caused by the insecticides meant to control them. The insecticides were overused leading to pest immunity and disappearance of natural enemies, so a big resurgence occurred.. In order to solve the problem IPM strategies were implemented, adapted to the local conditions and the population dynamics of the pest. In order to make sure the farmer were able to use IPM, education for the farmers based on field practicals and self based learning was needed (van den Berg et al. 2007). This lead to the implementation of a school in which farmer participation and self based discovery learning stood central, namely the Farmer Field School (Ooi 1996; Matteson 2000).

The FFS has a few key elements which describes the policy approach. Firstly, the farmer is seen as an expert, they are partners and participants in the development process. Secondly, innovation is not restricted to the existing agricultural technology, but can also be institutional arrangements. Local knowledge should also be included. Moreover the natural processes should be observed and understood. Thirdly, in order to empower the farmers there should also be a focus on community life and livelihood, ecological management and organizational development. Fourthly, the learning process should be based on farmer observation and interference (Nederlof et al. 2006; Röling 2002; Nkunika 2002).

In practice FFS should work as follows. Groups of 25 to 30 neighboring farmers come together one morning or afternoon each week during a whole season. They have three fields. In one the local methods are used, in the second an IMP method is used, and in the last farmers can do experiments. These fields are observed and analyzed (agro-ecological analysis). The results are

discussed and can lead to the implementing of new farmer practices. The farmers are given additional knowledge by for instance scientists, to improve their methods. Experiments are devised in order to allow farmers to learn by observation. These experiments can be: artificial defoliation, to show that leaf loss does not always lead to yield loss; or spraying one field with insecticides and using one control without spraying to show that natural control can be more effective than spraying. Also a method known as 'insect zoos' can be used; with this method insects are placed in a jar, so farmers can observe the differences and relationships between pest insects and beneficial insects. The goal of these experiments is to give the farmers expertise through these tests and have them conduct discussions so they are able to make evidence-based crop management decisions to increase their yield and improve the health of their crop (van den Berg et al. 2007; Ooi 1996; Matteson 2000; Nederlof et al. 2006; Nkunika 2002).

4.1.2 Trainers and implementation of FFS

In order to implement FFSs, facilitators (extensionists / IPM trainers) must be used to get the information and skills to the farmers. The facilitators are educated in Farmer Training Facilities (FTF) or Training-of-Trainers (TOT) sessions (Ooi 1996).

It is important that the trainers who facilitate the FFS know how to best assist the farmers in learning. They should respect the experience and knowledge of the farmers. The 'top down approach', in which someone tells the farmers what to, does not work and the farmers often do not trust advice given by them. The facilitators should put the focus on the farmers; this is called a 'bottom-up approach'. The farmers should be encouraged to learn by observation and experience. This can be done by setting up tests and letting the farmers discuss observations. This is the set up of the FFS, but this method is not always used in FFSs, so it is wise to check whether FFS is implemented correctly (Ooi 1996; Nederlof et al. 2006).

The effectiveness of these facilitators on the implementation of IPM in Nicaragua has been investigated (Meir 2006). It showed that all trainers had to adapt their initial methods in order to effectively train farmers to become experts. The most effective method to implement IPM turned out to be identifying the situation of the farmers by asking questions, then discussing and solving problems, and implementing experiments.

In IPM scientist play a big role because they conduct the research with leads to new IMP methods. A danger can be that the influence of the scientist on implementation becomes too big and farmers are ignored. This is known as the 'Technology Transfer' paradigm. The agenda and problems of the farmers should be taken into account. A so called 'Farmer First' approach needs to be adopted. With this strategy farmers can influence IPM development and focus on problems which are important to the farmers. In the Farmer First model farmers are the starting point, both in problem definition and technology development. The FFSs are based on this approach (Matteson 2000; Morse et al. 1997; van Huis et al. 1997).

FFSs can be very effective in building farmers' decision-making capacity and expertise. But this can only happen when implemented correctly.
Non-negotiable aspects of the curriculum development should be:

- topics chosen by the community
- training building on farmers' existing knowledge
- training based on farmers' needs
- participants involved in curriculum development

These topics are related to the 'bottom up approach' in which the farmer is placed first. If these aspects are used then the FFS should be effective. But in practice these topics are not always used. For example, in cowpea FFS in Ghana, farmers and participants hardly had an influence on the curriculum development. The curriculum was determined by the trainers and scientists. This leads to a curriculum which was not adjusted to the needs and problems of the farmers. The researchers used the FFS to promote the implementation of their technologies to the farmers (Nederlof et al. 2006). So it should be checked whether the FFS is implemented correctly in order to avoid misuse.

4.1.3 Effects of FFS

Even though FFSs are used to train the farmers in order to increase their yield, additional skills can emerge. Evidence has shown that FFS can also cause empowerment of the farmers. This empowerment occurs because of several factors such as strengthened friendships and trust among the farmers, the organization of collective activities, and farmers gaining more self confidence (Khalid 2002). Because of a bigger friendship, trust and the collective activities the farmers can organize themselves. When they are organized they have a bigger influence on policies, and as such will be able to propose measures that improve their livelihoods. So through unity, the farmers empower themselves. Also through the increased interactions with fellow-farmers and other stakeholders more information and knowledge is exchanged. This increases the knowledge base of the farmers. By gaining more knowledge, farmers become more self-confident. However, this does not happen with all farmers who have participated in a FFS (Nederlof et al. 2006).

In Sri Lanka, many FFSs have been established. The effectiveness of the FFS program was investigated. The results showed that the FFSs had a significant impact on the participating farmers. The insecticide use was reduced to one third, the farmers were more aware of pest agro-ecological relationships and several new techniques were introduced. Some of the techniques are: monitoring the field for pests in order to determine when to apply (botanical) insecticides (using economic thresholds), and straw incorporation to enhance soil fertility. It must be noted that these techniques were only implemented when they required low labor costs or had a high gain (higher yield). Other techniques which required more labor were hardly accepted. Not much evidence was found that the farmers became more innovative and began experimenting, which was one of the goals of the FFS. Overall it can be observed that FFSs in Sri

Lanka had a positive effect on the participating farmers (Tripp 2004). But it must be said that the farmers had many recourses and that their knowledge base was relatively at a high level. The farmers in Malawi do not have many resources and not much knowledge. So the effect of FFSs on the Malawi farmers can be quite different.

In order to continue motivating farmers to conduct experiments, Follow-up Farmer Field Studies (FFFS) are advised. In FFFS farmers who have participated in FFS formulate ideas and devise tests. The outcomes and conclusions of these experiments can be shared with other farmers. FFFS are also used to evaluate recommendations devised by the government, organizations or industries. These FFFS are organized by farmer trainers and graduates of the FFS. (Ooi 1996)

4.2 FFS specific information

4.2.1 African FFSs

In Africa the Integrated Pest Management Farmer field School approach (IPM FFS) was first introduced in 1995 in Ghana. It was implemented trough a season long training of trainers (TOT) and three associated FFSs. After that many other countries followed like Mali, Kenya, Zimbabwe, Malawi and many others (Simpson 2002).

Although the FFS is based on the implementation of IPM and reduction of pesticides, this is not needed for most farmers in Africa. Application of pesticides has been low or is even not used by most farmers. So there is no need to use IPM as an alternative to chemical control. Furthermore pests are only a small part of the constraints in increasing yields. Poor soil fertility, low, erratic or very high rainfall and limited resources are far greater constraints on the yield than pests (Orr et al. 2004; van Huis et al. 1997). So the focus of the FFSs should be more on these issues than IPM. The main issue should be the health of the crop and reaching optimal yield. This can be achieved by many methods including increasing soil quality, proper water management, improved planting material, and planting strategies (van Huis et al. 1997).

Most farmers in Africa have small fields, are resource pour, produce crops for their own subsistence and use traditional methods (van Huis et al. 1997). Modern cropping technologies and transgenic crops usually cannot be used by these farmers because they lack resources or knowledge. Since many techniques devised by scientists require certain resources, those techniques are not suitable for resource pour African farmers. Only few farmers with big holdings can benefit from these techniques. So the techniques used by the FFSs should be either adjusted to the resources by the farmers or devised with the farmers themselves using local knowledge.

In Kenya it was found that the interaction between local knowledge and technologies developed by scientists was a challenge. So the PFI-FFS project was set up. PFI means Promoting Farmer Innovation, this initiative promotes local knowledge and innovation. Since the FFS curriculum sometimes does not connect to the needs of the local farmers, a new approach was needed, i.e. add local knowledge to the curriculum. By combining IPM with FFS, farmers were stimulated to integrate new techniques with local knowledge and innovation, thus adjusting FFS to the needs of the farmers (Duveskog et al. 2002).

So in order to effectively implement FFS with resource pour farmers in Africa several key elements must be included:
- The actual needs of the community must be determined
- On basis of those needs the FFS curriculum should be developed
- Training facilitators on the FFS and farmer first approach.
- Implementing experiments and interaction of farmers during the FFS sessions
- Monitoring and evaluation of the FFS process

If these concepts are followed FFS should be effective in Africa.

4.2.2 Malawi FFSs

Malawi is one of the poorest countries in the world and depends on its agriculture. It consists of many smallholder farmers of which many grow maize. Since maize depletes the soil from nutrients, the soil becomes poor leading to many soil fertility related problems.

In Malawi several FFSs and IPM projects have been set up. They focused on crops like maize, rice, cassava, tobacco, sweet potatoes, pigeon peas and beans. IPM turned out not to be effective because Malawi farmers have little yield loss due to pests, which is what IPM focuses on (Orr et al. 2004).

Field trials were conducted in three crop seasons looking at the production of maize, beans, pigeon peas and sweet potato. It showed that the value of crop loss due to diseases and pests was 16%. With new IPM strategies the net income could rise with 15%. However if new technologies would be adopted to improve soil fertility the net income would rise with 36% (Orr et al. 2004). So when comparing these two, the focus should be on improving soil fertility instead of IPM in order to effectively increase yield and livelihood.

The FFS in Malawi are now focusing more on increasing yield through new crop husbandry methods and use of soil improving methods, not on pest reduction.

4.2.3 Hara Irrigation Scheme

In the province Chilumba the Hara Irrigation Scheme is located. It consists of farmers who grow rice, cassava, maize and sometimes sweet potato or ground nut. Some farmers grow only one crop but the majority grows two or more crops. The field size can vary from one plot (1/6 acre) to several acres. Young starting farmers usually have a small field while older farmers with a big family have several large fields. In one year there are two crop seasons, a dry and a wet season. The dry season is in the period August-December and the wet season in January-July.

In the area maize is grown which can deplete the soil. Furthermore in the rice fields of the Scheme no fallow is allowed so the nutrient content of the soil cannot be increased this way. So the soil is quite nutrient poor and much fertilizer is needed. During the rainy season fertilizer is subsidized so the farmers can buy fertilizer for a relatively low price. However this is not the case during the dry season, Also fertilizer is not always available or too expensive for certain farmers. Therefore not all farmers can cope with the degrading soil.

The education level of the farmers is quite low. Most farmers have only followed a few years of primary education before they dropped out. Only a small number of farmers have followed a few years of middle education. Reasons for dropping out are expensive school fees or death of parents so they had to work in the fields and take care of the family.

In the scheme six rice FFSs have been conducted, each during one cropping season. Since a cropping season lasts half a year, FFSs have now been conducted for three year. The first FFS was in 2003. A FFS starts in the beginning of the season, when the nursery is established, and it ends at the end of the season during harvesting.

Figure 3. FFS session in the Scheme

The rice FFSs have the following set up. A group of 20-30 farmers meet together. There the FFS approach is explained. The farmers discuss their problems and what they want to learn. With this information a curriculum is made. Usually the topics are: good cropping practices e.g. spacing, amount of fertilizer needed, application time of fertilizer, characteristics of different rice varieties. Every week on Wednesday morning a session is held. Techniques and methods are discussed. Simultaneously field experiments are set up which will run the entire season. The experiments consist of two fields where in one field the farmers' method is used, and in the other the recommended method is conducted. These experiments are used to address the problems the farmers want solved. So the experiments can be fertilizer, spacing and variety trails. These experiments are very effective because farmers can see for themselves what the best cropping practice is. With this method they are not told what to do, so they are more willing to adopt new methods if they see it is effective.

The rice FFSs were originally set up by an extension worker, Mrs. N. Kamwendo. She followed a training to learn about FFS.

The curriculum of the FFSs named by the extension worker[1]:

- Nutrient management
- Time of fertilizer application
- Plant population
- Rates of fertilizer
- Use of herbicides
- Crop protection
- Variety studies

The first FFS was facilitated by Mrs. Kamwendo, starting with 25-30 people. Of this group about half of them dropped out. This was due to wrong expectations. The farmers expected to get something for attending the FFS, like goods or money. However, the only thing they received was knowledge in the form of new cropping methods. So, farmers got disappointed and dropped out.

In the following FFS less people dropped out because now they know what to expect. These FFSs were conducted by two facilitators who are graduates of the first FFS. They did not receive special training but they were supervised by the extension worker. Many farmers graduated from these FFSs. However the last FFS, which was during my stay, was a failure. The participants hardly showed up, so only two sessions were conduced. This was not enough to conduct the field trails so none of the farmers could graduate. The reason for this failure has not been found yet.

[1] Presentation of experience on Farmer Field Schools at MIM in Lilongwe, Nancy D. Kamwendo, Karonga district agriculture office

5. Rice cropping

In this chapter the crop rice will be covered. Since the rice investigated is wetland rice, only the wetland rice will be covered. So when the word rice is said, wetland rice is intended. Firstly the different growth stages will be shown. Also the harvesting and preparing of rice grains will be discussed. The different rice varieties grown in the scheme and their characteristics are going to be told. Lastly several problems of rice like pests, diseases, deficiencies and weeds will be named.

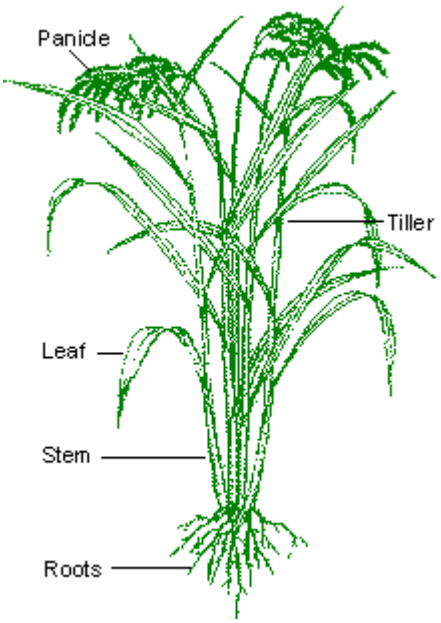
5.1 Growth stages of rice

In this part the growth stages of wetland rice are shown. Rice matures between three and six months, depending on the variety. During that time many stages in rice growing occur, which can be divided between two phases, namely vegetative and reproductive phase. All the different stages are shown in the following overview. The two phases with the different stages will be discussed in more detail below.

Growth stages of rice

- germination
- emergence
- seedling
- transplanting
- tillering
- stem elongation
- booting
- heading
- flowering
- milk stage
- dough stage
- mature grain

Figure 4. Parts of a rice pant



5.1.1 Vegetative phase

From germination to tillering is called the vegetative stage. It is characterized by an increase of plant height, emergence of leaves, and tillering. The seeds are sown in nurseries. During **germination** the plant appears from the seed. The **emergence** occurs when the plant surfaces from the earth, at that moment it is called a **seedling**. The seedlings stay in the nursery between two and four weeks. Afterwards the seedlings are **transplanted** to the rice plots. The young rice plants are put in stations which consist of three rice plants together and these

stations are located at certain distances in the plots. In the **tillering** stage many tillers develop. Tillers are shoots that spout from the base of the rice plant. In this stage the plant needs a large amount of nitrogen. During the vegetative stage the plant focuses mainly on growth and development of the plant, in the next phase reproduction is the goal.

5.1.2 Reproductive phase

In this phase the focus lies on reproduction. All stages starting from stem elongation to the mature grain are included. Firstly the plant height is increased by **stem elongation**. During **booting** stage swelling at the base of the leaf sheath occurs. Out of the bulge resulting from this swelling a panicle will emerge, this is in the **heading** stage. A panicle is the grain producing terminal shoot of a rice plant. Twenty-five days later these panicles will flower. During **flowering** stage pollen is spread, rice has both male and female parts so it is self-pollinating. After fertilization the grain starts to ripe during three stages; the milk, dough and mature grain stage. In the **milky** stage the content of the grain becomes a white liquid, the top of the panicle will bend in an arc. When the milky substance turns into hard dough it is called the dough stage. Lastly the grain matures; it can be distinguished by change in color from green to yellow. The grain is fully developed when the color has become completely yellow.

5.2 Harvesting

When the rice grain is mature the farmers will start harvesting. The water in the plots is drained so the rice plant can dry. Then the dried rice plants are cut. From these cut plants the grains are obtained. This is done by a process called threshing. Farmers hold the plants and hit them into a hard surface, this way the grain will be separated from the plant. The grains are collected on a mat. In the assembled rice grains also empty husks occur, these husks are also called rice bran. Farmers separate them from the full rice grains by putting the rice in baskets. The rice grains are then slowly dropped to a mat. The empty shells are very light so they will blow away. The full rice grains are put in bags and sold. When the farmers want to cook the rice the outer shell is removed by grinding with a tool.

Figure 5. Separating full grains from empty husks

Figure 6. Grinding rice to remove the bran

5.3 Varieties

In the scheme several varieties are grown. Varieties used are TCG 10, Pussa 33, Kilombero, Faya MT69 and Zambia. Each variety has its own advantage, namely: TCG 10 gives high yield, Pussa matures fast, Kilombero and Zambia are marketable, Faya is considered quite disease resistant. All the characteristics of these varieties are put in the table below. This data was supplies by a scheme specialist. It could not be confirmed with literature so it might be possible that some information is biased.

Table 1. Characteristics of rice varieties

Variety	Maturation time (days)	Yield (ton/ha)	Disease resistance		
			Bacterial leaf blight	Brown spot	Sheath rot
TCG 10	120-127	9	susceptible	tolerant	susceptible
Pussa 33	90-120	7	susceptible	tolerant	tolerant
Kilombero	127	5	susceptible	tolerant	tolerant
Faya MT69	135	6	susceptible	tolerant	tolerant
Zambia	127	7	susceptible	tolerant	tolerant

5.4 Plagues and problems on rice

Not much is known about the different insect pests occurring in the Chilumba rice fields. It could be that the environment is not conducive to pest outbreaks or that local methods are effective in keeping pests under damaging levels. But it could also be that problems are not perceived or reported. In this part an overview of different insect species and other animals found in rice fields in Malawi and neighboring countries will be given.

Other problems which can occur on rice are diseases and deficiencies. Diseases of rice in Malawi are mostly a wet season problem. However my research is done in the dry season so the occurrence of diseases was not very high. A few diseases and deficiencies which can occur on rice in Malawi will be shown.

Also weeds can be a problem. They can compete with rice for nutrients, space and sunlight, leading to lower yield. An overview of different weed species in rice fields will be made.

5.4.1 Insects

Grasshoppers, leafhoppers and planthoppers
Several grasshopper species have been observed in Africa. These are *Hieroglyphus daganensis* and *Oxya intricata*. The grasshoppers cause damage to the crop by chewing angular holes in the leaves (Dale 1994).

Also several leafhopper and planthopper species have been found in Africa. They damage the crop by feeding on the sap. The insects can also damage the plant by oviposition and transmission of diseases. Several species are White rice leafhopper *Cofana spectra* and Green leafhoppers *Nephotettix modulatus* and *Nephotettix afer* (Dale 1994).

Stem Borers and root feeders
There are many insect species which feed on the root and stems of the rice plant.

One type of pests is stem borers. These are lepidopterous or dipterous species, of which the larval stage feeds on the rice. The larvae feed on the meristem of young leaves or stem, and the symptoms of this feeding damage are deadheart and whitehead (Litsinger et. al. 2006; White et. al. 2005). These symptoms can lead to a decrease in yield.

Species that have been observed in Africa are the Stalk eyed fly *Diopses thorica* West. synonym *Diopsis macrophthalma,* the African rice borer *Chilo zacconius,* African pink borer *Sesamia calamistis* and White borer *Maliarpha separatella*. (Dale 1994; Pathak 1977, Brenière 1983, Alghali 1984)

Other stem and root feeders observed in Africa are:

Gryllotalpa africana, also known as mole crickets. Nymphs and adults feed on the stems below ground, they cut the tillers, and young plants are preferred. Because the mole cricket lives in the soil, evidence of the pest can only be observed when the tillers begin to dry. The plant can die if the mole cricket has caused too much damage (Dale 1994; Pathak 1977).

Orseolia oryzivora, the African rice gall midge. The main symptom of the gall midge is a ‘gall’ that resembles an onion leaf. Galls appear when the larvae feed on the crop. This species appears to be spreading in Africa (Dale 1994, Brenière 1983).

These species can be controlled in several ways including insecticides, natural predators, parasitoids and changing time of planting (Litsinger et. al. 2006).

Leaf and stem feeding Lepidoptera
Armyworms and cutworms are larvae of moth species that feed on leaves and stem causing damage to many cereals, including rice. Species which have been sighted in Africa are. *Spodoptera exigua* also known as lesser or false armyworm and *S. litura*, the common cutworm. The common cutworm occurs on many crops and has caused significant economic losses. During the seedling stage of rice they severe the seedlings at the base; when rice has matured the pest can defoliate the crop. (Pathak 1977)

In Malawi the moth species *Nymphula depunctalis*, also known as rice caseworm, has been observed. The larva causes damage to the plant by cutting off leaf tips and removing green tissue. Because of the ladder like appearance of the removed tissue, it is easy to determine this pest. (Dale 1994)

Beneficial insects
Mostly spiders are insects which are beneficial to rice. Spiders eat other insects, including rice pest insects thus decreasing the amount of harmful insects (Riechert et al.1984).

Species that have been spotted in Malawi are; *Ninetis russellsmithi*.(Huber 2002), *Trabea nigristernis* and *Trabea setula* (Alderweireldt 1999).

5.4.2 Mammals, amphibians, reptiles and birds

Many animals can damage rice by cutting stems and feeding on the rice grains. Of the mammals small rodents are the main problem because they can eat the rice grains. Also some bird species feed on rice. However not all animals are harmful to rice. Some amphibian, reptile and birds species feed on pest insects. So these animals are indirectly beneficial to rice.

Mammals
Rodent species can be a pest in rice because they cut stems and feed on the rice grains. Rats and mice build their nests in the bunds and during the night they cut a piece of the stem and eat the grains and some part of the stem.

Species which occur in Africa are; the black rat *Rattus rattus* L., the multimamillate rat *Mastomys erythroleucus* and the striped mouse *Arvicanthis niloticus*. They are controlled through chemicals prayed on bait or by trapping and physical killing. (Brenière 1983)

Birds
Birds can be both beneficial and harmful to rice. Some species feed on the rice while other feed on pest insects. So occurrence of birds can either lead to a decrease or increase of yield.

Harmful birds that can be found in rice are grain eating sparrows, finches, weavers, doves or aquatic birds. Examples of species found are the red-billed quelea *Quelea quelea* and the golden sparrow *Passer luteus* (Brenière 1983; Ward et al. 1979).

Different way of controlling are: scaring, catching using nets and use of chemical sprayed bait.

But there are also birds which feed on insects, thus decreasing the (pest) insect population. Herons, egrets and bitters are wading bird species which feed on different kind of small animals including insects. These birds belong to the Ardeidae family. Species which occur in Malawi are: the little egret *Egretta garzetta* and black-headed heron *Ardea melanocephala*[1].

Amphibians and reptiles
Many amphibians and reptiles have insects in their diets. Thus they can have an impact on the insect population. A common reptile in Malawi is the monitor lizard in the family Varanidae. Of the amphibians, frog species are seen in rice fields.

5.4.3 Diseases and deficiencies

Not only pests can affect rice. Also diseases and deficiencies can have a large impact on the rice plant and yield. Diseases can be viruses, bacteria and fungus. Because bacteria and fungus usually depend on a moisture environment to survive, those occur more frequently during the rainy season. Since my research was conducted during the dry season not many diseases were spotted. However in order to make clear what kind of diseases the farmers can face an overview of the different rice disease is made in the next paragraph. Deficiencies are also a problem in rice. Deficiencies can be caused by either applying too much or insufficiently nutrients or water. Sometimes it is hard to differentiate between deficiencies and diseases.

Viral diseases
Tungro[2] is a viral disease on rice. Symptoms of Tungro are: stunting of plants, leaves turning yellow starting at the tips, young leaves having pale green/whitish spots, and grains being usually dark brown with brown blotches. Yield loss can be between 5 and 70%, depending on

[1] Wikipedia 2007
[2] Integrated pest management rice. Pocket reference manual. First printing. 1986 pp. 66-97

infection time. It can be controlled by removing diseased plants and host weeds, applying the correct amount of fertilizer, and having a crop free period so the disease will not survive.

Yellow dwarf[1] can be recognized by stunting of plants, yellowing of leaves, an increased tiller number and no panicles or unfilled grains. The yield loss depends on the time of infection. It can be controlled by the same methods as used for Tungro disease.

Bacterial diseases

Bacterial leaf blight[1] is caused by *Xanthomonas campestris*. Symptoms are white to yellow lesions (leaf blight) on leaves of the mature plant. It is controlled by removing affected plants, using disease free seeds and applying lower rates of fertilizer.

Another disease is bacterial leaf streak[1], *Xanthomonas campetris* pv. *oryzicola*. Its symptoms are narrow transparent/brown linear lesions between the leaf vines. Yield losses also range from 10 to 30%.

Fungal diseases

Rice blast[1] is caused by *Pyricularia oryzae*. This disease can by recognized by elliptical spots or lesions with a gray or whitish centre and a brown/reddish margin. Also nodes turn brown and rot. The yield loss can be up to 50%, however the damage is more severe on dry land rice than on wetland rice. It can be controlled by applying less fertilizer and having good water management. Also resistant varieties or fungicides can be used.

Sheath blight[1] is a fungal disease, the fungus is also known as *Rhizoctonia solani*. Symptoms are elliptic or oval spots on the leaf sheath. These spots are greenish/gray and later will turn garish/white with a brown margin. Yield losses can amount to 20%. Spraying of fungicide can control the disease.

Brown spot[1] is caused by *Helminthosporum oryzae*. Symptoms are oval spots or lesions on leaves. They will develop brown or whitish centers. The yield loss can vary from 50 to 90% with high seedling mortality. Ways of controlling are: crop rotation, planting at different dates, good water management, using disease free seed, and applying fungicides.

Sheath rot[1], *Acrocylindrium orzae* is usually related to stem borer attack. With this disease leaf sheaths rot, oblong gray centered brown margined lesions occur, and young panicles rot.

Stem rot[1], *Helminthosporium sigmoideum* symptoms are: small blackish irregular lesions on outer leaf sheath, collapsing of internodes and sometimes the sclerotia are attached to the infected parts. Yield loss can be between 30 and 80%. It is controlled by draining water, reducing nitrogen, increasing potassium, and burning rice stubbles.

[1] Integrated pest management rice. Pocket reference manual. First printing. 1986 pp. 66-97

Deficiencies
Deficiencies in rice are usually caused by application of the wrong amount of nutrients or water.

Applying too much or too little nutrients can lead to sensitivity to diseases. However sometimes some symptoms can be recognized when there is a deficiency of nutrients. When too little phosphorus is applied to the plant a phosphorus deficiency will occur. It can be recognized by purple coloration at the sheath. Also applying too little nitrogen can lead to deficiencies. Nitrogen deficiency symptoms are browning of the leaves starting at the tips.

Over application of water can make the plants rot and make them susceptible to diseases. Applying too little water can dry the plant out. So good water management is quite important for the health of the crop.

5.4.4 Weeds

Weeds can also be a problem in rice production. Weeds compete with rice for nutrients, water and light. This competition can be detrimental for the growth of the rice plant and development of rice grains, thus decreasing the overall yield. Furthermore weeds can harbor pests and diseases which can affect the crop.

There are several types of weeds which can occur in a rice field. Weeds mainly belong to the grass family, Gramineae. Because rice is a grass species, the circumstances for other grass species are favorable, so it is ease for other grass species to invade the rice fields. Gramineae have hollow stems called culms. The leaves are long with parallel veins, alternated connected to the stem at the nodes. An example of a grass species which can be a weed is *Cynodon nlemfluensis* (L.) Pers., giant dhoup grass.

Another type of weeds which can occur in the fields is sedges from the Cyperaceae family. These plants superficially resemble grasses, and are of the monocot flowering taxon. These plants flourish in wetlands. Since the rice fields are quite wet, sedges occur, in particular *Cyperus esculentus* L..

However not all weeds are harmful to rice production. Some weeds suppress other weeds, thus decreasing the incidence of other more harmful weeds. So these weeds indirectly aid rice. This beneficial weed is called azolla which is a genus in the Azollaceae family. Azolla floats on the surface of water, spreading throughout the entire field, eventually covering the entire water surface. When this plant covers the water surface, other weeds cannot establish anymore. And Azolla also fixes nitrogen, acting as a natural fertilizer, thus increases the soil fertility. So Azolla is very advantageous for rice.

6. Results

In the first part the FFS curriculum will be shown. Afterwards the perception of the farmers on their problems will be given. The opinion on FFS named by participants, non-participants and dropout are revealed. Lastly the amounts of yield named are made known.

6.1 Curriculum of FFS

An overview of the topics given at FFS is made. Two listings of the curriculum were obtained. The first one is devised by the extension worker Mrs. N. Kamwendo. The second list is devised by the participants interviewed.

6.1.1 Listing made by the extension worker

This list is created by Mrs. N. Kamwendo. It was obtained through a report[1] written by her. She initiated all six rice FFSs and facilitated some of them. Most of the topics were covered using field trials. A listing of the subject is found below.

An overview of the curriculum of all Bundi rice FFSs according to the extension worker:

- Nutrient management
- Time of fertilizer application
- Plant population
- Rates of fertilizer
- Use of herbicides
- Crop protection
- Variety studies

Nutrient management/ rates of fertilizer
This part covers the amounts of fertilizer that needs to be applied. Farmers do field test using different amounts of fertilizer. Also manure and organic fertilizer can be discussed.

Time of fertilizer application
Farmers determine at what times fertilizer application is most effective. Fertilizer is applied firstly as basal and later a top layer is spread. It is recommended that basal is applied during transplanting

[1] Presentation of experience on Farmer Field Schools at MIM in Lilongwe, Nancy D. Kamwendo, Karonga district agriculture office

Plant population
In this section farmers learn that three seedling per planting stations and using correct spacing can contribute to higher yield.

Use of herbicides
Farmers learn correct amounts of herbicides and how to apply it. However it must be noted that none of the farmers named this as a topic given at FFS. So it could be possible that this part was not covered.

Crop protection
This part deals with using measures to protect the crop against treats, for instance pests and diseases.

Variety studies
Farmers are shown the different rice varieties that are used in the scheme. Their characteristics are discussed, these are; time of maturity, amount of yield per plot and disease resistance.

6.1.2 Listing made by the participants

The second overview is created by asking all participants which topics are given. Participants came from different FFSs; therefore this is a summary of the different FFSs. The topics given are an overview of all the rice FFSs together. So it is possible that not all topics were given during a certain season of FFS. Looking at the list devised by the farmers, the topics which were named most often are in the top, the ones that named only once or twice are at the bottom.

<u>An overview of the curriculum of all Bundi rice FFSs according to farmers:</u>

- cropping practices
  - planting in lines
  - number of seedlings per planting station
  - spacing
- fertilizer application
- varieties
  - time of maturity
  - yield
  - disease resistance
- seedbeds and time of transplanting
- water management
- Agro EcoSystem Analyses (AESA)
- weeding
- time of rice tasks
- manure making and application

- pest and diseases
- other crops

Cropping practices and fertilizer application was named by almost all farmers as a topic of FFS. So these are probably a mayor part of the curriculum. Varieties were named by 21% of the participants. All other topics were mentioned only once or twice. It could be that only a few FFSs covered these topics or that farmers did not consider it as very important so they forgot to name it.

Cropping practices
With cropping practices, methods of rice planting are shown. Farmers learn to plant in lines and planting stations. Some farmers used to randomly sow the rice. Now farmers create planting stations in which three rice seedlings grow. These planting stations are separated by a certain space. Planting distances ranging from 15cm by 15 cm to 23cm by 23cm depending on rice variety or participant asked.

Fertilizer application
Farmers are shown at FFS when to apply fertilizer, at which amount and the method of spreading it trough field trials. The type of fertilizer which is used is 20:20, 23:21 and/or urea. Farmers first apply basal fertilizer (20:20 or 23:21) and later top fertilizer (urea). Basal fertilizer is applied during transplanting of rice so the young rice can immediately use the nutrients. The top fertilizer is advised to apply after weeding. This is done so there are no weeds in the fields that use the fertilizer. The amount of fertilizer applied is 5 kg/plot.

Varieties
In this part the different rice varieties are covered. Farmers learn about different aspects of varieties like maturation time, amount of yield and disease resistance. Farmer were shown trough field trials that the variety Pussa is fast maturing and gives low yield, Kilambero and Faya are longer maturing and give low yield, TCG10 is long maturing and gives high yield.

Seedbeds and time of transplanting
Before the rice plant is put in the plots they are first grown as seedlings in a nursery. In FFS classes farmers learn to make the seedbeds (nursery) and at what time the seedlings are transplanted to the plots. Farmers said that the seedlings are transplanted in the rainy season when they are two weeks old and in the dry season when they are three weeks old. In the dry season seedlings grow slower so they are transplanted a week later.

Water management
Water management consists of the amount of water that should be in the plot during the different growth stages. Also farmers can learn how to maintain the water channels and bands at their plot.

Agro EcoSystem Analyses (AESA)
Agro EcoSystem Analyses is a tool for decision making, that aids the farmers understand farming practices. This is done by the following method; farmers discover a problem, the cause is determined, a solution is devised.

Weeding
Farmers are shown at what time it is best to weed though field trials. This is done in combination with time of fertilizer application. Early weeding is promoted so the weeds do not have a detrimental effect on rice.

Time of rice task
With time of rice tasks is meant the time it takes to accomplish a certain task and at what stage of rice growing it should be conducted.

Manure making and application
Farmers said that manure making and application was not covered at most FFS. It has been added recently. Therefore not many farmers named it as a topic. What farmers did say is that it covers the use of rice bran as fertilizer, making manure from organic material and feces and application methods. Furthermore a field trail was conducted in which the yield was compared using artificial fertilizer, manure and a control with no fertilizer.

Pest and diseases
Diseases were covered when looking at rice varieties. Farmers were told which variety has a resistance to a certain disease. One farmer said insect pests and natural enemies were covered during FFS but she did not know the species anymore.

Other crops
A few times it was said that another crop was covered. This was the crop maize. The participants were told about varieties and a planting method called sasakawa.

6.2 Farmers perception of problems

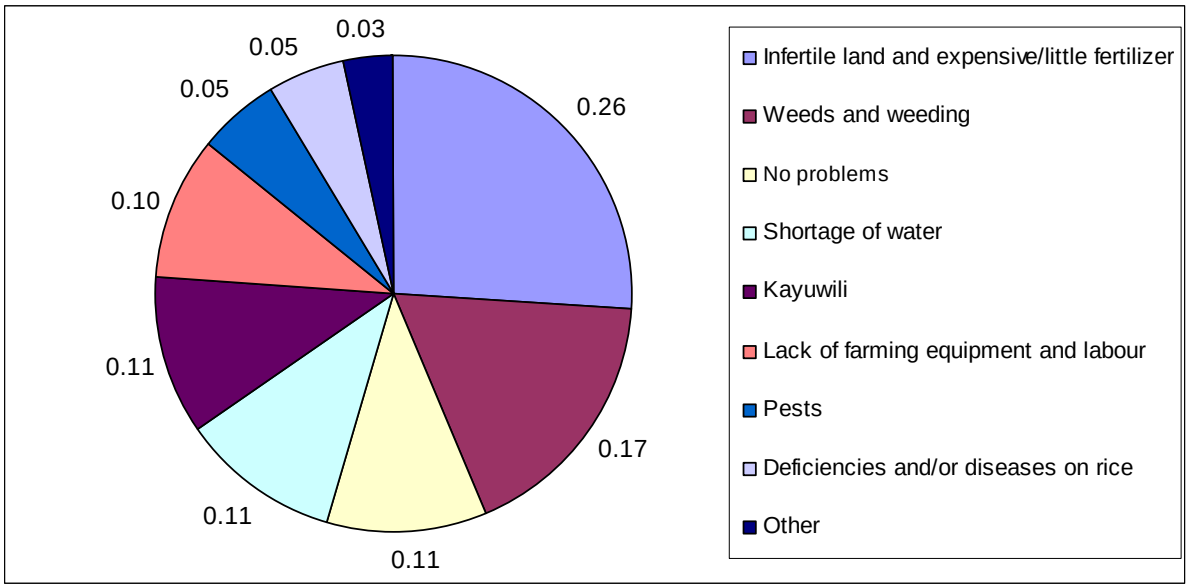
In order to see whether the FFS curriculum connects to the situation and problems of the farmers, firstly the problems must be identified and characterized. The farmers were asked to name their problem and indicate the most important one. With this an overview of farmers' perceptions about their problems could be obtained.

6.2.1 Main problems

The farmers were asked about their main problem, and the answers are put in the graph below. Then a description of the named problems will be given. A table has been made of the main problems faced by participants, non-participants and drop outs.

In total 87 farmers were interviewed. One participant did not answer the question, so she was not included in Figure 7 and table 2. Of the famers interviewed six farmers gave two answers when asked about their main problem. Because they considered the problems equally important both answers are included in the results. So instead of 86 answers, 92 are given. Of the interviewees who gave two answers, one is a drop out, three are non participants and two are participants.

Figure 7. Main problems as perceived by farmers



The main problem that was named most often and included 26% of all answers is infertile land and expensive/little fertilizer. Farmers meant with this answer that their land is very infertile. Therefore they have to use a lot of fertilizer, most of the time using artificial ones. However artificial fertilizer is not always readily available. And some farmers feel it costs too much money. During the rainy season coupons are given so farmers can buy fertilizer at a discount. However these coupons are not distributed during the rainy season.

The second problem named is weeds and weeding (17% of the respondents). Weeds are perceived as a problem because they compete with rice for nutrients, sunlight and space, therefore rice will give lower yield. Local names of weeds named are: Mbatawata, Nyadanga Hanyezi/Ndawu/Ndao, Twatawa, Shawa, Lusangano, Malubambo, Kaping, Masupuni, Waputheputhe and Azolla. Moreover weeding is also considered a problem because it is very

labor intensive so farmers either have to spend a lot of time weeding or have to get ganyu (hired labor).

Of the farmers interviewed 11% said that they have no problems.

Eleven percent of the interviewees felt that shortage of water is their main problem. The rice grown is wet land rice. So the rice always is grown in plots which contain several centimeters of water. The water is supplied by several channels which are running throughout the scheme. However during the dry season the water supply is not sufficient so the plots will not receive enough water. Furthermore channels can get blocked so some fields have no access to water anymore.

Kayuwili was named by 11% of the farmers as a problem. The name is used when there are physical problems with rice, like drying of parts, spots, yellowing of rice or lack of grains. It is not yet clear if these problems are caused by a pest, disease or deficiency. It is also possible that farmers use the term Kayuwili when there are different causes. Some farmers are often not aware that insect pests and diseases are different, and therefore mix them up. Similar problems are listed in the graph, however because of the term Kayuwili it was put separately.

Lack of farming equipment and labor was mentioned by 10% of the interviewees. With farming equipment farmers mean tools like ploughs, but also carts and oxen. Ploughs are used to prepare the soil for planting, and carts and oxen are used to transport rice and fertilizer. If this equipment is not available, time consuming labor is needed or equipment needs to be hired. During some stages of rice growing, much labor is needed. Sometimes friends and family will assist. But if that is not possible either the farmers must work alone or he/she has to hire ganyu (hired labor).

The problem pests was only mentioned a few times (5%). The first pest named was Mpheta, which are birds of the weaver finches species, the Red-billed Quelea (Ploceidae *Quelea quelea*). The second species mentioned is Bongololo, which literally means worms but is also used for millipedes and caterpillars.

Deficiencies and/or diseases on rice are also named by 5% of the farmers as their main problem. The symptoms they named are dried leaves and scorching of leaves. The farmers said that they do not know the cause; hence it is not clear whether it is a disease or deficiency.

Only 3% of the farmers named other problems, and they were only mentioned once. The first is capital, meaning lack of money. The second is market, the farmer indicating that there are not enough markets that fetch a good prize. The last problem mentioned is sundu, which is the local name for bloodsuckers. They live in the rice fields and sometimes suck blood from the farmers.

The most important problem as perceived by farmers is infertile land and expensive/little fertilizer, followed by weeds. Other problems are shortage of water, kayuwili which is a term farmers use for symptoms caused by diseases and pests, and lack of farming equipment and labor, pests, diseases and deficiencies, market, capital and bloodsuckers. Eleven percent of the farmers claim to have no problems.

6.2.2 Overview main problems divided between FFS Participants and non-participants

In this paragraph main problems are analyzed as perceived by those that participated in FFS and those that did not (the drop outs will be mentioned marginally since the sample size was small). It is expected that there will be a difference as FFS trained farmers learned ways of dealing with problems concerning soil fertility. The differences found between participants and non-participants will be evaluated in the discussion.

Table 2. Percentage of farmers (participants, non-participants and drop outs) naming their different main problems

Main problems	Participants % (n=40)	Non-participants % (n=45)	Drop outs % (n=7)	Total % (n=92)
Infertile land and expensive/little fertilizer	30	24	14	26
Weeds and/or weeding	8	24	29	17
No problems	18	4	14	11
Shortage of water	10	11	14	11
Kayuwili	10	13	0	11
Lack of farming equipment and labor	10	11	0	10
Pests	3	7	14	5
Deficiencies and/or diseases on rice	5	4	14	5
Other	8	0	0	3

6.2.3 Main problem: poor soil and fertilizer

Farmers consider soil fertility as the main problem. The soil is drained of nutrients and the farmers have to use means to increase the fertility. The farmers believe that the best way to deal with the degrading soil quality is by applying artificial fertilizer.

However, fertilizer is not always available and it is expensive. The government subsidizes fertilizer by supplying farmers with coupons at which they can buy fertilizer at a lower price. However coupons are only given away during the wet season, and the farmers have no guarantee that they will get the coupons every year. Moreover artificial fertilizer is not always readily available, and then farmers have to put in a lot of effort to procure it.

The farmers deal with the high price of fertilizer by buying the fertilizer right after the rice has been sold, as they then have money available. Some sell rice early to get a good price. Other ways to earn money is to work as a hired laborer - they call it ganyu. Some buy it collectively as buying in bulk is cheaper. However the farmers feel that the government should also aid in solving this problem. For instance by handing out more coupons and also supplying them during the dry season. Or they talk to extension workers about assisting them in getting a fertilizer supplying company.

Because of these problems with artificial fertilizer it might be a good idea to look at alternatives to improve soil quality. In this section the different alternatives and its use by farmers will be discussed.

At FFS the farmers learn methods to increase fertility like using manure and organic fertilizer. They also learn how to make compost themselves, for instance by using rice bran. So it is expected that farmers who have attended FFS will have an increased use of organic fertilizer and manure and a decreased use of artificial fertilizer. Subsequently it will be checked whether there is a difference between FFS participants and non-participants in the use of soil quality improving methods.

Even though learning to use manure and to make organic fertilizer is listed in the curriculum of FFS, it is likely that only a few FFSs have covered this topic.

Farmers were asked whether they use the following soil restoring methods: artificial fertilizer, manure, organic fertilizer, rotation, and fallow. In the following table the percentage of farmers that use a certain soil restoring method are listed.

Table 3. Percentage of farmers which uses methods to restore soil fertility

Method	% FFS participants (n=39)	% Non-participants (n=42)
Artificial fertilizer	100	98
Manure and/or organic fertilizer	31	14
Rotation	5	5
Fallow	5	7

Both FFS participants and non-participants use artificial fertilizer (no difference with P= 0.333). This is not in line with my expectations because it was assumed that through the knowledge gained at FFS about using manure and organic fertilizer, the use of artificial fertilizer would decline. When asked why they still used artificial fertilizer they said that it leads to higher yield

compared to other methods and it is less labor intensive as the other methods. However when money or fertilizer is scarcely available, manure and organic fertilizer are used.

Two non-participants did not use fertilizer in at least one of their fields. The first one claimed the soil was already fertile. The second one did not apply fertilizer on one of the fields because he was conducting an experiment. He was using rice bran as organic fertilizer and compared this with a field in which artificial fertilizer was applied.

A total of 31% of the participants use manure while 14% of the non- participants use manure, the difference being weakly significant (P-value 0.075).

Other methods that can be used to improve the soil are rotation and fallow. Of all participants and non-participants only 5% uses rotation. Most farmers did not conduct rotation because the fields were waterlogged, and draining them to grow a different crop is too much work. When there was rotation the crops named are tomato, cassava and maize. However rotation was not used to restore soil fertility; it was used when there was insufficient water. The farmers used different crops when the water levels were low and rice could not grow. Farmers do not consider rotation as a method to restore soil fertility.

Fallow is not allowed by the scheme authorities. They believe that if a farmer does not grow crops in the fields they do not need that field so it is taken away and given to someone else. Still we asked the farmers if they used fallow. Two farmers of which one a FFS participant and the other one a non-participant claimed to conduct fallow to improve soil fertility. A few mentioned that food insecurity was their reason for not using fallow. It could be that some farmers are not aware of the fact that fallow is not allowed. The only other time when farmers use fallow, is when there is not enough water in their plot and no rice can be grown. Usually this is during the dry period, which is one season, this is allowed.

Farmers mostly solve the soil fertility problem by applying artificial fertilizer. They apply it even though it is considered expensive. In artificial fertilizer application there is no difference between FFS participants and non-participants. So FFS did not have any effect on the use of artificial fertilizer. Sometimes manure and organic fertilizer are used by farmers. This is usually done in combination with artificial fertilizer or it is applied when artificial fertilizer is not available or too expensive. Other soil restoring methods are hardly used.

6.2.4 Weeds and weeding

Weeds are considered a problem because they compete with rice for nutrients. Weeding is labor intensive and costs a lot of time. In this part the weeds that cause these problems are discussed. All the different weeds named by farmers are put in a table and the frequent occurring ones will be looked at in more detail.

The farmers were asked to name all the weeds they observe in their field. They also explained whether they were beneficial, harmful or neutral, and the specific effects it has on rice.

The farmer talked about the weeds in the local language Tumbuca, so only local names were given. Later these local names were translated by a scientist into English names and descriptions. Through these English names and descriptions Latin names were found. A list of all the names can be seen in table 4. The weeds named most frequently are listed first in the table.

Table 4. The different weeds named by farmers

Tumbuca name	English name / Description	Latin name
Mbatawata	Water lily	Nymphaeceae family
Nyadanga	Wild rice Barnyard grass	Poaceae *Oryza* spp. Poaceae *Echinochloa crus-galli*
Hanyezi (Ndawu/Ndao)	Sedges (onion like)	Cyperaceae *Cyperus esculentus*
(Zo)twatawa	Creeping weeds	
Shawa	Leaves look like ground nuts	Oxalidaceae *Oxalis semiloba* Sond.
Lusangano	Giant dhoup grass	Poaceae *Cynodon nlemfluensis*
Malubambo/Luwembe/ Maluwambo	A type of grass	
Kapinga	Dwarf dhoup grass with fine leaves	Poaceae *Cynodon dactylon*
Azolla	Aquatic fern	Azollaceae *Azola nilotica*
Masupuni	Water lettuce	
Waputheputhe		

The weeds named by almost every farmer are Mbatawata, Nyadanga and Hanyezi. The other weeds were mentioned less than five times.

Mbatawata is the Tumbuca name for a Water lily species. Mbatawata is considered as both harmful, neutral and beneficial. Farmers consider it harmful because it competes with rice for nutrients. Mbatawata grows very quickly and can spread on the entire water surface. So it is difficult for rice to keep up. As a result of competition rice can have stunted growth or it can become yellow due to lack of nutrients. A few farmers told that Mbatawata can block sunlight and decrease air circulation which is also detrimental for rice. One farmer said it hardens the soil making it more difficult to work on. Many of the characteristics which make Mbatawata strong in competing against rice can also be beneficial for rice. Since Mbatawata grows very fast and can spread on the entire surface, other weeds do not stand a chance. So letting Mbatawata grow is a method to suppress other weeds. In addition Mbatawata does not kill the rice. Therefore 20% of all the farmers consider Mbatawata beneficial or neutral. Another

beneficial property is that when Mbatawata starts to rot it adds nutrients to the soil. So it is a natural way to increase soil fertility. However it should be weeded in time otherwise it takes too much nutrients from rice.

Nyadanga is the local name for wild rice or barnyard grass. This type of plant looks very similar to cultivated rice. Most farmers consider it very harmful. Although the reasons for finding it disadvantageous differ. The one thing farmers agree on is that it takes nutrients from the soil thus competes with rice. But the opinions about the effects of this competition on rice differ extensively. Some farmers say rice gets stunted growth, while other farmers say it has no effect, a few say it kills the plant while other do not. Several farmers indicate that the plant becomes yellow due to lack of nutrients. Six farmers consider Nyadanga partly beneficial or neutral. Their reasons are: it does not affect or kill rice; easy to uproot; and adds nutrients to the soil when buried. Farmers told that the seeds of Nyadanga can contaminate rice, since these seeds smell and taste bad, therefore it decreases the quality of rice. Nyadanga has to be uprooted in time so it cannot produce seeds. Farmers consider it a difficult weed to find because it looks so similar to rice, but when found it is easy to uproot. Other negative aspects found are: Nyadanga has a strong scent so it attracts birds which also feed on rice; it grows faster than rice thus blocking the sun and decreasing air circulation; it uses the space of rice; and it hardens the soil.

The last weed is called by many names, namely Hanyezi, Ndao and Ndawu. The English translation is sedges. Hanyezi is mostly seen as a harmful. Thought some positive aspects were also mentioned. Beneficial characteristics are that it can bind nitrogen, thus increases the soil quality. Some say it does not kill rice however not all farmers agree. Harmful aspects mentioned are similar to the weeds above. It competes with rice for nutrients, thus leading to yellow rice and stunted growth. It hardens the soil and blocks sunlight and air circulation. Hanyezi can grow around rice so it is very difficult to weed.

The weeds that occur frequently are Nyadanga, Mbatawata and Hanyezi. Farmers deal with it by weeding them. There are special tools but most farmers do not know it or have them at their disposal so they weed by hand. Farmers often conduct early weeding so they are easier to remove. Also extension workers are asked for advice. If the work is too time consuming ganyu (hired laborer) can be employed. A problem that occurs during weeding is that that can get hurt when plants cut them. The farmers say nothing much can be done about it except by wearing protective clothing, but many farmers do not own any. Some farmers are aware that there are weeds that are beneficial because they suppress other weeds, e.g. Mabatawata and Azolla.

6.2.5 Shortage of water

Another problem is shortage of water. The Hara Irrigation scheme is responsible for irrigating all plots of the rice fields. This is done with channels that run thought the entire rice scheme. It

was expected that rainfall does not affect the level of water in the plots; most water comes from the channels. But farmers told that shortage of water occurs, and this most often happens during the dry season. So rainfall is needed for properly irrigate the plots. Therefore the problem mostly occurs during the dry season. Farmers who have to deal with shortage of water have fields at poor locations. These plots are located high or far from the main channels so they do not get irrigated as well as other fields. Things that are done to deal with water shortage are: asking advice from extension workers, early planting, and diverting water from channels. However, most farmers feel that they cannot do anything about it.

6.2.6 Kayuwili

Kayuwili is a term farmers use when they see detrimental symptoms on rice. The symptoms can be stunted growth, grains that do not mature (deadheart) or are damaged, spots, lesions and yellowing of leaves. It is not really clear what exactly Kayuwili is. It can be a disease, pest or deficiency. Farmers often mix up symptoms of diseases, deficiencies and pests so it is likely that the term Kayuwili is used for several causes. Because it cannot be placed in one of the categories it was named separately from the two groups pest and deficiencies/diseases.

The farmers came up with a number of solutions. Planting different varieties e.g. Kilomebro and Faya and changing them often was mentioned. This is also an advice that extension workers give to the farmers. The farmers believe that not all varieties will be affected similarly by Kayuwili and environmental circumstances so there will always be varieties that are resistant. The varieties that are affected little by Kayuwili are still able to give high yields. Therefore farmers are assured of yield. Also good spacing and applying the correct amount of fertilizer was recommended. When wrong management is practiced the plants become more susceptible. Early planting to avoid Kayuwili is recommended as well. However there were also farmers who felt that nothing could be done about it.

6.2.7 Lack of farm equipment and labor

Lack of farm equipment and labor was also mentioned by the farmers. Farmers meant with equipment ploughs and carts with oxen. Ploughs are needed to prepare the field, but most farmers do not own this equipment. So they have to do the work manually or get ploughs by borrowing or hiring. Carts with oxen are needed for transporting. They move sacks of seeds, fertilizer and/or manure, the cut rice stalks and the bags of rice. If farmers need to transport they either have to rent a cart with oxen, which cost money, or they have to transport it manually, which is time and labor consuming.

Farmers solve the lack of equipment by working hard and saving money so they can buy the tools. Ploughs are mentioned most often as equipment they need. Other solutions named are hiring a plough and a cart with oxen. Or they hire ganyu that own this equipment, so they will

do the work for them. They also make deals with friends so they can hire equipment at a low rate.

Lack of labor was also mentioned often. At certain stages of rice cropping time and labor consuming tasks come up, like weeding. Farmers deal with lack of labor in two different ways. If they have enough money ganyu is hired to aid the farmers with their work. But farmers more often request help from fellow farmers. They have made agreements with family members and friends to work together. When a lot of work needs to be done in a certain field everyone will help. When another farmer asks for help a next time, everybody will also come to his or her assistance. Since the rice in different fields does not mature at the same time, there are always people available to give a hand. When everyone works together there will be enough manpower to conduct the labor.

6.2.8 Pests

According to farmers pests are also a problem. The term pests in this reports stands for animals like insects, birds, mammals, amphibians and reptiles that feed on, or damage rice. In order to determine de number of pests in the area the farmers were asked in the interviews to name the animals that were found on or near rice fields. Also the knowledge of farmers about the named subjects was determined. This was found out through asking the farmers whether they think these animals are harmful, beneficial or neutral. In addition the farmers were asked to tell the reason why a certain species is considered harmful, beneficial or neutral. Also insects were collected from different sites for determination. In the first part insects are discussed. After that birds will be talked about. In the last section other animals will be dealt with.

Insects

The farmers were asked to name the different insects they see in their rice fields. The names given were in the local language Tumbuca. These local names were later translated in English. These English names and descriptions turned out to be so general that it was not possible to get to the species level and to connect it to Latin names. In order to solve it insects were collected in local rice fields, so insect species could be recognized. An overview of all the insect names given can be found in appendix II.

Several insect species were collected from rice fields during a number of days. These were determined by Family, Genus and species. The Tettigoniidae could only be determined up to the family name. The insects were placed in three different categories. The first category is harmful, covering all insects feeding on rice. The second group is the beneficial insects or natural enemies of rice pests. The last category consists of insects (and one snail) which are neutral, because they do not feed on rice, their diets consist of other species of plants, thus they do not influence the rice plant. The harmful and beneficial insects found are placed in table 5, the neutral insects can be found in Appendix II.

Table 5. Harmful and beneficial insects found on and near rice fields

Name Family – *Genus* – *species* Common name/ Malawi name	**Description**	**Harmful/ Neutral/ Beneficial**
Pyralidae *Maliarpha separatella* African white stemborer	Stemborer	H
Noctuidae *Sesamia calamistis* Pink maize borer	Stemborer	H
Diopsidae *Diopsis* spp. Stalk eyed flies	Stemborer	H
Acrididae *Acrida* spp. Short horned grass hoppers	Grass hopper, feeds on rice	H
Cercopidae *Locris arithmetica* Red spotted Spittle bug	Feeds on grasses, can suck on rice	H
Tettigoniidae Long horned grasshoppers	Can eat plant materials. But many species are exclusively predatory, feeding on other insects, snails or small vertebrates.	H/N/B
Libellulidae *Crocothemis erythraea* Scarlet Dragonfly	Predator on flying insects including butterflies, mosquitoes and flies.	B
Libelludidae *Orthetrum julia* Julia Skimmer	Predator on flying insects including butterflies, mosquitoes and flies.	B
Coenagrionidae *Pseudagrion* spp. Damselfly species	Predator on flying insects including butterflies, mosquitoes and flies.	B

The local name that was give most often is Nthefunthe, 63% of the farmers named it. The meaning of Nthefunthe is grasshopper. Farmers all considered Nthefunthe harmful because it sucks on rice grains during the milking stage, leading to a decrease in yield. Some farmers also said it eats leaves and cuts stems. Half of the farmers do nothing to control them. Some farmers spray chemicals (e.g. 7:7, Chitetezo), scare them by shaking rice, or catch them to eat. Two farmers said they were eaten by the birds Nyanginyangi and Chagoga, it was not clear what kind of species these are. When looking at the grasshoppers in the table above it is quite likely that Nthefunthe is a short horned grasshopper (Acrididae *Acrida* spp.). These grasshoppers feed on rice plants, thus damaging the plant and decreasing yield, this is similar to what the farmers told. It may perhaps be a long horned grasshopper species (Tettigoniidae). This is not very likely, because all farmers named Nthefunthe a harmful species. Since Tettigoniidae are mostly predatory some farmers might have named it beneficial.

Secondly Mphazi was mentioned, which simply means grasshopper. Most of the farmers thought they are harmful, but some also found them neutral of beneficial. Mphazi is considered harmful because it sucks milk from developing grains and cuts and eats leaves and stems. Most farmers do nothing to control this pest, a few say chemicals should be used or they kill them by hand. The farmers who consider Mphazi neutral say it just moves in the field, so it does not

feed on rice. One farmer considered Mphazi beneficial because it feeds on weeds. Mphazi could be either a short horned grasshopper (Acrididae Acrida spp.) or long horned grasshopper (Tettigoniidae) species.

Lastly farmers named bongololo. Bongololo can mean several things namely worm, stemborer, caterpillar and millipede. Farms use bongololo when an insect has the shape of a worm. Most of the time it turns out to be a caterpillar or stemborer. The farmers named several types of bongololo characterized by color such as green, black, white, red, khaki, khaki/green and black/white striped. Green bongololo was named most often, namely by 29% of the farmers. Almost all farmers consider it harmful. It eats leaves and straws of rice, both in the nursery and when the plants are mature. So it is probably a caterpillar species. A few farmers consider it beneficial or neutral because it either does affect rice or it feeds on weeds, however this was only the opinion of a small fraction. Secondly 21% of the interviewees mentioned the black bongololo. The effects of the black bongololo are similar to the green bongololo, so these also feed on leaves and straws of rice. The bongololo with other colors were only mentioned once or twice. It is likely that most bongololo mentioned are caterpillars. Most farmers say bongololo should be dealt with by spraying chemicals, like Chitetezo and 7:7, these are insecticides. Farmers get these chemicals from extension workers or ADMARC. It is not clear if the farmers that said insecticides are the best control method, actually use it.

Farmers said that some bongololo bore in the stems of rice. So these are probably stemborers. Farmers consider them harmful. During the insect collecting three stemborer species were found, these are placed in table 5. The stemborer species found are; *Maliarpha separatella* (Lepidoptera: Pyralidae), *Diopsis* spp. (Diptera: Diopsidae) and *Sesamia calamistis* (Lepdioptera: Noctuidae). Stemborers are harmful to rice because the larvae dig into the stem of rice and destroy the growing parts of rice. The symptoms of this damage are deadheart and whitehead (Litsinger et. al. 2006; White et. al. 2005; Ba et al, 2008). It can lead to a decrease in yield. In one location hundreds of Diopsidae *Diopsis* spp. was observed. So this species might occur in abundance.

When asking the farmers about beneficial insects, earthworms were named. Earthworms are considered beneficial because they dig in the soil, making the soil soft, thus easer to work on. Furthermore they add nutrients to the soil when they digest. Around 20% of the farmers say that there are no beneficial insects.

Farmers never named dragonflies or damselflies, however these were collected. Three species were found and they turned out to be beneficial to rice. The first two are dragonflies of the species Scarlet Dragonfly *Crocothemis erythraea* (Odonata: Libellulidae) and Julia Skimmer *Orthetrum Julia* (Odonata: Libellulidae). The last is a damselfly species *Pseudagrion* spp. (Odonata: Coenagrionidae) which looks quite similar to a dragonfly however it is smaller. These three species are predators of flying insects, for instance butterflies, flies and mosquitoes. The larvae of some butterflies and flies are pest on rice. By feeding on these flying insects the dragonflies and damselfly decrease the number of pests on rice, thus are beneficial to rice

Collected birds

Farmers were asked to name all the birds they saw in rice and subsequently if they are considered harmful, beneficial or neutral. One bird was named by almost all farmers (94%), namely Mpheta. Farmers said Mpheta is considered as a major pest. All farmers except one said it is harmful. The interviewee who thought it was not harmful found it beneficial because she could eat them when caught. Mpheta is considered detrimental because they eat the rice grains. If many are around they can have a major impact on rice yield. Two samples of the species were caught. They were characterized as weaver finches, *Quelea quelea* (Passeriformes: Ploceidae) also known as the Red-billed Quelea. Weaver finches eat grass seeds and grain. This is in line with what the farmers observed.

Farmers deal with the pest by scaring or trapping. The farmers catch them by using nets. One farmer mentioned that he put chemicals on rice to kill them. Mostly the birds are scared away. They throw rocks at them or children stay near the fields to chase them away. Furthermore noise is made, by hanging tins or paper on strings or by putting plastic bags on poles. Mpheta used to be one of the mayor problems of rice farmers. But a few years ago Chinese developmental workers came who brought nets so the birds could be caught. In the following years many birds were caught decreasing the population dramatically. Due to the decrease farmers do not consider the birds as a big problem anymore.

Secondly yuwulu was named as pest. They feed on rice grains. It is very likely that it also is a weaver finch of another species, but it could not be confirmed. Most farmers regard it as harmful; yet one farmer told it was beneficial because it eats the weed Hanyezi. Farmers deal with them in a similar matter as Mpheta.

Not all of the birds are considered harmful. Two birds are often mentioned and considered beneficial, namely Nyanginyangi and Chagoga. Unfortunately the English name of the birds could not be found. According to the farmers Nyanginyangi and Chagoga feed on snakes and harmful insects like Nthefunthe, Mphazi (both grasshoppers) and bongololo (probably caterpillars). Snakes are considered harmful because they can bite people and some species are poisonous.

Many other birds are named however not as frequent as the birds above. All the birds mentioned are listed separately in appendix II.

Other animals

Farmers were also asked to list all other animals in their field. Sezi were named most often, these are cane rats (Thryonomydae *Thryonomys* spp.). Mbulu and Nyanga were named quite often. Mbulu is characterized as a monitor lizard (Varanidae *Varanus* spp.). It was not possible

to find an English name for Nyanga but it might be a feline species. Also cows and pigs were mentioned. All other animals mentioned can be found in appendix II.

Farmers said that almost all of them have rats in their fields. They live in the bunds. Bunds are ridges of earth which surround the plots, farmers can walk on them and they keep the water in the plots. Cane rats eat rice both in nursery and fields. In the nursery they dig and eat the sprouting seedlings. In the fields they cut the rice straws so they can get to the grains. Farmers deal with them by digging the bunds. If rats are found they are killed physically with sticks or poisoned with chemicals. Chemicals named are 7:7, Tamic, Malathon, Chitetezooce and Latex. Also bait is placed that is impregnated with a chemical, and rats eating from it will die. Baits can be made from bran, groundnut butter or maize. The farmers also flood their fields. They believe that the rats cannot access the rice anymore or drown. However rats can swim, so it is not sure if this method is effective. Furthermore bunds are downsized, hence the rats have less space to build their nets, and grass is cut so they cannot hide in it. One farmer told that cats feed on them after the harvest. Some farmers eat the rats when caught.

The opinion of farmers on Mbula (monitor lizard) is diverse. Some find it harmful because it disturbs the rice so grains can fall down. Others say it is neutral or beneficial because it just moves in the field and eats fish, but some say it is helpful because it can eat pests. Some farmers chase them away or try to kill them, but most just let them be.

Nyanga could be a feline species, however that is not sure. The animal is considered both harmful and beneficial. Many farmers say it is beneficial because it eats rats and other small animals that are pests on rice. Some find it harmful because it can damage rice when they move in the fields. Two farmers said it feeds on the rice. Farmers do nothing to deal with these animals.

Cows and pigs are kept as livestock by farmers. They are beneficial because their droppings can be used as manure. They are often kept on grasslands or harvested rice fields. However when farmers do not keep an eye on them they can go to fields which are still full of rice. There the pigs can destroy rice when they dig in the earth and the cows can feed from the plants. So owners should look after them.

6.2.9 Diseases and deficiencies

Deficiencies and diseases on rice are a problem for the farmers. A deficiency is caused by a lack of nutrients, while a disease can by caused by viruses, fungi or bacteria. Most diseases occur during the rainy season. Since my research was conducted in the dry season not many diseases could be observed. A scheme specialist was consulted to tell about the diseases and deficiencies that occur in the rice scheme. He named three diseases and two deficiencies: bacterial leaf blight, brown spot, sheath rot, and phosphorus and nitrogen deficiency.

Sheath rot[1], *Acrocylindrium orzae* is usually related to stem borer attack. With this fungal disease leaf sheaths rot, oblong gray centered brown margined lesions occur, and young panicles rot. Infection occurs on the uppermost leaf sheath at late booting stage. The variety TCG 10 is mostly affected.

Bacterial leaf blight[1] occurs in the scheme. It is caused by the bacteria *Xanthomonas campestris*. Symptoms are white to yellow lesions (leaf blight) at the margins of the leaf blade. It affects the tillering stage. It can lead to a yield reduction ranging from 10 to 30%. It is controlled by removing affected plants, using disease free seeds and applying lower rates of fertilizer.

Brown spot[1] is a fungal disease caused by *Helminthosporum oryzae*. The symptoms describe are: oval spots on leaves, about the size and shape of sesame seeds. They are relatively uniform and fairly evenly distributed over the leaf surface. Young spots usually dark brown, fully developed lesions are brown with a grey or whitish center. These symptoms can occur during any stage of rice growing. The yield loss can vary from 50 to 90% with high seedling mortality. Ways of controlling are: crop rotation, planting at different dates, good water management, using disease free seed, and applying fungicides.

Deficiency of nutrients can be spotted by several symptoms. If rice plants have a phosphorus deficiency it can be seen through a purple coloring at the sheath. Rice plants can also have a nitrogen deficiency. Symptoms are a browning of the tips of leaves. These deficiencies can be solved by applying the right amount of fertilizer.

6.2.10 Other main problems

Some other small problems were also mentioned: not being able to find a good market to sell the rice; lacking capital; and being attacked by bloodsuckers. The bloodsuckers will be discussed in another part.

Market

Market has not been mentioned much by the farmers; only one person considered it a main problem. However, during further questioning it appeared that market is a problem for many farmers. There are little markets for the farmers to sell their rice to and they feel that they do not get a good price.

The markets that are available to farmers are: Swahili vendors, towns and cities, ADMARC (Agricultural Development and MARketing Corporation) and NASFAM. The advantages and disadvantage of each market is shown in table 6. These markets will be discussed in more detail in the discussion.

[1] Integrated pest management rice. Pocket reference manual. First printing. 1986 pp. 66-97

Table 6. Advantages and disadvantages of different markets

Market	Advantage	disadvantage
Swahili vendors	Always buy, readily available	Give low price for rice
Towns and cities	Give good price	Transport, takes a long time
ADMARC	Give good price	Is not always open
NASFAM	Give good price	Buys only good quality rice, is not always open

Capital

Capital was mentioned by one farmer as his main problem. However, lack of capital is related to many other problems. For instance buying artificial fertilizer is a problem because farmers cannot afford it. Lack of farming equipment is also linked to capital, when having enough capital they can buy or rent the tool.

Lack of capital is mostly caused by two things, lack of income or wasting money. Some farmers do not know how to handle money. As soon as they earn it they spend it on beer or other useless things. Then little money is left for basics like schooling, clothing or food. Also little is then left for farming inputs, for instance buying seeds, fertilizer or tools. Another reason for lack of capital is little income. This can be caused by not having enough yields to sell, not getting a good price for rice, or not having an additional means of income.

Some farmers want to increase their income by learning new ways of generating income. Other farmers feel they cannot do anything about it, they say government should help them by supplying coupons, goods or capital.

6.2.11 Small problems

Besides the main problems also some other problems were mentioned. The main problems are related to the rice cultivating and affect rice. Most of the smaller problems affect the farmers.

<u>These problems are:</u>

- lack of sacks for rice storage
- cuts from weeds
- snakes
- tsetse flies
- mosquitoes
- lack of toilets
- Bilharzia
- backache
- rheumatism
- big lizards (Mbulu/Gondwe) who magically steal rice for other farmers

- lack of chemicals
- getting hurt by hoes
- thieves who steal rice
- lack of fields

Of the problems named some were only mentioned once or twice, so these are only individual problems. However some problems were mentioned quite often. The ones that are frequent mentioned are: animals which can harm farmers, body pains and Bilharzia.

Some animals are a problem because they can attack the farmers while working. Animals that are considered harmful are; snakes, bloodsuckers, tsetse flies and mosquitoes. Snakes are the most dangerous. In the area many poisonous snakes occur. Most of the time they flee when people are around, but sometimes they attack. If a farmer is bitten by a poisonous snake he or she must be rushed to a hospital or medical facility to get anti-venom. Bloodsuckers (local name Sundu) are considered annoying. They can attach to people sucking blood. Farmers say they can be avoided by putting on gum boots or creams like Vaseline and oil. When one does attach the farmers remove it by hand. Lastly stinging insects are named namely mosquitoes and tsetse flies. Mosquitoes sting people and suck blood. This is irritating but not harmful; the dangerous part is that they can carry malaria thus infect people. Most people have mosquito nets above their bed however many have holes so they are not very effective anymore. The sting of the tsetse fly is more painfully than mosquitoes and sometimes tsetse flies can transfer sleeping disease. So they are also considered harmful.

Body pains were also mentioned often. Body pains include back ache, swollen painful legs, headaches and painful knees. Farmers told that back aches are caused by over kneeling. Farmers have to kneel frequently when working in the field, especially during weeding. They feel nothing can be done about it. Another problem mentioned is swollen, painful legs and knees. This is caused by chemicals which are in the water. The origin of these chemicals is fertilizer. Farmers say that it can only be avoided by wearing gum boots, but not many people own these. Lastly headache was named. According to the interviewees it is caused by sunstroke. They avoid it by working during times when there is little sun or when it is not hot, for instance during the morning and evening.

The last problem named often is Bilharzia. Bilharzia (Schistosomiasis) is a parasitic worm that lives in the water and can infect people. When a person who is infected urinates in the water, eggs will contaminate the water. The hatched parasites grow in snails and later pierce the skin of humans. Most farmers are aware that Bilharzia is caused by a parasite and that it gets in the water through urine. The farmers say the best solution is making sure no one pees in the water by supplying toilets near the fields and educating people. Also taking anti-Bilharzia pills and wearing gum boots were named as a solution. One person said ducks are beneficial because they eat the snails in which the parasite grows.

6.3 Farmer perception of FFS

In order to determine the perception of farmers on FFS a survey was held. In this chapter the viewpoints on the FFS method of the participants, non-participants and drop outs will be dealt with.

- FFS participants: the perception of farmers on the curriculum, what they would like to change, and what they like and dislike about FFS.
- FFS drop-outs: the reasons for not finishing FFS
- Non-participants: what they know about FFS, and whether they would like to join.

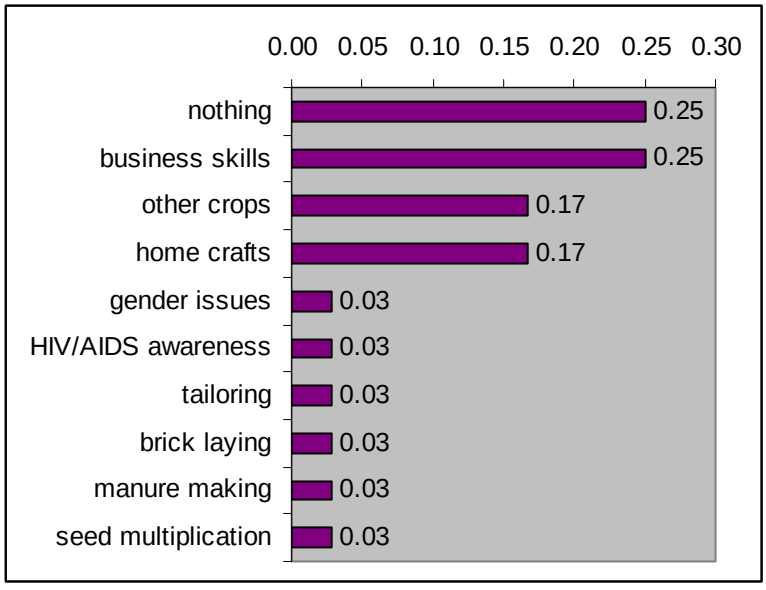
6.3.1 Participants

In this part the topics will be mentioned that farmers would like to include in FFS, changes that are advised, and positive and negative aspects of FFS will be discussed.

Topics that should be included

In order to determine whether the farmers believe the curriculum to be sufficient or should change, the farmers were asked which topics should be included. Three of the thirty-nine participants gave double answers, so a total of forty-two answers were given. Of all participants 25% stated that no other topics were needed because the curriculum is sufficient. But the other 75% did think other topics should be included.

Figure 8. Topics which should be included at FFS as indicated by farmers (n=42)



The answer that was given most often was that business skills should be included. Business skills named are: markets, management, sales, business administration, marketing, fund management and home economics.

Two other topics which are considered important are other crops and home crafts. When looking at the topics of the curriculum of FFS, maize has been included in the curriculum of FFS. However, it is possible that other crops such as maize were not dealt with in each FFSs season. What can be meant as well is that more different crops should be included. When asked which crops should be included maize was mentioned most often, meaning that maize was not always included. Other crops that were mentioned are: vegetables, cassava, ground nuts, beans and millet.

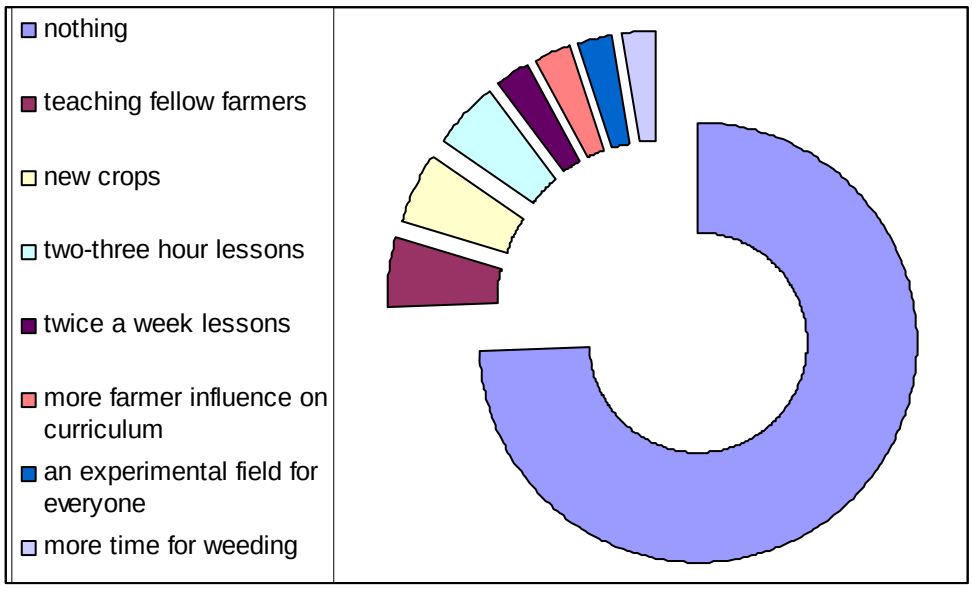
The second topic which was also considered important is home crafts, such as cooking, knitting and needle work. This was only mentioned by females, not males. All the other topics were named by both males and females. That only females named this topic is due to the fact that in Malawi culture, women are responsible for the household.

Manure making was also mentioned. This is a topic in FFS, but apparently it has not been dealt with during all FFSs.

Changes that should be made to FFS

The overall outlook on the setup of FFS is positive. Of all participants 74% thought FFS did not need to change, it is fine the way it is. However 26% did feel some changes were necessary. An overview of the ideas that were offered is given in figure 9.

Figure 9. Percentage of farmers (n=39) suggesting changes on FFS setup



Since only 26% did think FFS should change and there were many changes named, each change was only represented by no more than 5% of the interviewees, which is 2 people.

Some farmers think that knowledge should be transferred to other farmers, and that FFS should supply the means for that. The participants were asked whether they told other farmers what they had learned at FFS. It came out that some participants did show other farmers new techniques without resorting to FFS. So it is possible for farmers to teach fellow farmers without aid from FFS.

It was suggested to cover other crops. This has also been mentioned as a topic which should be included in the curriculum. So farmers consider learning about the production of other crops besides rice important.

Another thing was mentioned was that sessions should not last longer than 2-3 hours, instead of 4 hours. However it was also said that there should be two lessons a week, however without indicating what topics should be covered in the extra lesson. But it could also mean that they should have two sessions of two hours each.

At one time it was mentioned that farmers should have more influence on the curriculum. They should be able to choose themselves if they want a certain topic covered or not. The FFS program should not come from the top. Though the FFS schedule is made by the extension workers and facilitators, farmers have a big influence on the content of the curriculum, because they are asked what topics they want covered during the sessions. Thus the farmers seem to have quite an influence on the curriculum.

It was mentioned that all farmers should have their own experimental field at FFS. Yet this is not possible due to practical considerations. There is only a small area which can be used as an experimental plot. So farmers have to work together on the plots. They always have the possibility to make an experimental plot in their own field. One thing that has also has been mentioned that weeding is too much work for one day. If every farmer would have their own plot it would be more labor intensive. Therefore the current set up seems sufficient

Farmers' perception on positive and negative aspects of FFS

In order to find out what the satisfaction of participants is, they were asked to name positive and negative aspect about FFS. Of these answers two tables are made. One with all the good things concerning FFS and one with all the aspects farmers dislike.

Table 7. Percentage of farmers indicating positive issues of FFS (n=41)

what participants like about FFS	percentage
everything, all lessons and topics	**32 %**
cropping practices:	**24 %**
how to plant rice	3 %
counting number of straws per planting station	2 %
time of planting	5 %
seedling planting	2 %
weeding	2 %
fertilizer application	5 %
comparing manure and fertilizer	2 %
making manure	2 %
topics:	**17 %**
AESA	7 %
how to increase yield	7 %
following farm calendar	2 %
other aspects:	**25 %**
punctuality	5 %
good group	2 %
strength in numbers	2 %
the way the lessons were conducted	2 %
field trials	2 %
demonstrating experimental activities to visitors	2 %
visitors who bring new knowledge	2 %
knowing most of the things already	2 %
gaining knowledge	2 %
Nothing good about FFS	**2 %**

In total 38 farmers answered this question however three farmers gave two answers which are included in the table, making it a total of 41. The positive aspects can be divided in several subjects (table 3). The first part, with a total of 33%, consists of farmers who feel that everything of FFS is good. The second component consists of the cropping practices that the farmers covered. It is divided in many topics including planting methods, weeding and fertilizer. A total of 25% were positive about this part. Thirdly some other topics were mentioned by 17% of the farmers, namely AESA (Agro EcoSystem Analyses), methods to increase yield and following the farm calendar. Lastly some other aspects of FFS were mentioned as positive. Aspects like punctuality, conducting field trials and gaining knowledge. A total of 25% mentioned these different aspects. One farmer did not think anything was good about FFS. So he was very dissatisfied with FFS. The reasons for dissatisfaction of all farmers are in table 8.

Table 8. Percentage of farmers indicating negative issues of FFS (n=36)

what participants do not like about FFS	percentage
Nothing bad about FFS	81 %
too much time spend at sessions with no food available	6 %
hard work, e.g. leveling on experimental plot	3 %
unplanned FFS sessions	3 %
Working on experimental plots for the farmer practices	3 %
absence of fellow members	3 %
Not given ploughs	3 %

A total of 36 participants answered the question about negative aspect of FFS, two interviewees did not want to answer. What is obvious to note is that the majority of the participants, namely 81%, feels that there are no negative aspects of FFS. This implies that most farmers are satisfied with the way FFS is conducted. However some negative points were given. These are: spending too much time during a session, so farmers say they should be shorter or food should be supplied. Farmers were also not happy about the hard work on the experimental plots. One farmer did not see the point of conducting farmer practices on the experimental plot since these methods were already conducted in the fields of the farmers themselves. Another thing that participants did not like was absence of fellow farmers. Lastly it was mentioned that a farmer expected to get ploughs when attending FFS. It could be that this farmer had wrong expectations, or that the ploughs were promised but not given.

Overall it can be seen that the participants were mostly positive about FFS and the way it is conducted.

6.3.2 Drop outs

Drop outs are the farmers who joined FFS but never graduated. In this section their reasons for dropping out will be covered. Then it can be seen whether they stopped because they felt FFS was not needed, they did not agree with the set up, or because they did not have the possibility to attend enough lessons.

In total six people were interviewed. Of these six: two farmers dropped out due to sickness, two did not have enough time, one dropped out because the lesson he learned at FFS are similar to the one learned at Simarq, the last dropped out because fellow members also dropped out.

Reason for not graduating:

- Sickness (HIV/AIDS)
- Too busy with:
  - Building a house
  - Working in the gardens
- Already learned what was taught at FFS
- Following other drop outs

Since only six drop outs were found no definite conclusions can be drawn. Nevertheless these answers indicate that farmers who decide to drop out usually do it because lessons cannot be attended, due to sickness or lack of time, or they have already learned the knowledge from another place. So farmers do not seem to drop out because they do not like the way FFS is conducted.

6.3.3 Non-participants

In this section there will be looked at the non-participants. It will be discussed if they have heard from FFS and from whom. Also what they know about FFS will be named. Lastly reason for joining or not joining will be covered.

Knowledge of FFS

Of all non-participants 88% has heard of FFS. This fraction is high because all non-participants that were interviewed came from the same village. Since farmers have much communication and connections within a village, information spreads quickly. Mostly they were informed by friends and extension workers, but family and participants also mentioned FFS to them. The remaining 12% have not heard about FFS at all.

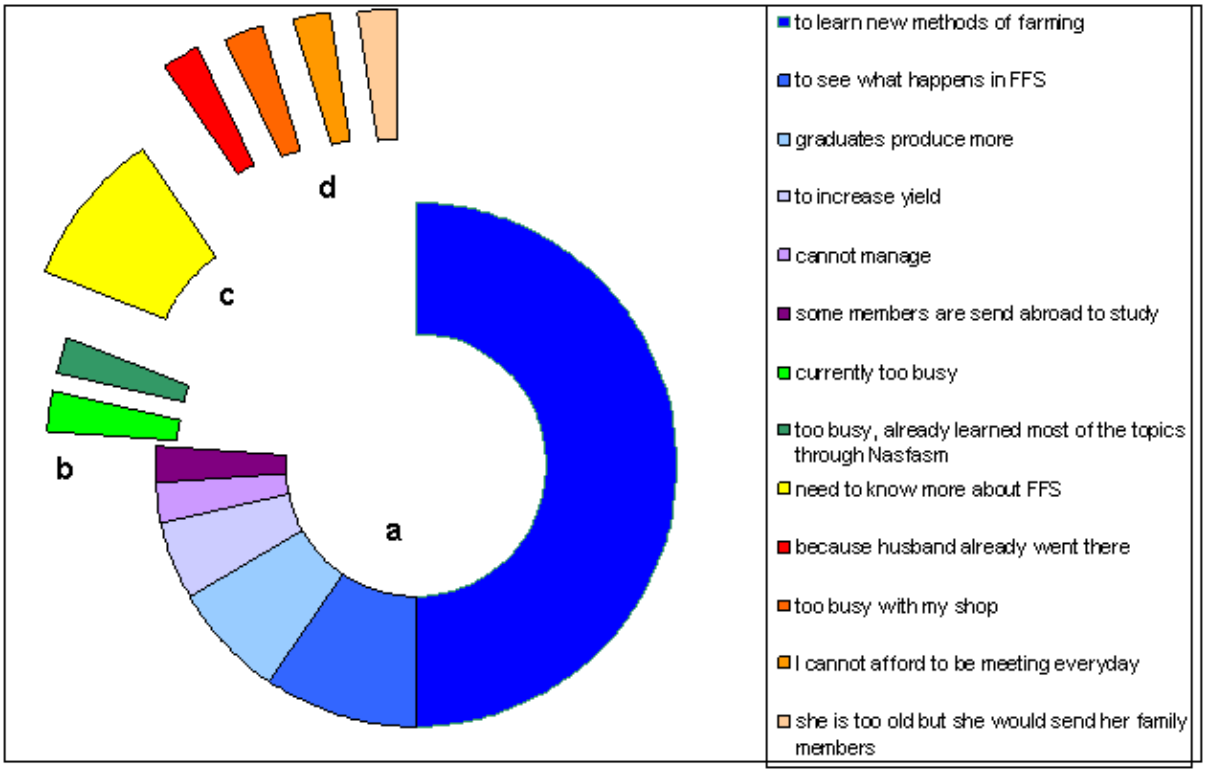
About half of the farmers that have heard from FFS know that it covers farming methods including: cropping techniques, fertilizer and manure making and application, and water management. A few also mentioned that experimental plots were used and that the AESA (Agro EcoSystem Analyses) method is used. About 40% have heard of it but they know nothing of its contents.

Reasons for (not) joining

The non-participants were asked whether they would like to join FFS. Of the people asked over 75% would like to join, about 5% currently could not join but might join in the future; around 10% was not sure yet, they first wanted to hear more about FFS before they made a decision; and the last 10% did not want to join. In figure 10 the reasons for these decisions are lined up. The blue/purple section are the reasons for joining, the green section consists of the motives

for not joining right now, the yellow section shows why farmers have not made a decision yet, and the red/orange section shows the motivation of the people who do not want to join FFS.

Figure 10. Reasons for (not) joining FFS, divided per section



- **a.** reasons for joining
- **b.** reasons for joining later
- **c.** reasons for making a decision later
- **d.** reasons for not joining

Half of the farmers want to join FFS to learn new methods of farming and enlarging their farming skills. A few farmers mentioned that they had seen bigger yields at participants' fields. Also farmers were curious about the contents of FFS so they consider it a reason to participate. One farmer told he could not cope on his own so he felt he could learn more. Lastly it was mentioned by that FFS participants could have a chance to study abroad, however this has not occurred yet, so it might be that this farmer has wrong expectations.

Farmers who would like to join but not at this time, mentioned that they are currently too busy. One also mentioned that he already knew learned most of the topic so attending FFS was not that important for him.

A few farmers questioned could not make a decision yet. This is because they do not know the precise contents, meaning and goal of FFS. When they hear more about FFS an informed decision can be made.

Lastly some farmers did not want to join. Their motives are: family members already participated so they do not feel it necessary to join; being too busy with other activities such as running a shop; not being able to afford meeting frequently; one farmer mentioning that she felt like she was too old, however she would send her family members.

6.4 Farmers perception on yield

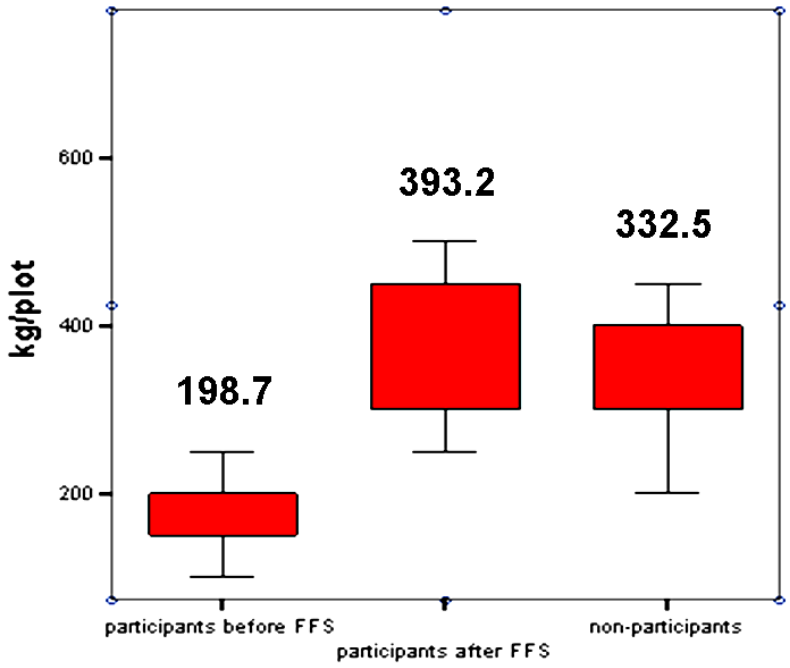
Farmers told how much yield they produced in one season per plot. These are perceptions as the yield was not measured.

The participants were asked about their yield before and after attending FFS. The non-participants were asked about their average yield. It is expected that non-participants and participants before they attended produced the same amount of yield. Since it is assumed that FFS assists farmers in raising yield, participants should have more yield than before attending FFS, and also higher when compared to the non-participants.

It is estimated that there is no significant difference between non-participants and participants before they attended FFS. A significant difference is expected for participants after attending FFS, compared to the other two groups.

A box plot was constructed to see how the amount of yield between the different groups is divided. And which group produced the most yields. The means of the three groups are shown in the box plot below.

Figure 11. Box plot of yield level per plot (1/6 Ha) as perceived by the different categories of farmers



When looking at the participants before and after attending FFS a high significant difference between produced yield can be found, with a P-value of $5.3 * 10^{-11}$ it is considered as an extremely significant difference. Before attending FFS a mean of 198.7 kg/plot was produced while after graduating FFS 393.2 kg/plot was produced. The amount of yield produced has almost doubled.

I anticipated no difference between non-participants and participants before attending FFS. However non-participants have produced a mean yield of 332.5 kg/plot compared to 198.7 kg/plot of the participants before attending FFS. Hence the yield produced by non-participants is higher than expected. A very high significant difference with a P-value $8.9 * 10^{-9}$ was found.

Participants after finishing FFS and non-participants were compared. A weakly significant difference was found, P-value 0.035. When looking at the box plot the participants have produced a slightly higher amount of yield with a mean of 393.2 kg/plot, in contrast to the 332.5 kg/plot produced by non-participants.

From this result it can be concluded that FFS has a positive impact on the yield. However the average yield produced by non-participants turned out to be higher than expected.

7. Discussion

In this chapter it will discussed whether the FFS curriculum relates to the needs, opportunities and problems of farmers. Also the differences of the problems between participants and non-participants will be looked at. A SWOT analyses will be made to get an overview of the strengths, weaknesses, opportunities and threats of the rice FFSs. Based on the analyses strategies are devised.

Firstly the curriculum development will be concentrated on. In this part the problems of the farmers will be mentioned, and also the curriculum of FFS will be shown. Those two will be compared to see if the curriculum development is in line with the needs, opportunities and problems of the farmers. Topics farmers want to have included are discussed and the effectiveness of FFS will be looked at by comparing the problems of the participants to those of non-participants.

Next the livelihood of the farmers will be addressed. This will be conducted by looking at the yield of the participants and non-participants and the impact of FFS on it. Also marketing will be discussed.

A SWOT analyses will be conducted to have an overview of the strengths, weaknesses, opportunities and threats of the Bundi rice FFS. Subsequently several strategies will be devised on basis of the SWOT analysis.

All the results acquired are opinions and viewpoints of the interviewees. So these are not hard facts. A translator was used to convert the Tumbuca answers to English, so these answers were subjected to the translators' interpretation.

7.1 Curriculum development

The problems of the farmers will be compared with the curriculum of FFS, so it can be verified whether the curriculum of FFS connects to the problems and needs of the farmers. Also ideas which will improve FFS offered by farmers will be discussed.

7.1.1 Main problems of the farmers

The farmers experience many problems, and a short overview is given on the following page (main problems at the top).

Main problems named by farmers:

- Infertile land and expensive and/or little fertilizer
- Weeds and weeding
- Shortage of water
- Lack of farming equipment and labor
- Kayuwili
- Pests
- Deficiencies and/or diseases on rice
- Lack of market
- Lack of capital

It is in line with the findings in literature. In the articles written by Orr et al. 2004, van Huis et al. 1997 and Carr 1997, it is said that the main factor contributing to low yield is soil degradation. Other factors influencing yield are erratic rainfall and lack of resources. The interviewed farmers told that they consider as their main problem poor soil quality. Lack of recourses especially looking at capital, farming tools and artificial fertilize is also considered as a problem for the rice farmers. Shortage of water named by Bundi farmers is similar to erratic rainfall. However the farmers in the scheme are hardly dependent of rain because there is irrigation coming from channels leading to the lake. So in the scheme the focus is more on irrigation problems than erratic rainfall. Pest and diseases (including Kayuwili) also turned out to be a part of the problems. Even though it is not considered as big as a problem as infertile land it still is a major concern. What was not expected is that weeding is considered a big problem by farmers. In literature weeding has not been mentioned.

7.1.2 Curriculum of the Bundi rice FFSs

The focus of the curriculums lies on cropping techniques. Especially spacing and fertilizer is covered. The list of issues in the curriculum made by the farmers is chosen to use in the comparison with problems. This overview was selected because it is more extensive than the overview of the curriculum made by the extension worker.

An overview of the curriculum of all Bundi rice FFSs made by farmers:

- cropping practices
    - planting in lines
    - number of seedlings per planting station
    - spacing
- fertilizer application
- varieties
    - time of maturity
    - yield
    - disease resistance
- seedbeds and time of transplanting

- water management
- AESA (Agro EcoSystem Analyses)
- weeding
- time of rice tasks
- manure/organic fertilizer making and application
- pest and diseases
- other crops

In the FFSs mostly cropping techniques are covered. These rice FFSs try to improve the yield by giving the farmers better cropping techniques. It seems to be effective since the yield of participants (393.2 kg/plot) has doubled compared to before they participated (198.7 kg/plot). Topics that are addressed little are manure and organic fertilizer, pests and diseases.

7.1.3 Linkage between problems and curriculum

In order to make sure that the curriculum connects to the problems and the needs of farmers, all the problems were compared to the topics. The topics that connect to the problems are put in the table below.

Table 9. The linkage between the problems of the farmers and the topic given in FFS

Problems	FFS topics
Infertile land and expensive/little fertilizer	• fertilizer application • manure/organic fertilizer making and application
Weeds and weeding	• weeding • cropping practices
Shortage of water	• water management
Lack of farming equipment and labor	• time of rice tasks
Kayuwili	• pests • disease resistance of varieties • cropping practices • water management • AESA
Pests	• pests • varieties • cropping practices • water management • AESA
Deficiencies and/or diseases on rice	• disease resistance of varieties • cropping practices • water management • fertilizer application • AESA
Lack of markets and capital	

Many of the problems are covered by FFS, but most only indirectly or the topics are given at only a few FFSs.

Infertile land is covered directly because 'fertilizer application' is given at all FFSs. So here the curriculum connects to the problems named. Farmer lean to apply proper amounts of fertilizer at set times. Due to this new way of application less artificial fertilizer has to be used to get high yields. However artificial fertilizer still remains very expensive according to farmers. The topic making and applying manure and organic can deal with this problem, since farmers can always make organic fertilizer when artificial fertilizer is too expensive or not available. However this topic has probably been given only at a few FFSs, so not all participants have these skills.

Weeds and weeding was mentioned as a topic, however only by a few farmers. So it is likely that weeds and weeding were not given at all FFSs. Furthermore good cropping practices facilitates weeding, because with good spacing of rice it is easier to remove weeds.

The problem shortage of water is dealt with by the topic water management. Still it is not clear exactly what the farmers were taught during the session. So no conclusion can be made on whether the curriculum connects to this problem.

Good time management can be of help in dealing with lack of labor. Because farmers know what time a task takes and they can try to get help when need. However good time management does not solve the problem but it can help the farmers to cope with it. Nothing was shown at FFS on how to solve the lack of farming equipment. So here the curriculum does not connect to this problem. A Japanese guy in the scheme was busy teaching the farmers how to make farm tools. This could be included during FFS.

When looking at the problems Kayuwili, pests, and deficiencies/diseases, the FFS topics cropping practices, varieties and water management may help to solve the problems. Because resistance of plants against diseases, deficiencies and pests is higher with proper crop management. Also AESA is advantageous because farmers learn to properly analyze and deal with problems. However the problems itself are hardly covered during FFS. Some farmers were taught about disease resistance of certain varieties, but that was all. So it might be wise to put a bigger focus on these problems during FFS sessions.

Lack of market and capital is not dealt with in FFS. FFS only focuses on improving yield, not business skills.

7.1.4 Topics to be included according to farmers

FFS connects to some of the problems, but most of the time they are covered indirectly. In order to deal with it farmers were asked to name what they would include in farmers field school.

The answer given most was business skills, which relates to the problems lack of capital, market and farming equipment. It is not surprising that business skills are named because it deals with many problems farmers have, but FFS does not cover it at all. So it would be advisable to include this topic. Examples named by farmers are; market finding, management, sales, business administration, marketing, fund management and home economics.

Farmers would also like to learn about other crops. There are FFSs which cover other staple crops like cassava or maize in the area. So it might be wise to inform farmers about these FFSs. Because it is not necessary to include it in the curriculum when there are already FFSs around that deals with these crops. On the other hand there are no FFSs around that cover vegetable growing or other crops like groundnuts, beans and millet. So this could be included. Farmers would also like to learn about seed multiplication so they are not dependant on seed suppliers.

Another topic named is home crafts, but only by women. It includes cooking, knitting and sewing, these are household tasks women conduct. Most women can cook, but there are only a few dishes made from a handful of ingredients. They want to add other produce but need to learn to prepare it. Furthermore if woman learn to knit and sew they can make clothes for their children and themselves, saving money.

Furthermore farmers would like to learn about other means of income. With additional income farmers are less dependent on their crop. Subjects named are brick laying and tailoring. In the area there are always young farmers in need of a house and people always can do with extra clothes so these are good ways to generate capital.

Manure making was also mentioned as a subject to be included. This already is a topic in FFS, but apparently it has not been dealt with during all FFSs. This subject will be discussed more thoroughly later.

The last topic named is social issues, but only by one interviewee. The matters he would like to have included are HIV/AIDS awareness and gender issues. HIV/AIDS is a mayor social problem in Malawi. When looking at gender issues, there is a big separation between man and woman. Women have to cook, clean and take care of the children, while men work in the field. It is very interesting that a man would like to have this topic discussed.

Farmers feel there is a need for more social and economical topics to be discussed at FFS. FFS should be more multidisciplinary according to farmers. This correlates with findings in literature

which recommend a broad approach in FFSs looking at livelihood in general (Okoth et. al. 2002).

7.1.5 Comparing problems of participants with non-participants

Due to the topics given at FFS, it is expected that participants have other main problems than non-participants, or even no problems. So it is anticipated that many participants have no problems. Moreover the problems infertile land and expensive/little fertilizer, weeds and weeding, shortage of water and pests, diseases and deficiencies are expected to be less because FFS partly deals with them.

Table 10. Percentage of main problems named divided between participants and non-participants

Main Problems	Participants (n=40)	Non-participants (n=45)
Infertile land and expensive/little fertilizer	30	24
Weeds and/or weeding	8	24
No problems	18	4
Shortage of water	10	11
Kayuwili	10	13
Lack of farming equipment and labor	10	11
Pests	3	7
Deficiencies and/or diseases on rice	5	4
Other	8	0

Soil degradation

The main problem is infertile land and expensive/little fertilizer, both for participants and non participants (difference not being statistically significant (P= 0.702). Thirty percent of the participants still see it as their main problem compared to twenty-four percent of the non-participants. This is not in line with the expectations since it was assumed that FFS aids in solving soil fertility problems. Because FFS participants still consider it as their main problem, this topic might not have been sufficiently covered during sessions. When looking deeper at the answers given by the participant and non-participants it can be seen that they focus more on the lack and high price of artificial fertilizer than the degrading soil. For instance participants said ‘my field is infertile and I can't afford to buy fertilizer, so I try to find money to buy fertilizer’ and ‘fertilizer is scarce, I go to Karonga to look for it’. So even though farmers learn how to apply fertilizer properly it is still a problem because it does not solve the lack and high prize of fertilizer. In order to deal with this problem, farmers will need to look at alternatives, like manure and organic fertilizer. Manure and artificial fertilizer has been named as a topic at FFS, but there is evidence that it has been conducted only recently. So many participants did not cover this topic. It is advisable that manure and organic fertilizer making and application will always be included in FFS and becomes a priority. Furthermore farmers should be made

aware of the advantage of applying manure and organic fertilizer, namely that money is saved if artificial fertilizer is not needed.

Weeds and weeding
Looking at the table only 8% of the participants sees weeding as a main problem, while 24% of the non-participants see it as one of their biggest problems. So participants think of weeds as a smaller problem than non-participants, the difference being weakly significant (P= 0.045). Weeds and weeding was not covered much during FFS. But probably due to good cropping practices and fertilizer application rice grows faster and stronger, so it can better compete with weeds. Also when the rice is planted in lines it is easier to walk between it and remove weeds. So the good cropping practices shown at FFS reduce the weeding problem.

No problems
About 11% of all farmers told that they had no problems. It was named by 18% of the participants and 5% of the non-participants, the difference being weakly significant (P= 0.075). So it seems that farmers who have attended FFS have fewer problems than those that did not attend FFS. This result connects to my hypotheses. Participants have fewer problems as a result of FFS.

Water shortage
Shortage of water was mentioned by 10% of the FFS participants and by 12% of the non-participants, the difference not being significant (P= 0.821). It was expected that rainfall would hardly influence the amount of water in the plots, due to irrigation in the scheme. So if participants learned how to manage water irrigation well it would not be a problem. However it is still considered a problem for both participants and non-participants. The farmers only mentioned water shortage as a problem during the dry season. This could mean that only part of the water supplied to the plots comes from the lake, the rest needs to be filled by rainwater. So rainfall does influence the water level in the scheme. During the dry season there is little water, consequently not all plots can be supplied with water. This especially affects plots at poor locations like on high ground and far from the water channels. This can only be solved by better supply of water coming from the lake. However this means the entire irrigation structure needs to be improved. This is a task for the scheme managers. This problem cannot be solved at FFS sessions.

Kayuwili
Kayuwili is mentioned more often by non-participants (14%) than by participants (10%), but the difference is not significant (P= 0.604). It could be that with good cropping practices and water management the rice of the participants is less susceptible for Kayuwili. Diseases and pests including Kayuwili, are hardly covered during FFS sessions. So it is expected that a similar percentage of participants and non-participants consider it a problem. In the FFS curriculum pest, deficiencies and diseases should be included. Furthermore Kayuwili's source should be investigated and the results need to be communicated during FFS.

Lack of farm equipment and labor

Another problem that was named is lack of farm equipment and labor. Farmers often do not have oxen and ploughs thus have to do all the work manually, which is strenuous and time consuming. Ten percent of the participants considered it a problem, which is similar (P-value 0.821) to the 12% of the non-participants. FFS cannot do much about these problems because it is caused by a lack of equipment and labor. FFS only deals with lack of knowledge. It is expected that FFS improves livelihood so farmers can invest in equipment and labor. This should help in solving the problem. But the effect cannot be seen here. It could be that the farmers did not have a bigger income, or they spent the capital on other things than equipment and labor.

Pests, deficiencies and diseases

Pests, diseases and deficiencies of rice were mentioned very little by both participants and non-participants. So these are not seen as big problems by the farmers. Pests are named by 3% of the participants and by 5% of the non-participants (P-value 0.606); diseases and deficiencies by 5% by the participants and 2% of the non-participants (P-value 0.521). So there are no significant differences. It is not seen as big problems by the farmers. Only if Kayuwili is included it suddenly becomes a bigger problem. FFS also does not put much emphasis on these problems. Even though it is considered a small problem it should be named during a session so farmers can be made aware of the difference between diseases, deficiencies and pests and how to deal with it, then farmers might be able to properly handle Kayuwili.

Capital and market

The last main problems that were named are: lack of market, lack of capital and getting attacked by bloodsuckers. Only 8 % of the participants noted these as main problems, non-participants never named them (difference weakly significant; P-value 0.065). Capital and market are not covered by the FFS. This is because FFS focuses on improving yield, so the livelihood will indirectly be improved. Yet markets, and generating capital are not talked about at all and these also have a big influence on the livelihood. Lack of market is a big constraint on sustainable agriculture[1]. Furthermore capital has an influence on many of the problems named. So if income becomes higher it will help in solving the other problems. Moreover farmers said they wanted to learn about create other ways of income and improve business skills. So it is considered important by farmers. Therefore it is advisable to focus on business skills and ways to generating capital.

[1] C. Asiabaka; Promoting Sustainable Extension Approaches: Farmer Field School (FFS) and its role in sustainable agricultural development in African. Department of Agricultural Economic and Extension, Federal University of Technology

7.2 Livelihood

Does FFS contribute to improving livelihood? There are several factors which contribute to a poor livelihood in Bundi, namely: lack of capital, big families to take care of, high AIDS occurrence and mortality, poor education, low yield, high price of fertilizer, wrong investments, not knowing how to save and not having other means of income. In the first part the yield issue will be addressed. Subsequently the effect of FFS on the yield of farmers is discussed. In the second part another possibility to raise income, namely the market will be discussed.

7.2.1 Yield

The FFS focuses merely on improving yield. This is done through showing the farmers good cropping methods, making and using fertilizer and good water management. These topics all come back in the FFS curriculum.

Participants have a much higher yield after participating at FFS than before they enrolled (P-value $5.3 * 10^{-11}$). So FFS does aid the farmers in increasing yields. This is due to the improved cropping techniques and proper fertilizer use which the farmers learn during their time at the FFS.

However, the average yield produced by non-participants turned out to be higher than expected. The yield of participants after attending FFS was still slightly higher than non-participants (P-value 0.035); however the yield of non-participants was much higher than participants before attending FFS (P-value $5.3 * 10^{-11}$). It was anticipated that non-participants would have a similar amount of yield as the participants before attending FFS. It could be explained by the fact that the participants showed the cropping techniques acquired from FFS to the non-participants. Subsequently their yield has also gotten higher. It is also possible that farmers who already had a high yield were less inclined to go to FFS. Or when looking it at the other way, farmers might be more willing to join FFS when they had low yields, which explain the low yield values for participants before they joined FFS. The obtained yields were from different years (farmers participated at FFS in different seasons), so it is unlikely that the difference is due to a good or bad season.

The levels of the yields were estimated by the farmers themselves. The amounts were not measured to verify. So the amounts mentioned are the viewpoints of the farmers. It could be guesses and farmers might not always guess right. They could also have told higher or lower amounts on purpose, because they either are proud and do not want to name low amounts or think that if they name low amounts they will receive extra aid. So the amounts named might not be the real amounts.

In conclusion it can be said, that FFS seems to help in improving the amount of yield, thus FFS has a positive impact of the yield. This is realized through the given topics of FFS and the field trials conducted.

7.2.2 Marketing

Marketing is the forgotten factor in FFS. The Bundi rice FFS focuses on improving cropping techniques and the participants have increased yields as a result. However the farmers do not have a big increase in capital and livelihood if they cannot sell the rice for a good price. Thus good marketing skills are very important for improving the livelihood of the farmers.

Set price

One way of improving the capital is by selling rice for a good price. In order to achieve it a commission was created that has established a fixed price for rice to make sure all farmers get a good deal. However many farmers do not follow the fixed price. This is due to the fact that farmers are either not aware of it, or they feel they cannot sell it otherwise. Various farmers interviewed did not know about the fixed price. While other farmers that are aware of it said that some farmers still sell at a lower price so they cannot sell if they stick with the fixed price, therefore they also sell at a lower price. This is a vicious circle. There is no regulation to enforce the fixed price, so farmers can do as they please.

Markets

The markets that are available to the farmers are: the Swahili vendors. ADMARC, NASFAM and big towns or cities like Karonga, Rumphi and Mzuzu. Swahili vendors are readily available, they go to the farmers themselves and they will always buy their rice. Yet the farmers say they never get a good price from them. Farmers often sell below the set rice prize. So the advantage of Swahili vendors is that they will always buy rice, but the disadvantage is that the farmers do not get a good price. ADMARC and NASFAM give a good price for rice. However they are only open at certain times during the year. So farmers cannot always sell rice to them. Furthermore NASFAM expects certain varieties of rice or a high quality, which farmers do not always have. One farmer said that NASFAM buys on credit whiles she wants to receive cash. So the advantage of ADMARC and NASFAM is that they give a good price, but the disadvantage is that there is a time and sometimes a quality restriction. The last option named is selling rice in big towns or cities. In these places rice can be sold to many buyers and usually a good price is given. But the rice needs to be transported to the town and therefore a car needs to be rented. This also costs quite a lot of money; nevertheless farmers solve it by renting a car together so they have to spend less money per person. Furthermore it takes quite a long time to sell the rice because the transport also takes up a lot of time. So the advantage of selling rice in town is that they will sell the rice and get a good price for it. The disadvantage is that transports is needed which costs money.

Solution

These problems with selling rice have to be dealt with. So a solution has to be found. One way of dealing with it is creating central selling points. Momentarily these do not occur in the area. At central selling points the fixed prices can be used and it is easy to control the use of the set prices. Naturally an eye should be kept on these points to ensure the use of fixed prices. All people in the area should be made aware of these selling points and the fixed prices. And there ought to be consequences when it is not followed. FFS can also be of help. The participating farmers can be made aware of the set price for rice at FFS. Furthermore the participants can be encouraged to set up central selling points. Also business skills and money management can be discussed during FFS sessions.

So FFS does not focus on marketing. But there are several ways FFS can assist in improving business skills and indirectly capital, namely by putting business skills in the curriculum, making farmers aware of the set price, and by stimulating the participants to organize.

7.3 SWOT analysis

A SWOT (Strength, Weakness, Opportunity, Threat) analysis is used to have an overview of all strengths and weaknesses of the Bundi rice FFSs and the threats and opportunities that they face. The SWOT analysis will be used to divide different aspects of the Bundi rice FFSs, both positive and negative. The strengths can be used to take advantage of an opportunity and to counter or avoid a weakness. By improving or avoiding weaknesses, opportunities can be used and weaknesses opposed. An overview of all the different strengths, weaknesses, opportunities and threats is shown in the SWOT matrix, they are explained further in detail in the next paragraph. A SWOT matrix is a table in which all the strengths, weaknesses, opportunities and threats are lined up.

Table 11. SWOT Matrix of Bundi rice FFSs

Strengths - Facilitators are locals - Trial fields - Focus on cropping techniques	**Weaknesses** - Facilitators are locals - Only one extension worker initiates FFS - Insufficient focus on soil fertility methods - No focus on market or capital - Distance travelled by farmers
Opportunities - Good communication between villagers - Farmers are positive about FFS - Interest of farmers for new topics like, Market and business skills, Other crops, Home crafts, Other ways of income - Exchanges	**Threats** - Indifference of some participating farmers - Lack of market - Funding

7.3.1 Strengths

Facilitators are locals
This is both a strength and a weakness. It is a strength because the facilitators know how to communicate with the farmers and they take into account the conditions and habits of the farmers. The farmers are on familiar terms with the facilitators thus easily trust and listen to them. Furthermore are they aware of the problems which the farmers face because they are rice farmers themselves. The weakness will be discussed later.

Field trails
In the field trials farmers try out different experiments in trial plots; in one field the farmers conduct farmer practices and in another field the recommended practice is used. The trials are a good way of showing techniques because farmers themselves can see which method works best. Farmers are more inclined to use techniques they have practiced themselves than techniques which are told to them. Moreover farmers are stimulated to experiment. The rice farmers said they believe this is a good method.

Focus on cropping techniques
In the curriculum there is a large focus on crop management techniques like water management, weeding, spacing, and fertilizer use. This is a strength because many farmers consider weeding, water management, and soil fertility as a problem, as is stated in the results. Thus the FFS curriculum connects to the needs and problems of the farmers.

7.3.2 Weaknesses

Facilitators are locals
It is not only a strength, but also a weakness, because farmers might not listen to local facilitators. They believe the facilitators have no extra knowledge because they are from the same village and thus are no different from the other farmers. Furthermore the facilitators have not received special training. The farmers can become facilitator when they have graduated from a FFS. They get no training on how to transfer information and work with groups. Thus the FFS might not be facilitated optimally.

Only one extension worker initiates FFS
There is only one extension workers who lets farmers know about FFS, initiates it and makes sure everything is arranged well, namely Mrs. N. Kamwendo. Subsequently the success of FFS depends on one person. The season I attended FFS the extension worker had little time to supervise it, and this FFS was a failure. The lack of attention spent by the extension worker on FFS is not the only reason for the failed FFS season, but it certainly contributed to it.

Insufficient focus on soil fertility methods
Soil fertility methods are given at FFS. Fertilizer use is discussed and in some of the FFSs manure and fertilizer was compared and the farmers were shown how to make organic fertilizer. However it is still seen as the main problem by both the participants and the non participants. So apparently it is not covered sufficiently.

Distance travelled by farmers
Since the rice scheme is quite vast, some farmers and facilitators might need to travel an immense distance (> 30 minutes walking). This takes a lot of time. So some farmers do not wish to attend FFS because it is too much trouble to travel or it consumes a great deal of time.

7.3.3 Opportunities

Good communication between villagers
The village Bundi lies in the rice scheme. Though it is a big village which expands for many kilometers, much communication occurs. This is due to ties between families, neighbors and friends. Often people talk with each other thus information is transferred quickly. This is advantageous for FFS because awareness of it and its content travels quickly. Good communication between villagers has a big influence on the spread of FFS knowledge (Simpson 2002).

Farmers are positive about FFS
Many farmers who have participated are satisfied with FFS. Since information spreads quickly, also many non-participating farmers have a positive opinion of FFS. Thus many farmers are interested to join.

Interest of farmers for new topics
Farmers still have a need to learn about new things and they feel this can be done by the FFS. Topics named are: market and business skills, other crops, home crafts and other ways of income. Market and business skills are considered important because farmers feel they do not receive enough money for their rice, moreover they are not aware on how to properly conduct business. Farmers would also like to learn to grow different crops properly so they will have an increase in overall yield. Also home crafts are considered important so woman can cook the new crops, sew and knit thus saving money. Furthermore other ways of income are considered important because farmers want to enlarge their income. If FFS focuses on these topics, FFS will connects between to the needs of farmers. So many farmers would consider joining.

Exchanges
Farmers and facilitators should be given the chance to visit other areas. This way and exchange of information will occur and farmers gain more knowledge. Some farmers from other areas have already visited the rice scheme. However the farmers from the rice scheme have not had the opportunity to go. It was said that this is an opportunity that they want to take advantage of.

7.3.4 Threats

Indifference of some participating farmers
FFS is seen as a positive impact by the farmers. But unfortunately not all participants take FFS seriously. Participants show up late for sessions or they do not show up at all. When other courses are given it has a low attendance, and new methods which are shown are not always picked up. Furthermore some farmers expect goods or money in return for attendance. This attitude negatively influences all the participants.

Lack of market
In the area not many markets are found and not all markets are used optimally. The biggest market is the Swahili vendors. However they often do not give a good price for the rice. A few other markets exist like ADMARC and Nasfam, but they do not always buy. It is also possible for farmers to sell in big cities, but the transport is very difficult and expensive. It is no use for the farmers to attend a FFS and produce more yields if they cannot sell it or get a good price.

Funding
The government has given knowledge and funding to set up FFS. Now FFS is running, but it is not clear if it needs money to continue. And if some funding is required the government is not a stable factor. Therefore if the government will not fund FFS, it will be difficult to arrange the money.

7.4 Strategies

As was mentioned earlier opportunities can be taken advantage of by using a strength and solving or avoiding weaknesses. The same way a threat can be solved or bypassed through strengths and weaknesses. Through these methods strategies can be devised. These strategies will aid in improving the Bundi rice FFS and subsequently the livelihood of the farmers.

Several types of strategies are devised with advices to improve the Bundi rice FFS. Firstly curriculum strategies are shown. These are strategies looking at the possibilities for changing the FFS curriculum and adding topic or courses. Afterwards social strategies are named. These focus on the communication of the farmers to make them aware of FFS possibilities and to get then to cooperate to solve issues. Lastly a financial strategy is discussed.

7.4.1 Curriculum strategies

Strategy 1
Better linkage of the current FFS curriculum to the problems of farmers
FFS connects quite well to the problems of farmers. However it can be seen that not all problems are covered directly. Furthermore some topics, like fertilizer use, are given at FFS but farmers still consider it a mayor problem, so it might need more attention.
Looking at the topics given at FFS and the problems named by the farmers; fertilizer use and pests, diseases and deficiencies (including Kayuwili) are topics that need more attention. FFS should focus more on the importance of soil improving techniques, since poor soil quality is still considered as the main problem even though fertilizer use is covered at the FFSs. Mostly getting artificial fertilizer is difficult for farmers. Many participants have not learned how to make organic fertilizer or use manure and the ones that have, still mostly use artificial fertilizer because they say it gives more yield. Topics on which the focus should be: different ways of making and using fertilizer like animals manure, organic compost, and the use of rice brands as manure; comparing artificial fertilizer with organic fertilizer and manure; emphasizing the financial advantages of using manure and organic fertilizer, because less artificial fertilizer needs to be bought; also other ways to restore soil fertility e.g. nitrogen binding plants, rotation and fallow must not be forgotten
Pest, disease and deficiencies on rice are hardly covered at FFS. This is because pests, diseases and deficiencies are not seen as a big problem by farmers. But when Kayuwili is included it becomes quite a big problem. FFS should make the farmers aware of the different diseases and pests in the scheme and how farmers can recognize and deal with it.

Strategy 2
Include new topics in the FFS curriculum.
This strategy deals with the opportunity concerning the interest of farmers for new topics. Nowadays FFS only focuses on cropping practices, but farmers also have a need to learn other

things like business skills. Curriculum items suggested by farmers are, ‘market and business skills’, ‘other crops’, ‘home crafts’ and ‘other ways of income’. If these topics are added to the curriculum it will connect to the needs of farmers. The focus of FFS will change more to business and social aspects. The topics named are considered important by the farmers because it concerns problems they have to deal with or it can improve their livelihood.
For instance the topics ’market and business skills’ and ‘other ways of income’ can help the farmers to generate more capital, which improves their livelihood.
As can be seen in the SWOT matrix, the focus of curriculum is found in the matrix on three occasions; the strength ‘focus on cropping techniques’ and the two weaknesses ‘insufficient focus on soil fertility methods’ and ‘no focus on market’. These must be changed to allow the opportunity ‘interest of farmers for new topics’. However there are a lot of topics so it might be wise just to focus on one. In my opinion it would be best to focus on market and business skills because it strengthens the position of farmers when selling rice and it will improve their income.
Farmers consider market and business skills very important because they earn very little money. Farmers feel they do not receive enough money for their rice. Moreover they are not aware on how to properly conduct business. FFS can focus on these topics and teach the farmers business skills and how to manage their money. And farmers should learn to cooperate to strengthen their position. For instance by creating a farmer union or by having a central selling point to make sure the set rice price is given. Additionally they can be shown how to find new markets and to expand current markets.

Strategy 3
Offer specialized courses to FFS participants
Farmers want to lean many things. This comes back in the opportunity ‘interest of farmers for new topics’. However so many topics were named that FFS can not cover it all. Moreover not everyone had the same interest for certain subjects, for instance only woman want to learn home crafts. So it could be interesting to give a special course which only focuses on one topic. For instance a tailor can show interested people how to make clothes. In addition people are brought together so they can exchange experiences thus they will learn from each other. Courses can be given concerning other ways of income. This will make them less independent of their crop. Topics can be house building, fishing, making a pond, and tailoring. Furthermore farmers are interested about methods to grow vegetables and other crops and learning how to prepare them. So this could also be covered during special courses.

7.4.2 Social strategies

Strategy 1
Make farmers aware of other FFS in the area
The FFS researched is a rice FFS, so the curriculum consists mostly of rice topics. Sometimes another crop is mentioned e.g. maize however it is covered little. In addition a few cassava and

maize FFSs are conducted in the area. However, most farmers are not aware of the FFSs. So it might be wise to inform farmers about the other FFSs. Good communication between the farmers is a strength. So this can be used to quickly inform all farmers.

Strategy 2

Involving all farmers with FFS

All farmers, both participants and non-participants, should be made aware of what FFS entails. In this way it will be easier to find people willing to join and to start new things. This strategy is easy to implement because of the opportunity 'good communication between villagers'. It is simple to let people know about FFS. Good communication between villagers has a big influence on the spread of FFS knowledge (Simpson 2002). Most farmers are positive about FFS, so this image gets spread. And if a lot of people are involved they can form corporations to get things done and solve problems.

Some participants have little interest in attending FFS sessions or taking it seriously. They do not show up or come in late which is detrimental for the other participants. This can be countered by the strengths and weakness 'facilitators are locals' and the opportunity 'good communication between villagers'. Because there is good communication people can talk to each other to make clear that it is important that everyone shows interest in FFS and takes their responsibility. This can be done by friends and family. Facilitators often know the people who are disinterested and can explain to them why it is important that they show interest. However the danger is that because facilitators are locals the disinterested farmers might not take them seriously.

7.4.3 Financial strategy

Strategy 1

Make the rice FFSs financial self sustainable

FFS is now being financed by the government. However it is not clear whether funding will continue. Setting up FFS is expensive because people need to be trained (Quizon et. al. 2001). But when FFS has been running for quite a while there are less costs involved because the facilitators are already trained and since they are locals they can train new people with no extra cost. The costs made with every FFS season are renting the experimental plots, lesson and cropping materials, and rice seeds. These cost need to be covered. Asking participant for course money it not an option, because many farmers would not join FFS. It could be discussed with the scheme manager that the experimental plots can be rented for free. And the rice obtained for these plots can be sold to get money to pay for the expenses. So it is possible to create a financial self sustainable FFS.

8. Conclusion

In this part the answers to the research questions will be addressed by using the information in the results and discussion. The hypotheses mentioned in the beginning can be accepted or rejected. First the sub research questions are dealt with, before answering the main research question.

Sub research question 1
What problems do the Bundi rice farmers encounter in rice production?
It was expected that soil degradation would be the main problem. Other problems that were hypothesised are pests and diseases, lack of water and lack of resources. In the results and discussion degrading soil quality is considered the main problem by most farmers. Other problems named are kayuwili (which is a pest, deficiency or disease), lack of farming equipment and labor, shortage of water, pests, deficiencies and diseases. They were all expected except weeding. So the hypothesis proved correct.

Sub research question 2
What topics are given at the Bundi Rice FFS?
The curriculum was anticipated to have topics related to the problems of farmers, such as poor soils, pests and diseases, lack of water and lack of resources. The topic that were named turned out to be: cropping practices, fertilizer application, manure, varieties, disease resistance, seedbeds and time of transplanting, water management, weeding, time of rice tasks and AESA. Fertilizer and manure relate to the poor soils. Diseases are partly covered by the topic disease resistance of varieties. And water management deals partly with lack of water. So these predicted topics are in the FFS curriculum. However lack of recourses is not covered in FFS and farmers indicated that dealing with this problem should be included. Furthermore many topics were mentioned that were not expected like cropping practices. It can be concluded more topics were given at FFS than was expected.

Sub research question 3
Do the problems and needs of the farmers connect to the topics given?
It was hypothesized that the curriculum connects to the problems of the farmers. However, some did not, for instance the topic ‘fertilizer use and manure making and application’ deals with the soil degradation problem. Some problems connected only indirectly, for example proper cropping practises decrease the chance of diseases, pests and deficiencies. However these problems were not addressed straightforward. Although the FFS covered methods dealing with soil degradation, it was still considered by many participants their main problem. So the way the topics were treated, may not have been effective. The farmers said they would like to have business and social issues included in the curriculum. FFS now only focuses on crop growing; it should change to connect entirely to the needs of farmers. There is a need for a multidisciplinary FFS. The conclusion is that FFS curriculum connects only partially to the problems and needs of the farmers, and this may have to change.

Sub research question 4

How do these farmers perceive FFS?

It was assumed that the Bundi rice FFSs are conducted properly, so the participants would be satisfied. Over eighty percent of the participants are happy about the FFSs and seventy-five percent did not want to change anything. Modifications that were proposed concerned new topics. Most of the non-participants were aware of FFS and the overall image was positive. Many farmers consider joining. Of the few dropouts interviewed most stopped due to sickness or lack of time, not because of dissatisfaction. So the overall image of FFS is positive, which was hypothesized.

Sub research question 5

What kind of impact does FFS has on yield?

It was expected that that FFS would increase the perceived yield. Before attending FFS the mean yield was 198.7 kg/plot and after attending FFS it became 393.2 kg/plot. So due to FFS the yield almost doubled. This is caused by the new cropping techniques participants learned. Non-participants also turned out to have high yield namely 332.5 kg/plot. It could be that the participants showed them the new cropping techniques, so their yield also increased. However, other explanations are possible. So the hypotheses that yield would increase because of FFS turned out to be correct.

Main research question

Does FFS connect to the needs and problems of the farmers and subsequently improve their livelihood?

The answer is that FFS connects partially to the needs and problems. The cropping techniques given at FFS connect to the problems farmers face. Only the topics: manure and organic fertilizer; diseases, deficiencies and pests should be emphasized more. Farmers have a need for subjects dealing with business skills and social issues, which currently are not covered in the curriculum. It is advisable to add these topics. The livelihood of the farmers has improved as a consequence of higher yield. The livelihood can be increased more if farmers learn business skills and other ways to generate income. To conclude; FFS connects to a certain extent to the needs and problems of farmers and improves livelihood through increased yield.

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Appendix I Questionnaire

Identity
Village name: ……
Chilimika (Chaka), zuwa: *Date*……
Zina la wakufumba: *Interviewer's name*……..
Zina la wakulemba: *Recorder's name*…….
Zina la wakuzyora: *Respondent's name*…….
Mwanalume/ Mwanakazi: *M/F*……..
Viaka/ Vilimika: *Age/ year of birth*…….
Umoyo wa Banja: *Marital status*
1. **Wambula Nthengwa (kawiro)**: *Single(never married)*
2. **Wapanthengwa na mfumu/ winu na winu mwanakazi:** *Married with monogamous*
3. **Wapanthengwa na wanakazi/ wanalume wa mitala:** *Married with polygamous*
4. **Kuwerako kunthengwa:** *Divorced*
5. **Walikulekaka na mfumu wake nanyifa:** *Widowed*
6. Other……..

Uyo akuwusa pabanja: *Name of Household head*……

Mulikufika mpha namasabiro yinu? *How far have you gone with your education?*
.....
Kupatulako kusukulu, muli kusabirapo vya luso/ umisili uli wose? *Any vocational trainings other than schools?*
.....

Katundu na vyuma vwa ntheura: *Type of Assets*
……..……..……
……..……..……
Number of gardens (indicate in the map)
……..……..……

Food/Hunger
Munda yinu yonse, napala vula yawa makola, yikumpasani vuna yakumkwunani chilimika chose? Inya/ Yayi
(With these fields, and good rains, do you produce enough for the whole year? Y/N)
……..……..……**Usang i chara (yayi), mukukhala miyezi yiringa wambula chakurya?**
(If not, for how many months without food?) ……..……
Kwasono, kasi muli na chakurya cha kukwana kufikira vuna inyake Inya/ Yayi
(Currently, do you have enough till the next harvest?) Y/N
……..……..……

Rice tasks

Mukwamba nyengo uli kupanga nasale? *When do your start nursery establishment?*
……
Chifukwa: *explanation*
……
……
Mukwamba nyengo uli kupanda? *When do you start transplanting?*.....
……
Chifukwa: *explanation*
……
……..……..
Mukwamba nyengo uli kuthira feteleza wakwamba na wachiwiri? *When do you apply fertilizer? (both basal and top)*
……
Chifukwa: *explanation*
……
……..……..
Mukwamba nyengo uli kuchesa? *When do you weed?*
……
Chifukwa: *explanation*
……
…….....

Kasi ni njani wakuguliska mpunga? *Who sells the rice*……
Chifukwa: *explanation*
……...
Kasi mungaguliska kochi mpunga winu? *Where can you sell your rice?*
……..
Kanandi mukuguliska kochi? *Where do you usually sell your rice?*
.....…….
Chifukwa: *explanation*
……
……..……..
Pali masuzgo yaliyose ayo mukukumana nayo pakuguliska mpunga winu? *Do you have problems when selling your rice?*
……
……
Sono mukumalana uli na masuzgo agha? *How do you deal with it?*
……
……..……..

Farmer Field School (participants and drop outs) sukulu yawa

Kasi muli kumalizga sukulu ya FFS? *Have you graduated from FFS?.....*
Ni pauli apo mukawapo lumoza na wanyinu pa sukulu iyi?
When did you participate in the Farmer Field School (FFS)?.....
Ni chifukwa uli mukayanayana vyakunjira sukulu iyi?
Why did you join the FFS?
……
Kasi mukasambilanga visambizgo wuli kusukulu kwinu?
What topics did you cover in the FFS? ……..
……
……
……...
Kasi mukuvwiraso walimi wanyinu ivyo mukasambira ku FFS? *Do you help fellow farmers with what you learned at FFS?.....*
Chifukwa: *explanation (how do you help them and what do you teach them)*
……
……
Kasi vili kumujumpha nipo visambizgo vya FFS? (inya/yayi/nkhumanya yayi)
Did you miss sessions? (Yes/ No/ Don't know/ other)
……..……
Chifukwa: *explanation*
……
……
Pala muli kuleka, nivifukwa uli?
(If you have dropped out of FFS, what was the reason?)
……
……
Muchali mundanjire sukula ya FFS kasi mukawa na masuzgo uli?
What problems did you have before attending FFS?
……
……
……
Kasi sukulu ya walimi yili kumuvwilani kuchepesya masuzgo pa munda?[Inya,yayi,nkhumanya yayi]
Did the FFS help you reduce your problems in the field? (Yes/ No/ Don't know/ other)
……..
Chifukwa: *explanation (which problems and how)*
……
……
Pasono muli na masuzgo uli? *What problems do you have now?*
……
……

Kasi mwasintha kalimilo chifukwa cha sukulu ya walimi pa munda?
[inya,yayi,nkhumanya yayi] *Have you changed your cropping practices because of the FFS? (Yes/ No/ Don't know/ other)*
……...……
Pala inya,yasintha uli? *If so how?(ask for cropping practice examples)*
……
……
Muchali mundanjue sukulu ya FFS kasi pa puloti yimoza mukasanganga unandi uil wa mpunga *How much rice did you produce per plot before attending FFS*
……..
Ndipo sono mukusanga uil? *How much do you produce now?*
……
Kasi sukulu ya FFS ya mpindulilani pa umoyo winu? (inya/yayi/nkhumanya yayi)
Do you think the FFS has had a positive effect on your livelihood? (Yes/ No/ Don't know/ other)……...……
Pala enya, yapindula wuli? *If so how?*
……
……**Kwaso no, kasi mukufwasa kugwila ntchito na wanyinu lumoza? (inya/yayi/nkhumanya yayi)**
Do you think you are better in working with groups? (Yes/ No/ Don't know/ other)
……..……
Chifukwa: *explanation (ask for example)*
……
……
Kwasono, na umo mwasambilira FFS, kasi muli makola pa ku dumbiskana na wanthu? (inya/yayi/nkhumanya yayi)
As of now, do you think you are better in negotiation skills? (Yes/ No/ Don't know/ other)
……..……
Chifukwa: *explanation (ask for example)*
……
……
Kasi mukakondweskekanga na vichi vya FFS? *What did you like about FFS?*
…….....
.....
Kasi icho chikamukondweskaninge yayi ntchi vichi ku FFS? *What didn't you like about FFS?*
……..……
…….
Pala mungapasika mwawi wakusintha FFS, mungasitha vichi?
If you could change the FFS, what would you change?
……
……
Kasi ni visambizgo uli vinyake ivyo imwe mukukhumba kuti viwemo mu sukulu iyi?
What topics would you like to have been included at the FFS?
……...……

Farmer Field School (non-participants)

Kasi muli kupulikapo vya FFS? (enya,yayi)
Have you heard about the Farmer Field School (FFS)? Yes/No
Pala muli kupulikapo mukapulika kwa njani?
1. **walimi awo wakawamo kale**
2. **walangizi**
3. **walimi wanyakhe**
4. **wachibale**
5. **wabwezi etc**

If you have heard about FFS, who told you about it? (you can choose more than one)
1. *Farmers who have participated in the FFS*
2. *Extension workers*
3. *(Other farmers)?*
4. *Family members*
5. *Friends*
6. *Other.....*

Kasi mukumanyapo vichi pa FFS?
What do you know about the FFS?.....
……
……
Kasi Khumbo la kunjila FFS muli nalo?. (inya/yayi/nkhumanya yayi)
Would you like to join FFS? (Yes/ No/ Don't know/ other)
……
vifukwa
Reasons
……
……
Kasi muli na masuzgo uli mu ulimi wa mpunga? *What problems do you have in rice production ?*
……
……..……..
……
Sono mukumalana uli na masuzgo agha?
How do you solve them?
……
……
Mukuvuna unandi uli wa mpunga pa plot?
How much rice do you produce per plot?
……

New methods and experiments

Kasi muli kusambirapo vya ulimi?
Have you received any trainings on farmer practices?
……
Mukasambirapo vichi?
What topics did you cover?
……..
Kasi mukuyezya nthowa zipya za ulimi mmunda mwinu?
Do you try new methods in your own field? (Yes/ No/ Don't know/ other)
……...……
Pala enya, ni nthowa zini?
If so what kind of methods?
……
……
Mukasambira kochi nthowa izi?
Where did you learn those methods
…….
Kasi mukupanga ulimi wa kuyezya mmunda winu? (inya/yayi/nkhumanya yayi)
Do you conduct experiments in your own field? (Yes/ No/ Don't know/ other)
……...……
Pala enya , viyezyo uli ?
If so what kind of experiments?
……...……

Mapping exercise

1. **Longolani Chiyezyerero cha ukulu wa munda winu, dera ilo wuri na mtunda wake kufuma pa nyumba.** *Show the approx size, location/distance from home,*
2. **Kapandiro ka mlimo winu (mbuto imoza pera, mbuto imoza kweni yakupambana mtundu, mbuto za kupambana)**. *Crop Stand (pure, mixed, intercropped), Varieties*
3. **Munda uwo ukasangika uli**. *How land was acquired*
4. **Manyaniso wanthu awo akugwira ntchito pamunda uwo (wenecho, banja lose, waganyu)** *Type of Labor used (family or Ganyu)*
5. **Mtundu wa dongo/ vundira, (lamchenga, …..churu or lakusazgana), mtundu wake (lifipa lituwa…..) fumbaniso vyakukhwasana na nyata ya ndongo la munda.** *Soil type(s) / color at each field, ask about Soil Fertility issues*
6. **Manyishani usangi munda unji ukuthika manyowa panyake feteleza wakugula.** *Note if any field receives fertilizer or manure*
7. **Manyishani usangi ulimi wakasithasitha** (rotation) **kasi mukuchirachi uli wakasinthasitha panyake munda mukugoneka munda** (fallow). *Note any fallow or rotation practiced*

Weeds, pests and human diseases

Kasi ni suzgo wuli ilo munda wino? *What is the biggest problem in your field?*
……
……

Thondo *Weeds:*
Kasi mukuwona thondo uli m'munda winu? *What weeds do you see in your field?*
Niviweme, pakatikati, viheni? *Are they beneficial, neural or harmful?*
Chifukwa uli ni viwemi, pakatikati panji veheni?/ Vikuchita vichi?/ Mbuni? *Why is it beneficial, neural or harmful?/ What does it do?/ How?*
Nithowa uli izo mukuchita pakumalana na thondo? *What methods do you use to control weeds?*

Name	**Beneficial,/ neutral,/harmful**	**Why/How**	**Control**

Viyuni *Birds:*
Kasi mukuwona viyuni uli m'munda winu? *What birds do you see in your field?*
Niviweme, pakatikati, viheni? *Are they beneficial, neural or harmful?*
Chifukwa uli ni viwemi, pakatikati panji veheni?/ Vikuchita vichi?/ Mbuni? *Why is it beneficial, neural or harmful?/ What does it do?/ How?*
Nithowa uli izo mukuchita pakumalana na viyuni? *What methods do you use to control birds?*

Name	**Beneficial,/ neutral,/harmful**	**Why/How**	**Control**

Mbewa: *Rats*
Kasi mbewa zilimo mmunda wino? *Do you have rats in your field?*
……
Pela enya, kasi mukumalana nazo uli? *If yes, how do you control them?*
……
……

vibungu/ vibenene *Insects:*
Kasi mukuwona vibungu/ vibenene uli m'munda winu? *What insects do you see in your field?*
Niviweme, pakatikati, viheni? *Are they beneficial, neural or harmful?*
Chifukwa uli ni viwemi, pakatikati panji veheni?/ Vikuchita vichi?/ Mbuni? *Why is it beneficial, neural or harmful?/ What does it do?/ How?*
Nithowa uli izo mukuchita pakumalana na vibungu/ vibenene? *What methods do you use to control insects?*

Name	**Beneficial,/ neutral,/harmful**	**Why/How**	**Control**

Vinyama *Other animals:*
Nivinyama uli vinyakhe ivyo mukuona m'munda winu? *What other animal do you see in your field?*
Niviweme, pakatikati, viheni? *Are they beneficial, neural or harmful?*
Chifukwa uli ni viwemi, pakatikati panji veheni?/ Vikuchita vichi?/ Mbuni? *Why is it beneficial, neural or harmful?/ What does it do?/ How?*
Mukumalana navyo uli? *What methods do you use to control them?*

Name	**Beneficial,/ neutral,/harmful**	**Why/How**	**Control**

Matenda *Human health problems:*
Kasi mukusanganana masuzgo uli yakukhwasyana naumoyo wino pa ulimi ya mpunga?
What are some of the health problems you encounter in production of rice?

Health problems	Cause	Prevention	Control

Other problems:
Mukusangana na masuzgo yanakhe mmunda wino? *Do you experience any other problems in your field?*
……
……

Samples

1st Sample…….
Chikuchitika ntchivichi ku khuni ili? *What is happening to this plant?*
.....
Mukuyanayana kuti chapangiska ntchi vichi? *What do you think is the cause?*
.....
Pali kwanangika kulikose kukuchitika ku khuni iri? *Does it do any harm to the plant?*
.....
.....
Pali chilichose chikuchitika kuvuna chifukwa cha ichi? *Does it affect the yield?*
……
…….
Kasi mukuchitafo uli pa kumazja suzgo ili? *What do you do to avoid this?*.....
.....
.....
Chifukwa vichi ivi vikuchitika ku hamba/khuni iri pera kweni kurinyake iri yayi? *Why is this leaf/plant affected and not this one?*
……
……
Ni mtundu uli wa mpunga uwo wukukoleka chomene na suzgo ili? *Which variety is more easily affected by this problem?*
……
Mbunandi uli wa mpunga uwo wasuzgika? *% of plants affected*
……..%
If you find an insect on or in the plant, ask these questions:
Kasi mukuwona vichi? *what do you see?*
……
……
Kasi mukuyanayana kuti tukuvyilapo nithowa iriyose pa suzyo iri? *[Do they have anything to do with this problem?]*
……
……. **Mukuchitapo vichi pa suzgo ili?** (*if so what do you do to this problem)*
……
……

Vyakuwonapo: *Observations*
……
…….

2nd Sample……

Chikuchitika ntchivichi ku khuni ili? *What is happening to this plant?*

.....

.....

Mukuyanayana kuti chapangiska ntchi vichi? *What do you think is the cause?*

.....

Pali kwanangika kulikose kukuchitika ku khuni iri? *Does it do any harm to the plant?*

.....

.....

Pali chilichose chikuchitika kuvuna chifukwa cha ichi? *Does it affect the yield?*

……

……

Kasi mukuchitafo uli pa kumazja suzgo ili? *What do you do to avoid this?*.....

.....

.....

Chifukwa vichi ivi vikuchitika ku hamba/khuni iri pera kweni kurinyake iri yayi? *Why is this leaf/plant affected and not this one?*

……

……

Ni mtundu uli wa mpunga uwo wukukoleka chomene na suzgo ili? *Which variety is more easily affected by this problem?*

……

Mbunandi uli wa mpunga uwo wasuzgika? *% of plants affected*

……..%

If you find an insect on or in the plant, ask these questions:

Kasi mukuwona vichi? *what do you see?*

……

……

Kasi mukuyanayana kuti tukuvyilapo nithowa iriyose pa suzyo iri? *[Do they have anything to do with this problem?]*

……

……. **Mukuchitapo vichi pa suzgo ili?** (*if so what do you do to this problem)*

……

……

Vyakuwonapo: *Observations*

……

…….

3rd Sample……
Chikuchitika ntchivichi ku khuni ili? *What is happening to this plant?*
.....
.....
Mukuyanayana kuti chapangiska ntchi vichi? *What do you think is the cause?*
.....
Pali kwanangika kulikose kukuchitika ku khuni iri? *Does it do any harm to the plant?*
.....
.....

Pali chilichose chikuchitika kuvuna chifukwa cha ichi? *Does it affect the yield?*
……
……
Kasi mukuchitafo uli pa kumazja suzgo ili? *What do you do to avoid this?*.....
.....
.....
Chifukwa vichi ivi vikuchitika ku hamba/khuni iri pera kweni kurinyake iri yayi? *Why is this leaf/plant affected and not this one?*
……
……
Ni mtundu uli wa mpunga uwo wukukoleka chomene na suzgo ili? *Which variety is more easily affected by this problem?*
……
Mbunandi uli wa mpunga uwo wasuzgika? *% of plants affected*
……..%
If you find an insect on or in the plant, ask these questions:
Kasi mukuwona vichi? *what do you see?*
……
……
Kasi mukuyanayana kuti tukuvyilapo nithowa iriyose pa suzyo iri? *[Do they have anything to do with this problem?]*
……
……. **Mukuchitapo vichi pa suzgo ili?** (*if so what do you do to this problem)*
……
……

Vyakuwonapo: *Observations*
……
…….

Notes to remember:

1. **Explain first to the farmers and we are conducting research on food security and how they grow rice. The result will also go to the district office and extension staff for their future planning. (though this does not automatically mean that the there will be assistances to the problems mentioned)**
2. **Try as much as possible to fill in all the points. If the respondent is not answering directly to the questions, simply repeat or rephrase it. Be patient.**
3. **Be attentive to whatever farmers are saying. If you find it difficult to concentrate, ask permission to the respondent and take a short break.**
4. **Don't wait for the recorder to finish writing down points. Continue the flow of discussion. Remember that we are using farmers' time who can be busy.**
5. **Make a clear distinction between "No" (as opposed to "yes"), "I don't know" (s/he has no knowledge) and "N/A" (question not asked).**
6. **Try to record as accurately as possible as the respondent said. E.g. carefully differentiate actions such as "uprooting" and "removing parts of plant". Leave it in Tumbuka if original statements are not straight forward in English.**
7. **Discard any presumptions- 'farmers don't have knowledge' 'local knowledge/ practices have no scientific background' as there may be some truth in it. Don't assume all farmers have same type/ level of knowledge.**
8. **Don't make any judgements or comments on their knowledge such as 'you know very well' and 'you have no knowledge on diseases'. Remind yourself that we are learning from them.**
9. **Your own comments or observations should be given separately and clearly marked; these should not be mixed with other answers.**
10. **Always be reflective (and express freely) on how we can improve the recording sheet in order to make the work smooth and easier.**

Appendix II Collected animals and pests/weeds named by farmers

Collected animals

Family – *Genus – species* Common name	**Description**	**Harmful/Neutral/ Beneficial**
Pyralidae *Maliarpha separatella* African white stemborer	Stemborer	H
Noctuidae *Sesamia calamistis* Pink maize borer	Stemborer	H
Diopsidae *Diopsis* spp. Stalk eyed flies	Stemborer	H
Acrididae *Acrida* spp. Short horned grass hoppers	Grass hopper, feeds on rice	H
Cercopidae *Locris arithmetica* Red spotted Spittle bug	Feeds on grasses, can suck on rice	H
Tettigoniidae Long horned grasshoppers	Can eat plant materials. But many species are exclusively predatory, feeding on other insects, snails or small vertebrates.	H/N/B
Libellulidae *Crocothemis erythraea* Scarlet Dragonfly	Predator on flying insects including butterflies, mosquitoes and flies.	B
Libelludidae *Orthetrum julia* Julia Skimmer	Predator on flying insects including butterflies, mosquitoes and flies.	B
Coenagrionidae *Pseudagrion* spp. Damselfly species	Predator on flying insects including butterflies, mosquitoes and flies.	B
Tabanidae Horseflies	Do not feed on rice. But can sting people and be a vector of diseases.	N
Acrididae *Acanthacris ruficornis* African grasshopper species	Feeds on leaves of trees	N
Acrididae *Afroxyrrhepes procera* Bush grasshopper	Mainly graminivorous; found om castor, maize, tobacco and Sclerocarya	N
Acrididae *Atractomorpha* acutipennis	Veel gevonden, misschien algemeen Defoliate Chenopodium spp.	N
Acrididae *Duronia Choloronota*	Found many samples during gathering	N
Acrididae *Paracinema tricolor*		N
Noctuidae *Helicoverpa armigera* Armyworm	eats cotton, corn, tomatoes	N
Gyrinidae Whirligig beetles	Water beetles	N
Ampullariidae *Lanistes* Apple snail	Eats algae and dead material.	N
Ploceidae Quelea quelea Red-billed Quelea	Weaver finch; eats grass seeds and grain, including rice	H

Pests named by farmers

Insects

Tumbuca name	English name / Description	Latin name
Mphazi	Grasshopper	
Nthefunthe	Green grasshopper	
Bongololo	Worm / Millipede / Caterpillar	
Phanana	Giant grasshopper with hooks on tibia	
Buwi	Fly	
Suwuwu	Stings like mosquito,	
Gombamthiko	Praying mantis	
Kangwudi	Looks like green spider	
Mphanana	A species of grasshopper	
Nchemberezandonda	Mealybug / Armyworm	
Watuwa	White?	

Birds

Tumbuca name	English name / Description	Latin name
Mpheta	weaver finches; brown with black stripes	Ploceidae Quela
Chagoga		
Yuwulu	black beak, sometimes black spot on neck	
Nyanginyangi	white	
Debadeba		
Njiwa	Love dove/ Common dove (pigeon)	
Tidi / Titi	Trush nightingale	
Katawa	Purple heron / hummer cock; long legs, long beak	
(Kan)dundulu	Tamborine dove	
Chaholi	Hawk / Crawl	
Nyalweni	Dark brown slow flying eagle	
Zwiri		
Soosera		

Animals

Tumbuca name	English name / Description	Latin name
Hembe	Squirrel	
Mbulu	Monitor lizard	
Nyenge / Nyenga	Katigondo	

Sezi	Cane rat	
Mbwalusi		
Mbawu	Otter	
Juja		

Weeds named by farmers

Weeds

Tumbuca name	**English name / Description**	**Latin name**
Mbatawata	Water lily	Nymphaeceae family
Nyadanga	Wild rice Barnyard grass	Poaceae *Oryza* spp. Poaceae *Echinochloa crus-galli*
Hanyezi (Ndawu/Ndao)	Sedges (onion like)	Cyperaceae *Cyperus esculentus*
(Zo)twatawa	Creeping weeds	
Shawa	Leaves look like ground nuts	Oxalidaceae *Oxalis semiloba* Sond.
Lusangano	Giant dhoup grass	Poaceae *Cynodon nlemfluensis*
Malubambo/Luwembe/ Maluwambo	A type of grass	
Kapinga	Dwarf dhoup grass with fine leaves	Poaceae *Cynodon dactylon*
Azolla	Aquatic fern	Azollaceae *Azola nilotica*
Masupuni	Water lettuce	
Waputheputhe		