Impact of Farmer Field Schools on Soil and Crop Management among Smallholders in North Rift, Kenya

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Abstract

The Farmer Field School (FFS) approach has been tried widely and has created a positive impact on crop and soil productivity in many Asian and African countries. Kenya Agricultural Research Institute (KARI) introduced FFS approach in the year 2001 as an alternative to the conventional approach to promote dissemination of Soil and Crop Management Technologies. The purpose of this study was to determine the impact of the Soil and Crop Management Technologies (S&CMTs) disseminated through Farmer Field Schools (FFSs) on the Farming Systems and farm productivity among the smallholder farmers in North Rift, Kenya. Eight technologies were scaled-out using the approach and the conventional extension methods. A survey methodology with an Ex-post facto research design was used with a sampling frame consisting of 6,560 small-scale farmers. A sample of 180 FFS and 180 Non-FFS farmers was chosen for the study, using proportionate stratified random sampling. Data was collected through interview schedules administered to FFS and Non FFS farmers. The results indicated that there were significant differences ($P<0.05$) in knowledge acquired in S&CMTs and impact of S&CMTs on farming system and productivity between FFS and non-FFS participants. It was concluded that farmers who were exposed to the FFS training methodology had a better understanding, adoption, practice and higher impact of S&CMTs as compared to the non-FFS farmers. The main recommendation from this study was therefore, the need to scale-up and scaling out the S&CMTs using the FFS approach in counties in the North Rift region of Kenya.

Introduction

1.1 Background to the Study

The conventional extension approaches have minimally succeeded in reaching millions of smallholders with new technologies. The Farmer Field School (FFS) has

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gained popularity as an extension and education program worldwide. The FFS approach started in Indonesia in 1989 and has rapidly expanded to many countries of Sub-Saharan Africa, other Asian countries such as India, Philippines, and other developing countries. According to Braun et al (2006), FFS approach is in place in at least 78 countries worldwide. In Kenya more than 2,000 FFSs with over 60,000 farmers had graduated as reported by Kenya farmer field school networks (Duveskog, 2013). Many donors, Governments, and Non Governmental organizations (NGOs) continue to promote FFSs in Sub-Saharan Africa and Asia today. As a result of its popularity, there was some discussion as to whether the FFS approach should be scaled up and scaled out and be incorporated into mainstream extension practices (Anandajayasekeram, Davis, and Workneh, 2007).

In Kenya, the Soil Management Project (SMP) phase one (1) was initiated in 1995 in four Districts of Trans Nzoia, Uasin Gishu, Keiyo and West Pokot in the North Rift region of Kenya, with funding from the Rockefeller Foundation. The SMP succeeded in developing eight promising Soil and Crop Management (S&CM) technologies and was disseminated through various FFSs as shown in (Table 1 and 2) in this paper.

These S&CM technologies were disseminated and largely adopted by farmers in the experimental clusters. In the year 2001, these technologies were up scaled beyond the experimental clusters by Kenya Agricultural Research Institute (KARI) to wider farming communities within Kenya Agricultural research-Kitale mandate region of Trans Nzoia, West Pokot, Uasin Gishu and Keiyo Districts. The dissemination methodologies used were conventional extension, Farmer Participatory Research (FPR) and FFS approaches.

The primary focus of this study was to investigate the impact of the already disseminated S&CMTs through FFSs on the farming systems and productivity among the small scale farmers in North Rift, Kenya.

1.2 Statement of the Problem

There have been relatively few efforts worldwide to document in a systematic manner the impact of FFSs approach. However, no study had been undertaken and documented on the impact of S&CMTs disseminated through the FFS approach on the farming systems and farm productivity among the smallholder farmers in the study locations of the North Rift, Kenya. Hence this study was undertaken.

1.3 Purpose of the Study

The purpose of the study was to determine the impact of the Soil and Crop Management technologies promoted through Farmer Field School approach on the farming systems and productivity among the smallholder farmers in North Rift region of Kenya. The study examined if there was any significant difference in means between the FFS participants and Non FFS related to the set objectives in order to determine the impact of the FFS approach.

1.4 The theoretical framework of the experiential learning in the FFS context

The Farmer Field school approach is based on experiential learning theory by Kolb, (1984). The experiential theoretical model as described by Braun et al. (2006) postulates that the farmer acts as a cognitive agent who pursues and adjust goals and purposes on the basis of iterating through information about changing circumstances which includes environment, knowledge, and perceived options for acting. This theoretical frame is linked to the farmer's decision making process within the context of their farming system.

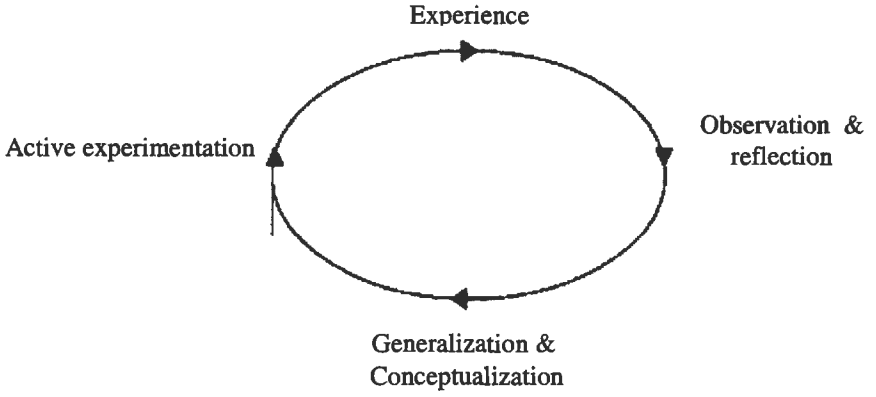

Figure 1: Experiential Learning Cycle Interfaced with FFS Process Adopted from Kolb's Learning Cycle (Kolb, 1984)

The theoretical frame of this study is linked to the farmer's decision making process within the context of their farming system. All FFS learning activities apply the learning cycle. The decision is then implemented over the following week (experimentation) and the cycle begins again. In the FFS model, besides experience and actual observation in a formal Agro-Ecosystem Analysis (AESA), the process of reflective thinking is a crucial step in the learning process: making sense out of experiences, evaluation, and sharing with other learners (Bunyatta, 2006 and De

Jager, 2007). In this study, the assumption is that the FFS participants adopted the S&CMTs and incorporated into their farm systems resulting into increased agricultural production, income and hence improved livelihoods.

The FFS training program utilizes participatory methods which encompass the principles of non-formal adult education to help farmers develop their analytical skills, inquiry mind, critical thinking and creativity and help them to make better decisions (Verduin, Miller, Greer, 1979; Kenmore, 1997). The focus of FFS is on human resource development for a more sustainable agriculture (Kenmore, 1991; Bentley, 1998; Roling and Van der Fliert, 1992). Davis et al (2010) noted that as FFS implementation is being scaled up in Africa, there are growing concerns and interest among stakeholders and donors regarding the applicability, targeting, cost-effectiveness, and impact of the approach. Therefore, the focus of FFS is not so much on teaching farmers about the new technologies but rather is concerned with developing farmers' own capacity to critically analyse the situation, think for themselves and empower them to develop their entrepreneurial skills and their own solutions.

1.5 Objectives of the study

a. To determine and compare the impact of the Soil and Crop Management technologies (SCMT) promoted through FFSs approach on the knowledge and skills of the FFS participants and Non FFS Participants in North Rift of Kenya
b. To determine the impact of the Soil and Crop Management technologies promoted through FFSs approach on farming systems (farm practices related to maize, vegetable and fodder production) of FFS participants before and after participating in FFSs in North Rift of Kenya
c. To determine and compare the impact of Soil and Crop Management Technologies promoted through FFS approach on productivity (farm income related to maize, vegetables and fodder production) of the FFS participants before and after participating in FFSs in North Rift of Kenya.

2 Materials and Methods

2.1.1 Research Design

The study employed a survey research method with an ex-post facto research design. This design according to Kathuri and Pals, (1993) refers to examining the effect of "a naturalistically occurring treatment after the treatment has occurred". The

study examined what had been done in the research sites as it pertains to implementation of several FFSs in the years 2001 and 2002.

The study locations were Yuya Location of Kaplamai Division, Trans-Nzoia County, Matunda and Siwa Divisions of Uasin Gishu County in the North Rift, of Kenya. Table 1 shows the eight S&CM technologies that were developed by KARI. The Farmer Field Schools were facilitated by a multidisciplinary team of researchers, extensionists and farmer innovators who had undergone season - long FFS training of trainers' course on how to open and conduct FFS in the year 2001.

2.1.2 FFS Enrollment

There were eight soil and crop management technologies validated and disseminated within the first batch of eight FFSs and later fourteen FFSs in the second batch as shown in Table 1 and 2 respectively.

Table 1. FFS Enrollment per School, and technology disseminated in the 1st batch –Yuya location Kitale - Trans Nzoia district

S&CM Technology	School Name	Members				
		M	F	Total	Before	After
1. Forage production and utilization	Khuyatana	13	18	31	30	30
2. Organic/inorganic fertilizers for maize	Bikholwa	5	16	21	18	18
3. Introduction of legumes other than beans	Bulala	18	10	28	21	21
4. Organic/inorganic fertilizer for vegetable	Busime	9	13	22	17	17
5. Introduction of suitable maize varieties	Twende	7	11	18	11	11
6. Quality seed production	Upendo	6	24	30	16	16
7. Low cost soil conservation methods	Mteremko	11	9	20	11	11
8. Indigenous technical knowledge for pest control	Mutua	8	14	22	16	16
Total		77	115	192	140	140

Source: Soil Management Project Report Trans Nzoia District- 2001

Table 2. FFS enrolment per School, Graduates and technology disseminated in the 2nd batch FFS site of Matunda, Motosiet, Birbiret locations of Trans Nzoia District and Kisionet location of Uasin Gishu District, Kenya

	Soil & Crop Management Technology	School name	Members			FFS graduates	
			M	F	Total		
						Before	After
1.	Forage production and utilization	Mwangaza	13	18	31	26	26
2.	Use of organic / inorganic fertilizers for maize	Mawazo	14	16	28	18	18
3.	Variety selection in maize (H-614, 625,626,512 511).	U-Hututu	15	20	35	24	24
4.	Organic/inorganic fertilizer for vegetable production	Weonia	19	24	43	36	36
5.	Introduction of maize varieties & organic/inorganic fertilisers for maize	Amua	18	11	29	16	16
6.	Forage production, utilization, and Low cost soil conservation methods.	Motosiet-	8	22	40	32	32
7.	Introduction of legumes other than beans	Mwangaza Samiko	16	14	30	26	26
8.	Organic/inorganic fertilizer for vegetable production	Jiokoe	11	15	26	18	18
9.	Use of organic/inorganic fertilizers for maize	U-kapsara	9	16	25	22	22
10.	Use of organic/inorganic fertilizers for maize	Miti-Moja	13	17	30	21	21
11.	Organic/inorganic fertilizers for maize	Matekesi	21	24	45	40	40
12.	Introduction of legumes other than beans	Kamito	23	21	44	39	39
13.	Forage production / utilization and organic/inorganic fertilizers for maize	Kaplelach	11	14	23	24	24
14.	Use of organic/inorganic fertilizers for maize	Koror	12	15	26	19	19
		Kamaisoi					
	Total		220		247	361	361

Source: Soil Management Project (2004)

2.2 Sample and Sampling Procedures

2.2.1 Sampling of FFS Participants

A proportionate stratified random sampling was used to determine the sample of FFS participants. The FFS Participants was stratified into their FFSs and simple random sampling method through the use of table of random numbers, was applied in selecting the respondents. The total number of the FFS Participants was 501 and was distributed into twenty two FFSs as shown in Table 3.

The sample of FFS respondents was 180 and proportion was worked out using the following formula derived from Tuchman, (1978):

$$\frac{Ps}{\Sigma Ns} \times n = ns$$

Where: Ps = Population in the stratum

$\sum Ns$ = Total population of FFS Participants.

n = Required Sample

ns = Sample size per FFS

Example Khuyetana- is $\frac{30}{501} \times 180 = 11$ Bikholwa FFS $\frac{18}{501} \times 180 = 7$ as shown in table 2. The same procedure of calculation was followed for other schools to arrive at the sample as indicated in Table 3.

Table 3. FFS population and sample per School

Name of FFSs	Population (FFS Graduates)		Sample	
	Before FFS Participation (FFS P)	After FFS P	Before FFS P	After FFS P
1) Khuyetana	30	30	11	11
2) Bikholwa	18	18	7	7
3) Bulala	21	21	8	8
4) Busime	17	17	6	6
5) Twende mbele	11	11	4	4
6) Upendo	16	16	5	5
7) Mteremko	11	11	4	4
8) Mutua	16	16	5	5
9) Mwangaza*	26	26	9	9
10) Mawazo	18	18	7	7
11) Umoja-Hututu	24	24	9	9
12) Weonia	36	36	13	13
13) Kwanuzu	16	16	5	5
14) Motosiet Mwangaza	32	32	12	12
15) Samiko	26	26	9	9
16) Jiokoe	18	18	7	7
17) Umoja-Kapsara	22	22	8	8
18) Miti Moja	21	21	8	8
19) Matekesi	40	40	14	14
20) Kamito	19	19	7	7
21) Kaplelach Koror	24	24	9	9
22) Kamaisoi	39	39	13	13
Total	501	501	180	180

Source: SMP, 2001

N/B- No. One to eight indicate 1st generation or batch of FFS of which **140** farmers graduated while the 2nd batch generation of FFSs Starting from Mwangaza FFS * 9 down to No 22 of which **361** farmers graduated making a total of **501** as indicated above.

2.2.2 Sampling of non-FFS participants

The total population in the research locations was 6,240 households out of which 501 were the households who participated in the FFS training (SMP, 2001). The remaining 5739 households formed the non-FFS participants. The non-participant households of 5739 were subjected to stratified simple random sampling technique. Farmers were stratified according to locations and finally villages and then simple random sampling was employed to select 180 non-FFS respondents through the use of table of random numbers. The sample size was 360 farmers. This group of farmers formed the control group which was compared with FFS participants in terms of the variables designed for the study.

2.2.3 Data Collection Procedure

The study used an interview schedule and a standardized test in data collection. The interview schedules were pre-arranged through appointments for the interviews to take place at the homes of the randomly chosen respondents.

2.2.4 Data Analysis

In analysis, both descriptive and inferential statistics was employed. The null hypotheses were tested at α 0.05 level of significance. Collected data was coded and analyzed by the Statistical Package for Social Sciences computer program. A t-test was used by the researcher to compare the sample means to determine whether there was any statistically significant difference between means scores of the two groups.

3 Results and Discussions

3.1.1 Impact of SCMT promoted through FFS approach on knowledge and skills

A Paired t-test was used to determine the mean scores between FFS participants before and after participation in the Soil and Crop Management Farmer Field Schools. These FFSs were established to disseminate the promising S&CM technologies verified by the research team in the study location. The results established the impact of the Soil and Crop Management technologies promoted through FFSs approach on the knowledge and skills between the FFS participants and Non FFS Participants in North Rift of Kenya. The results of the test are presented in Table 4.

Table 4. Test of significance in the knowledge and skills acquired in S&CMTs between the FFS and Non FFS participants in North Rift, Kenya

FFS Participation	N	Mean	Std. Deviation	Std. Error Mean
FFS participants	180	3.8303	0.74325	0.05540
NFFS participants	180	2.6323	0.92689	0.06909

t = 13.528 d.f. = 341.860 p = 0.000

The results in Table 4 indicate that the mean score for FFS participants was 3.83±0.06 and 2.63±0.07 for non FFS participants. Therefore by subjecting these two means to an independent t-test, the results show that there was a significant difference between the mean scores for FFS-participants and non-FFS participants (t = 13.528, d.f. = 341.860, p = 0.000) at (P< 0.05) level of significance. It was concluded therefore that, the results indicate that there was a significant difference in knowledge and skill acquisition between the two groups with the FFS participants having acquired more knowledge than the non FFS participants. This shows that participation in FFS had raised the knowledge of the FFS farmer participants above that of the Non-FFS farmers. The results are consistent with several other studies showing positive impact of FFS participants acquiring more knowledge than the Non FFS participants (Moumeni-Halali and Ahmadpour (2013), De Jager, 2007, Davis, 2006, Braun et al., 2005 and Van de Berg, (2002).

3.1.2 Impact of SCMT promoted through FFS approach on Farming Systems

The study investigated the impact of the Soil and Crop Management technologies promoted through FFSs approach on farming systems (farm practices related to maize, vegetable and fodder production) of FFS participants before and after participating in FFSs in North Rift of Kenya. A Paired t-test was used to determine if there was any significant difference between the mean scores of FFS participants before and after participation in FFSs. The test established if there was any impact on their farming system after the dissemination of S&CM through the FFS approach. The results of the test are presented in Table 5.

Table 5. Test of significance for impact in the farming system between FFS participants before and after participation in FFSs as a result of S&CMTs dissemination approach in North Rift Districts

Categories of participants	N	Mean	Standard deviation	Std Error Mean	2-tailed probability
Before FFS participation	179	1.9650	.67155	.05019	.000*
After FFS Participation	179	3.2775	85213	.85213	

(*) Significant at the 0.05 level.) , t=-20.611, d.f. = 178 p = 0.000; Correlation: r=0.394, p<0.001

The findings indicated that there was a significant difference between FFS participants before and after participation in FFSs on their Farming System (farm practices/enterprises) as a result of the impact of S&CM FFS dissemination approach in the study area of North Rift, Kenya (t = -20.611, d.f. = 178, p = 0.000). For this reason, the null hypothesis was rejected. This means that participation brought about a significant change or impact in the farming system as a result of S&CM technologies disseminated through FFS approach.

3.1.3 Impact of SCMT promoted through FFS approach on productivity before and after participation

The study investigated if the Soil and Crop Management technologies disseminated through FFSs had any change in farm productivity of FFS participants. A Paired t-test was used to test if the mean income from maize between FFS participants before and after participation in FFSs had any statistically significant differences. This will clearly show if there was any impact in the farming system after the dissemination of S&CM through the FFS approach. The results of the test are presented in Table 6.

Table 6. Paired t-test for differences in maize income before and after FFS participation

Maize income per acre	Mean	N	Std. Deviation	Std. Error Mean
Before participation	27380.56	180	24040.85698	1791.89968
After participation	53038.89	180	46354.27865	3455.04394

t=-10.240 d.f.=179 p=0.000 Correlation: r = 0.716 p<0.001

The findings indicate that the income received by farmers in relation to the maize production after FFS participation (53038.89±3455.04) was significantly higher than the income before participation (27380.56±1791.90). Therefore the results show that farmers who enrolled and participated in FFSs had higher income accruing from maize production due to the impact of S&CM technologies on their farming systems.

This implies that adoption and practicing of the S&CM technologies promoted through FFS approach was of greater benefit. A study conducted by Davis, et al (2010) found out that overall, farmer field schooling had a significant impact on crop productivity in Kenya and Tanzania. Further the results in this study are consistent with other several studies showing positive effects of FFSs on productivity (Gockowski et al. 2006; 2004; Yamazaki and Resosudarmo 2006). In this study the income from maize increased substantially for the FFS Participants after undergoing FFS training on maize agronomic practices.

4 Conclusions

Based on the finding of the study, a number of conclusions are drawn as follows:

1. There was statistically significant difference between the FFS and Non-FFS participants in the level of knowledge acquired in soil & crop management promoted through FFSs at ($P < 0.05$). Therefore the FFS participants had a better understanding, higher impact and practice of S&CM technologies than the Non FFS participants. Therefore it was concluded that there was a greater impact of S&CM technologies on the farming system and agricultural productivity of the FFS participants than the Non-FFS participants in the study locations.

2. There was a statistically significant difference between FFS participants before and after participation in FFSs on the Farming System as a result of the impact of S&CM technologies promoted through FFSs at ($P < 0.05$). Therefore it was concluded that participation in FFS had a higher impact on the Farming System as a result of the impact of S&CM technologies promoted through FFS approach in the study area of North Rift, Kenya.

3. The results indicated that there was statistically significant difference between the FFS participants before and after participating in FFS in their level of income as a result of the impact of soil & crop management technologies promoted through FFS tested at ($P < 0.05$). Therefore it was concluded that participation in FFS earned farmers a higher income than non-participation hence there was a clear difference between FFS participants after participating and practicing the S&CM technologies as compared to the same farmers before participating in the FFS training. Farmers improved crop yields and income after adopting and practicing the S&CM technologies disseminated through FFS training approach. Therefore farmers who participated in S&CM FFS training realized a greater impact on their farming system and productivity.

5 Recommendations

From the findings and conclusion of the study, the following key recommendations are made that have implication on the sustainability of the FFS as an educational and a participatory extension approach.

1. Scaling-up of Farmer Field School approach to a wider farming community

There is a need for expansion of FFS Approach from the cluster sub counties where they were initiated to a wider farming community. Therefore the SMP addressed the issue of the need of a strong starting phase for the initial FFS. The expansion of the FFS should have a strong backstopping or capacity building by well-trained facilitators. These imply that there is a need to have a strong focal point for implementation of any new Farmer Field School.

2. Impact of FFS on Farming systems and productivity among small scale farmers

This study established that there was a positive impact in terms of Farming system and productivity. Therefore the key recommendation is that FFS approach is a superior approach as compared to conventional extension approaches. The flexibility of FFS means that certain principles of FFS could be incorporated into existing extension approaches and methodologies, to make them more effective in reaching small scale farmers and hence creating a positive impact in alleviating poverty.

3. Promotion of farmer-to-farmer extension

Farmers are the best educators of other farmers, and so farmer-to-farmer extension, visits and peer training can greatly help in information exchange and dissemination. This was revealed through the FFS impact study in the North Rift, Kenya research sites. Therefore FFS is a good forum for farmer-to-farmer exchange of new ideas, innovations and information. Opening up of more farmer-led-field schools is a strong tool for dissemination and hence diffusion of S&CM technologies amongst the small scale farmers, like rice, maize, fish farming and other technologies together as a consortium and facilitating the process of information exchange and building FFS networks.

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