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Full Length Research Paper

Success story of implementing the self-sustaining agricultural extension system in Rwanda

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Rwanda is implementing the self-sustaining extension system through Farmer Field Schools (FFS) and Farmer Promoters (FP) approaches. The objective of this paper was to find out the impact of self-sustaining extension system in order to help stakeholders to improve its current implementation. The methodology includes a desk review of reports, face to face interview with 60 participants and 5 focus group discussions between February and May 2016. It also includes the interview of 400 trained farmers and 400 non-trained farmers. It was found that 92% of the trained FFS facilitators and 62% of the farmer promoters were very active in extension services. It was also found that for beans, the highest average yield was 1.2 t/ha for non-trained farmers, 1.5 t/ha for FFS farmers, 1.3 t/ha for FP farmers and the average yield of all the farmers was worked out to be 1.4 t/ha. It was found that FFS trained farmers produce 37.5% more than non-trained farmers while farmers trained by Farmer Promoters produce 10.8% more than non-trained farmers. In general, 37.8% of farmers apply Good Agricultural Practices (GAP) among the non-trained farmers, 73% of FFS farmers use the GAP and 68.3% of the FP farmers adopt the GAPs. It was found that 20% of the FFS group activities are involved in various income generating activities compared to non-trained farmers (10%). It is concluded that the implementation of self-sustaining agricultural extension system in Rwanda has a strong impact in agricultural development through motivation and increased trainings of farmer promoters.

Key words: Impact, implementation, self-sustaining extension.

INTRODUCTION

Rwanda is a land locked country in East Africa. The Government of Rwanda sees agriculture development as a key catalyst to engender long-term sustainable growth and remove thousands out of poverty. The Crop Intensification Programme (CIP) which is a flagship program implemented by the Ministry of Agriculture and

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Animal Resources to attain the goal of increased agricultural productivity in the country, has been very successful in increasing production of staple food crops, through improvements to smallholder productivity, and helping Rwanda achieve food self-sufficiency.

Most of the cultivated land is under food crops grown twice a year (Season A and Season B) with a total annual harvesting area of almost 1,500,000 ha. The area covered by lakes and rivers is estimated at about 135,000 ha, while marshlands occupy around 170,000 ha. There are some 1,385,000 ha potentially arable land. The size of farmland available for agricultural production ranges between 0.25 and 2 ha with an average size of 0.60 ha per agricultural household. Most of the farmlands in Rwanda consist of fragmented plots of land. Approximately 80% of farms have a surface area of less than 1 ha each.

Farming in Rwanda remains largely subsistence in nature. With a rapid increase in Rwandan population from 8 million in 2002 to about 10.5 million in 2011; the pressure on ensuring food security is a constant challenge for the stakeholders. Significant progress has been made in Rwanda in the past decade with regard to over all agricultural production. However, operational efficiency and farm productivity, and, therefore, the prosperity of a very large proportion of the rural population, continue to be a concern.

As the share of service sector on national economy grows larger, the government seeks to transform farming into a productive, high value, market oriented sector by modernizing 50% of its agriculture by 2020, and thereby improve livelihoods of rural population, achieve food security and increase exports of agricultural products as reflected in the Millennium Development Goals (MDG) and New Partnership for Africa's Development (NEPAD). The effectiveness of the agricultural extension system remains a constraint on further increases in production. In order to sustain the current rate of agricultural sector growth, Ministry of Agriculture and its implementing agency, the Rwanda Agriculture Board, need to successfully implement an extension system that is more effective and accountable to farmers. This paper present the impact of the adoption of self-sustaining extension system in crop productivity, increased revenue for Farmer Field School (FFS) trained farmers and Farmer Promoter (FP) trained farmers compared to non-trained farmers, Changes in applying Good Agricultural Practices (GAP), increased capabilities of farmers due to participation in FFS groups, group dynamics include the formation and functioning of the FP groups and FFS groups and the impact of FFS membership influencing the yield of different crops.

Brief reviews of literature pertaining to Self-Sustaining Agricultural Extension system are discussed in this section as the report of Bertus Wennink et al.(2016). Alston et al. (2000) provide an extensive review of the economic returns to investment in agricultural research and development. The analysis included over 1,128 estimated rates of return, and while 512 of these were for research and extension, only 18 were from extension only investments. The results of the analysis showed an average rate of return of 47 per cent for research and extension investments, while for extension only investments this was 80 per cent. However, as with other reviews, the methodology of the included studies is varied and few follow high quality impact evaluation methodologies.

In the 21st century, agriculture continues to be a fundamental instrument for sustainable development and poverty reduction. Agriculture remains the main source of income for around 2.5 billion people in the developing world (FAO, 2003). A range of approaches to extension delivery have been promoted over the years. Early models focusing on transfer of technology using a 'top - down' linear approach were criticized due to the passive role allocated to farmers, as well as the failure to factor in the diversity of the socio-economic and institutional environments facing farmers and ultimately in generating behaviour change (Chambers and Ghildyal, 1984).

According to Anderson and Feder (2003) productivity improvements are only possible when there is a gap between actual and potential productivity. They suggest two types of 'gaps' contribute to the productivity differential – the technology gap and the management gap. Extension can contribute to the reduction of the productivity differential by increasing the speed of technology transfer and by increasing farmers' knowledge and assisting them in improving farm management practices (Birkhaeuser et al., 1991). Additionally, extension services also play an important role in improving the information flow from farmers to scientists.

A number of models have been implemented since the 1970s, combining approaches to outreach services and adult education, including the World Bank's Training and Visit (T&V) model (Anderson et al., 2006), participatory approaches and most recently farmer field schools (FFSs) (Van den Berg and Jiggins, 2007).

Since the emergence of the Farmer Field School (FFS) approach in Indonesia in the late 1980s, this approach to extension has become increasingly widespread and has been introduced in some 78 countries (Van den Berg and Jiggins, 2007). The FFS approach draws on the participatory approach in terms of its focus on farmer experimentation and problem solving. Van den Berg (2004) provides a synthesis of 25 evaluation studies of integrated pest management (IPM) FFSs. Most studies focused on rice and measured immediate impact of the FFSs in terms of reduced pesticide use and changes in yields, reporting considerable reductions in pesticide use, with some studies also showing an increase in yields. However, in common with other reviews of extension services, the methodology of the studies is varied, highlighting the complexity of estimating impact for such interventions and the lack of an agreed conceptual framework for doing so. The review revealed that studies were either designed to be statistically rigorous, but with limited scope, or comprehensive, but with limited coverage. Van den Berg (2004) argues that by combining the results of different sources the comprehensiveness of the overall evaluation was

improved. Building on the latter, Van den Berg and Jiggings (2007) review studies evaluating FFS and pest management, finding that FFSs have had additional benefits to that of IPM including facilitating collective action, leadership, organisation and improved problem-solving skills. Noting that discussions on the fiscal sustainability of FFSs should include considerations of who will pay for the externalities of pesticide use, they conclude that the evidence gathered in the review suggests that FFSs can be a cost-effective way of increasing farmers' skills and thus contributing towards escaping poverty.

Van den Berg and Jiggings (2008) stated that public policy in developing countries has failed to invest in educating farmers on how to deal with variable agro-ecosystems and a changing world. It presented an assessment of a participatory training approach in changing crop protection by farmers from chemically dependent, to more sustainable practices in line with the tenets of Integrated Pest Management (IPM). The evidence from the studies on an educational investment designed to capacitate farmers to apply IPM, and discussed these data in the light of an on-going policy debate concerning cost effectiveness. The results indicate substantial immediate and developmental benefits of participation in Farmer Field Schools.

Maize (*Zea mays*), beans (*Phaseolus vulgaris*) and potato (*Solanum tuberosum*) are the major crops of the country. Maize and beans are used as a staple food and are the major and most important cereal crop of Rwanda which well adapts to its environmental conditions. The per hectare yield of maize and beans are very low when compared to other countries in the continent like South Africa and Zimbabwe. The low yield in the country is mainly due to drought, mismanagement, small land holding and non-availability of appropriate extension system. Hence, there is a need for implementing the Self Sustaining Extension System in Rwanda.

The effectiveness of the agricultural extension system remains a constraint on further increases in production. In order to sustain the current rate of agricultural sector growth, Ministry of Agriculture and its implementing agency, the Rwanda Agriculture Board, need to successfully implement an extension system that is more effective and accountable to farmers. This paper present the impact of the adoption of self-sustaining extension system in crop productivity, increased revenue for Farmer Field School (FFS) trained farmers and Farmer Promoter (FP) trained farmers compared to non-trained farmers, changes in applying Good Agricultural Practices (GAP), increased capabilities of farmers due to participation in FFS groups, group dynamics including the formation and functioning of the FP groups and FFS groups and the impact of FFS membership influencing the yield of different crops.

MATERIALS AND METHODS

This section explains the general approaches adopted to implement the self-sustaining extension system in Rwanda including the study area. The source of the primary and secondary data collected is from the documents of the Ministry of Agriculture and Animal Resources. The detailed methodology and the methods adopted to bring out the processed information to meet the objectives of the study are also explained.

Location of study area

The study was carried out by collecting the data from the Ministry of Agriculture and Animal Resources in Rwanda. The researcher was a senior officer in charge of organizing, executing and implementing the self-sustainable extension system in the entire country. The various data collected and reports produced under the guidance of the researcher in the ministry form the basis for the analysis of the extension system in Rwanda.

Methodology adopted

The methodology adopted to analyze the self-sustainable extension system consists of developing the institutional development of self-sustaining extension system. The self-sustaining extension system will be based on a pluralistic approach involving farmer to farmer extension model with many actors from both public and private sector playing different roles. Operating within the decentralization system, agriculture committees at village, cell, sector, district, province and national levels ensure that agricultural development agenda is prioritized in overall development agenda. Village is the entry point of self-sustaining extension system in Rwanda as shown in Figure 1 and the organization of Self Sustaining Agricultural Extension systems is shown in Figure 2.

Farmer Field School (FFS)

The FFS plot was the learning place for the members of the FFS group. The FFS Facilitator guided the FFS group members through a process of experimental learning by conducting weekly assessments of the crop growth in various comparative trials. Farmers got deep understanding of crop production in FFS plots and also learnt how to make good decisions based on observations and analysis. FFS groups at the rate of one per village were established across the country (Table 2).

RESULTS AND DISCUSSION

The self-sustaining extension system is a true 'home-grown solution' that has been developed and implemented by Rwanda Agriculture Board, under the responsibility of Ministry of Agriculture and Animal Resources, in close collaboration with Districts and Sectors. It is therefore a decentralized system which

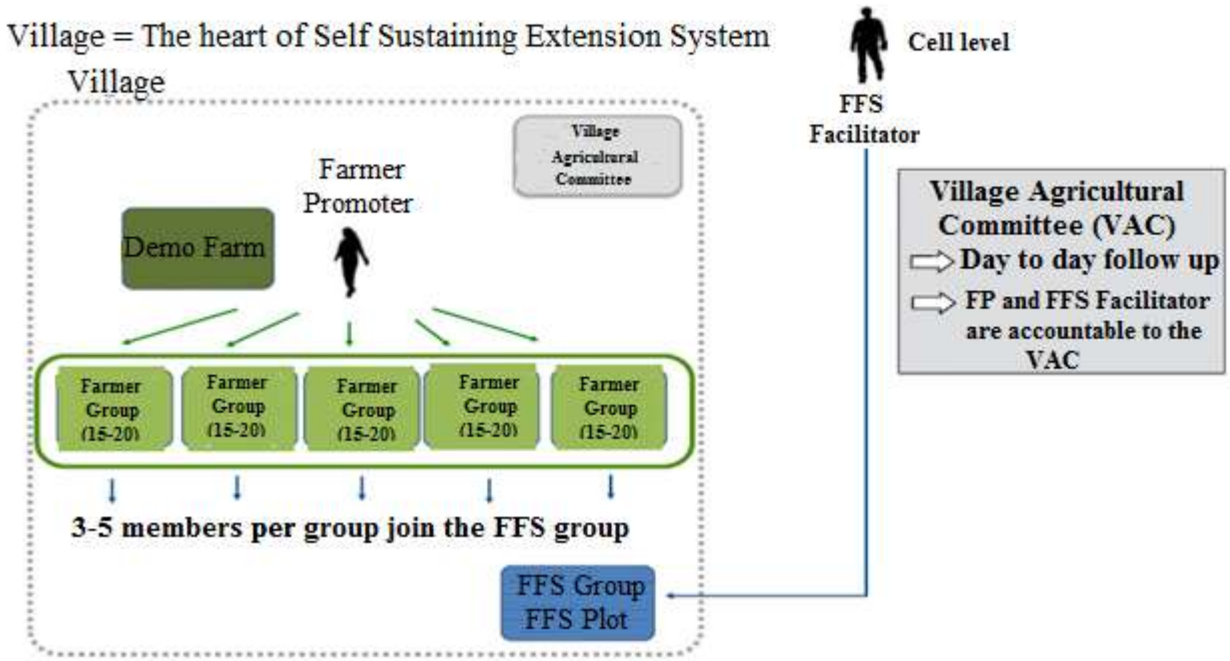

Figure 1. Village as the entry point of Self Sustaining Extension System.

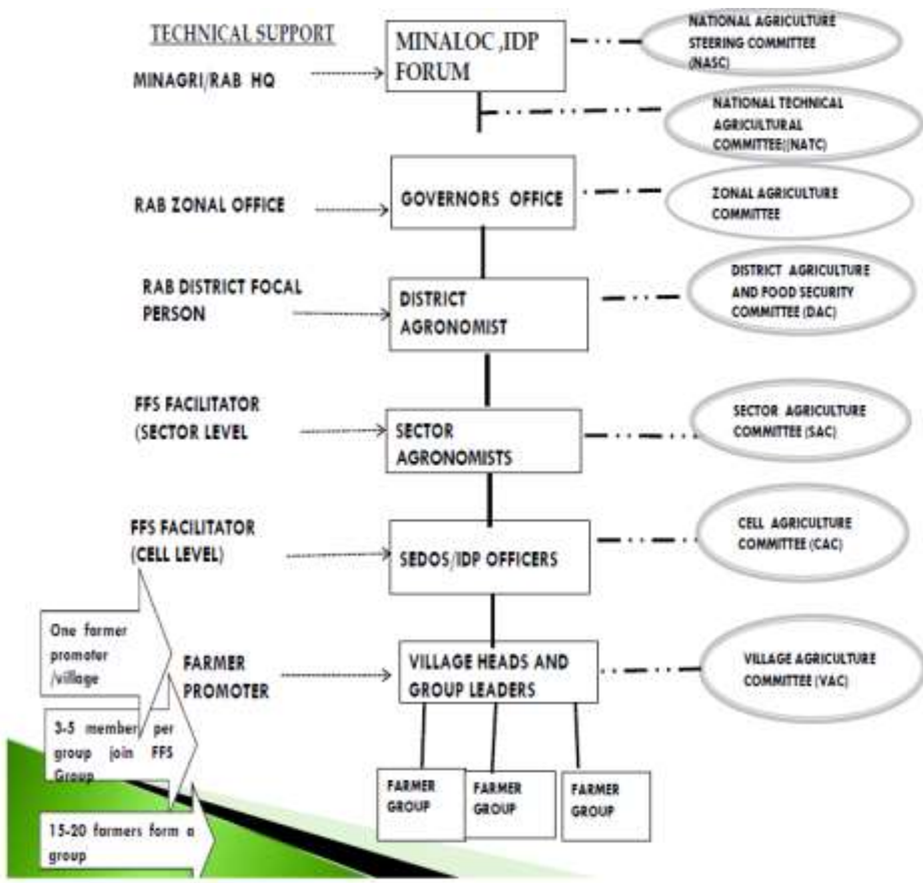

Figure 2. Organization of Self Sustaining Agricultural Extension systems.

gives farmers a key role in agricultural extension. The self-sustaining extension system relies on two extension approaches: the FFS approach and the Farmer Promoter approach.

Farmer Promoters reached all farmers with basic extension messages through mobilization of farmers and demonstration plots in each village. Farmers were organized in groups to serve as extension entry points. Organization of farmers into strong groups enhances farmer to farmer knowledge transfer with a view of making the farmers truly involved in the learning process. Each village identifies one Farmer Promoter through a participatory exercise based on criteria which were developed in a participatory way. The Farmer Promoters also mobilized the farmers to consolidate land, plant in time and buy and use inputs such as improved seed and inorganic fertilizer. The Farmer Promoters supervised the village demonstration plots in which the self-sustaining groups meet three times during the planting season.

FFS Facilitators gradually reached all farmers with in-depth knowledge by offering an experimental learning experience in the FFS plot. Farmers were organized in FFS Groups which are facilitated by Facilitators. Each FFS Group had its own experimental learning plot in which the group meets on a weekly basis. The FFS approach builds the skills and capacity of farmers to identify and analyze problems, and to conduct experiments aiming at developing local solutions appropriate to local specific challenges. Based on the principle "Learning by doing" farmers develop their decision-making skills which helps them to handle current and future challenges effectively and to become progressively managers of their farming activities. The self-sustaining extension system builds capacity of the Farmer Promoters to become the first line extension worker in the village while FFS Facilitators are capacitated to be competent facilitators (with strong technical and facilitation skills) to lead FFS Group members through the hands-on learning process.

At the end of 2015, the self-sustaining extension system was implemented by 2,300 FFS Facilitators and 14,200 Farmer Promoters as per details shown in Table 1.

The main role of Rwanda Agriculture Board (RAB) is to provide technical support, especially through the deployment of FFS Master Trainers, as well as other technical staff. The role of the Districts is to ensure that the agricultural extension activities are in line with the development plans of the District. Therefore, the decentralized levels play a crucial role in the planning process as well as in the day to day coordination of self-sustaining extension system activities.

Crop productivity in self-sustaining extension system

The survey was conducted in 80 villages. Six farmers were chosen from every village with the 3 categories (FFS farmers, FP farmers and Non-trained Farmers) giving 6 x 3 x 80 = 1440 farmers, who were randomly selected for studying the average yield. The production of their plots were effectively measured. Data from the Harvest Survey (season 2015B) is shown in Table 2.

Table 2 shows that the FFS participants achieve higher yields than farmer who have been trained by Farmer Promoters and non-trained farmers. It was found that for beans, the highest average yield was 1.25 t/ha for non-trained farmers, 1.52 t/ha for FFS farmers, 1.26 t/ha for FP farmers and the average yield of all the farmers was worked out to be 1.39 t/ha. Similar trend was noted for other crops like cassava, maize, rice, soya and wheat also. Hence, it is established that the FFS farmers perform better than FP farmers and non-trained farmers. Table 2 also shows that on average, FFS farmers produced 37.45% more than non-trained farmers while farmers trained by Farmer Promoters produced 10.78% more than non-trained farmers. However, these averages are strongly influenced by a few villages where very high production increases were noted.

Increased revenue for FFS farmers and FP farmers due to self-sustaining extension

The increased crop productivity for FFS farmers and FP farmers compared to non-trained farmers causes and increased revenue. The computation of increased yield of FFS farmers and FP farmers over non trained farmers is shown in Table 3. It should be noted that these are gross revenues which do not integrate the costs for applying the improved technologies; for instance, the use of fertilizer which often means considerable financial costs for smallholder farmers.

Table 3 reveals the fact that the cassava crop provides additional income of 560 Rwf/ha for the FFS farmers and 330 Rwf/ha for FP farmers. It was also found that rice crop, provides additional income of 172.50 Rwf/ha for the FFS farmers and a marginal negative effect of -12.5 Rwf/ha for FP farmers. This negative trend is not attributed because of training of FP farmers. The rice yield is affected by the season, rainfall, irrigation, weeding and other crop husbandry aspects. The data collected during the harvest Survey (season 2015B) show those farmers who have been trained by either FFS Facilitators or Farmer Promoters obtained higher yields than farmers who did not receive any training from these extension agents. Thus, the self-sustaining extension system used in Rwanda caused increased gross revenues of the agricultural households. The FFS trained farmers and FP trained farmers used new trained skill, additional inputs like employing family labors and buying fertilizers etc. also were the causes of increased yield. The increased income is not only due to training efforts but also due to application of land, family labors,

Table 1. Numbers and characteristics of FFS Facilitators and Farmer Promoters.

Characteristics	FFS Facilitators	Farmer Promoters
Total number	2300	14200
Gender	72% male & 28% female	80% male & 20% female
Age	68% is between 35-55 years old 17% is younger 15% is older	77% is between 35-55 years old 12% is younger 11% is older
Active	92% of trained facilitators is Active	62% is active since 2013 25% is active since 2014 13% has become active in 2015
Membership of FFS Facilitators Cooperative	95% is member of a cooperative	---

Table 2. Average yields (t/ha) for FFS farmers, FP farmers and non-trained farmers.

Crops	Non-trained farmers	FFS farmers	FP farmers	All farmers (Mean of non-trained, FFS and FP farmers)	Difference in yield % between non trained and FFS farmers	Difference in yield % between non trained and FP farmers
Beans	1.25	1.52	1.26	1.34	21.60	0.80
Cassava	17.1	22.7	20.4	20.07	32.75	19.30
Maize	1.92	3.06	2.34	2.44	59.38	21.88
Rice	4.09	4.78	4.04	4.30	16.87	1.22
Soya	0.68	1.12	0.73	0.84	64.71	7.35
Wheat	1.77	2.29	2.02	2.03	29.38	14.12
Average difference in yield % between non trained and FFS farmers or FP Farmers					37.45	10.78

Table 3. Increased revenue for FFS farmers and FP farmers compared to non-trained farmers.

Crops	Additional production for FFS farmers in t/ha	Additional production for FP farmers in t/ha	Average farm gate price, Rwf/t	Additional income for FFS farmers Rwf/ha	Additional income for FP farmers Rwf/ha
Beans	0.27	0.01	380	102.6	3.8
Cassava	5.60	3.30	100	560.0	330.0
Maize	1.14	0.42	175	199.5	73.5
Rice	0.69	-0.05	250	172.5	-12.5
Soya	0.44	0.05	500	220.0	25.0
Wheat	0.52	0.25	350	182.0	87.5

livestock, financial capital used to purchase of inputs like fertilizers and pesticides applied.

Changes in applying GAP and differences in yield due to application of GAP

The data collected during the harvest survey (season 2015B) show those farmers who have been trained by either FFS Facilitators or Farmer Promoters used more Good Agricultural Practices (GAP) than the farmers who did not receive any training from these extension agents. GAP are the technologies that, when applied correctly, increase the quantity and the quality of food crop production. They often are to be used in combination with agricultural inputs in order to achieve maximum increase

Table 4. Percentage of farmers applying GAP and differences in yield between farmers applying and not applying GAP.

Crops	Farmers applying GAP in %			Differences in yield (t/ha) by farmers not applying GAP and applying GAP		
	Non-trained farmers	FFS farmers	FP farmers	Farmer not applying GAP (t/ha)	Farmer applying GAP (t/ha)	Difference in yield (t/ha) between farmers not applying GAP and applying GAP
Beans	24	68	62	0.86	1.91	122.09
Cassava	35	62	69	15.02	24.41	62.52
Maize	43	95	85	1.60	2.72	70.00
Rice	71	88	87	3.35	4.60	37.31
Soya	19	54	52	0.69	1.05	52.17
Wheat	35	71	55	1.67	2.40	43.71
Average	37.8	73.0	68.3	3.87	6.18	64.63

in crop productivity. The percentages of farmers applying GAP are shown in Table 4.

Table 4 shows the fact there is an average of 37.8% of farmers that applied GAP among the non-trained farmers, 73% of FFS farmers used the GAP and 68.3% of the FP farmers adopted the GAPs to get higher yield from their farms. It was found that there was a difference of 4.7% between the FFS farmers and FP farmers. Hence, it was found that there was small difference between the FFS trained farmers and FP trained farmers in self-sustaining extension system used in Rwanda.

Table 4 reveals the fact that the average yield difference between the farmers not applying GAP and applying GAP was 64.63%. It is appreciably very high. It shows the importance of adopting self-sustaining extension system in increased yield. It was found that there was highest yield difference of 122.09% between adopting GAP and non-adopting GAP for the beans crop. It is followed by 70% for maize and the lowest yield difference of 37.31% is for the rice crop.

Increased capabilities of farmers (changes) due to activities initiated by FFS groups

The self-sustaining extension system adopted in Rwanda made many changes like increased capabilities of farmers due to participation in FFS groups. FFS training included the analyzes of the agro-eco system, design and implement experiments, taking decisions as a group to act and to work as group to solve the community problems. The activities initiated by FFS group and changes made are shown in Table 5.

Table 5 shows that there were increased capabilities of farmers due to the activities initiated by FFS groups. Some of the high lights of the changes made in farmers are increased knowledge from the experimental plots, decision making capacities, increased crop production capabilities, improved crop storage, handling and marketing, improved access to agricultural inputs, financial services and extension systems. It improved the relations with other stakeholders, group activities and acquiring knowledge in areas other than farming.

Group dynamics of FFS group and FP groups

Group dynamics include the formation and functioning of the FP groups and FFS groups. The functioning of the groups refers to activities undertaken collectively by group members. Rwanda has two major agricultural seasons. They were season A and season B. Data was collected for season A and B for the years 2015 and 2016. They were named as season 2015A and 2015B for the year 2015 and season 2016A and 2016B for the year 2016. Data on group dynamics are provided through the season 2015B and season 2016A. Table 6 shows the group dynamics of FFS groups and FP groups during the seasons 2015B and 2016A. Table 6 shows that during season 2015B, there was 3.4 average numbers of groups per village and it was 4.2 for 2016A season. It was found that there were 72 farmer members in FP group per village during 2015B season whereas there were 80 farmer members in FP group per village during 2016A season. It was found that there were 22 farmers per FFS Group in season 2015B and 20 farmers per FP group in season 2015B. It was found that there was 52% of women membership in FFS groups. It was found that 68% of the FFS group activities were towards saving and credit development. It was also found that 20% of the FFS group activities were towards various income generating activities. It was found out that both FFS groups and FP groups undertake collective activities pertaining to group savings and credits schemes stand out. Both FFS groups and FP groups undertook collective procurement of agricultural inputs and marketing of products. The most important benefits of being a FFS group member are having more food on the table and members helping each other. The most important benefits of being a FFS group work is that they are able to sell more agricultural produce to the market. Older groups have more group income generating activities and

Table 5. Activities initiated by FFS group and changes made.

S/N	Areas of activities	What is changed?	Examples of change
1	Group experiments	From experiments by researchers to experiments by farmers	Farmer controlled experiments; e.g. compare different crop varieties, types or doses of fertilizer, planting dates
2	Improved decision making	Farmers become more confident Capacity to take decisions when facing problems	Ability to come up with own ideas Take decision on how to fight banana disease
3	Production	From traditional practices to good agriculture practices	Respect of planting date Planting on line and spacing Use of organic and mineral fertilizer Positive selection of potato seed Pest identification Banana rehabilitation using suckers from the FFS plot
4	Storage and processing	Seed storage and post-harvest handling	Seed for the next season are put in store
5	Marketing	From subsistence farming to market-oriented farming Collective marketing	Collect the production at one site and then sell it at a good price Increase the production for the market
6	Access to agricultural inputs	Improved procurement of inputs Agro dealer is available at cell level	Inputs are well distributed from the agro-dealer to the group members Group members benefited from subsidies on improved seed and mineral fertilizer Banana seed distribution among group members
7	Access to financial services	Creation of the FFS Facilitators Cooperative	With the registration number the cooperative is able to access credit
8	Access to extension services	Increase of number of extension agents Farmer-to-farmer extension	From one sector agronomist to several FFS facilitators at Sector level and several Farmer Promoters at village level Farmers themselves are playing the role of extension agent within the community
9	Relations with other stakeholders	Working closely with the research institute	Knowledge from RAB is disseminated by FFS Facilitators
10	Group activities	Self-help activities within group	Financial contribution of members to social purposes; e.g. health insurance
11	Knowledge in areas other than farming	Special topics discussed	Knowledge on the role of soybean in human nutrition; for example soya milk Groups discuss societal topics; e.g. family planning

often they have become a formal cooperative.

Membership of FFS Groups and differences in yields

The period of FFS members has influence on the yield of different crops. The FFS members that started from 2009 to 2014 were taken as one entity and the FFS members that started during 2015 was taken as another entity in this study. The average yield difference of FFS members compared to non-trained farmers were worked out in % and are shown in Table 7.

Table 7 shows the fact that the % yield difference of principal food crop of Rwanda is high for the FFS members started since 2009 to 2014 compared to the recently joined FFS member. The recent FFS members since 2015 recorded lesser yields because they acquired lesser knowledge, understanding and practices of GAP. The table shows that the soya crop yield for older FFS members was 133.6% whereas it is 56.9% for members that joined in 2015. The differences in yield between older FFS members and recent FFS members may be due to the facts like education levels and experience between older FFS members and recent FFS members. Similarly for maize crop also, there was wider gap between the yield of older FFS members (114.7%) compared to recent FFS member (26.2%) due to differences in knowledge and experience of the members in older and recent FFS members.

Access to extension services

A household survey was conducted during 2012 and 2015. Data was collected about the access to extension services by different randomly selected households. It included FFS group members, FP group members and not trained farmers households. The result of the household survey for accessing the benefit of extension services is shown in Figure 3.

Figures 3 and 4 show the household survey 2012 and

Table 6. Group dynamics of FFS groups and FP groups during the seasons 2015B and 2016A.

Dynamics	FFS group		FP groups	
	Season 2015B	Season 2016A	Season 2015B	Season 2016A
Average number of groups per village	-	-	3.4 FP groups	4.2 FP Groups
Average number of active groups per village	-	-	-	3.4 FP Groups
Average number of members per village	-	-	72 farmers	80 farmers
Average number of members per group	22 farmers per FFS group	-	20,0 farmers/ FP groups	20,0 farmers/ FP Groups
Average % of women Membership	52% women Members	-	-	-
% of village HHs per group*	12% of the village households	-	44% of the village households	50% of the village households
Group activity: buying Inputs	-	-	53% of the FP groups	-
Group activity: selling Produce	-	-	20% of the FP groups	-
Group activity: savings and credits	68% of the FFS groups	74% of the FFS Groups	40% of the FP groups	-
Group activity: various income generating activities	20% of the FFS groups	21% of the FFS Groups	-	-

*The average number of agricultural households (HHs) per village is estimated at 161.

Table 7. Membership of FFS Groups and differences (%) in yields.

S/N	Crops	FFS members since 2009 to 2014	FFS members since 2015
1	Beans	27.6	29.1
2	Maize	114.7	26.2
3	Rice	11.8	21.8
4	Soya	133.6	56.9
5	Wheat	12.7	31.5

31.7% of the households are accessing the benefits of self-sustaining extension system where as in 2015, 31.0% of the households are accessing the benefits of extension services. There is no appreciable difference between 2012 and 2015. It is also found that 68.30% of households during 2012 and 69% of households during 2015 are not accessing the extension services. Hence, there is a need to increase the FFS and FP members for better extension. The number of trainings, quality of trainings, field visit and sharing the experiences of demonstrations farms has to be included for increased benefits to households by accessing the self-sustaining extension system.. These efforts were less between the survey periods of 2012 and 2015. Hence, there is no appreciable difference between the periods of 2012 and 2015 in accessing the benefits of self-sustaining extension system.

Conclusion

The self-sustaining agricultural extension system implemented in Rwanda has two pillars FFS and FP groups. These groups are spreading the improved agricultural technologies from one to another through supply of inputs and field demonstrations. The summary of the present research is given below:

1) It was found that at the end of 2015, the self-sustaining extension system was implemented by 2,300 FFS

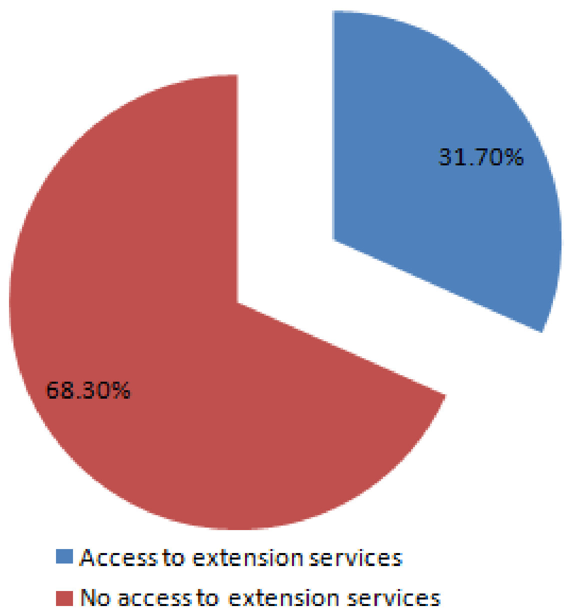

Figure 3. Household survey 2012.

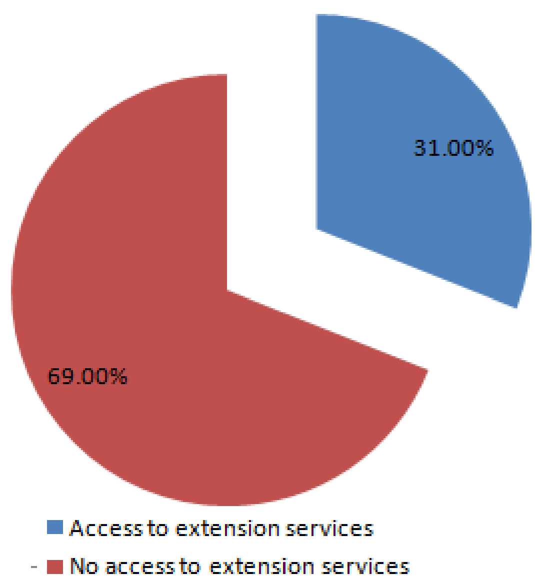

Figure 4. Household survey 2015.

Facilitators and 14,200 Farmer Promoters. FFS facilitators comprised of 72% male and 28% female. It was found that 92% of the trained FFS facilitators were active. It was found that 95% of the FFS facilitators are members of cooperatives. The FP groups comprised of 80% male and 20% female. It was found that 62% of the 2015 in Rwanda. It shows the fact that during 2012, Farmer promoters were active in 2013. It was found that 25% of FP is active in 2014 and it is decreased to 13% active during 2015. Hence, the activeness of the Farmer Promoters is decreasing year after year of starting the FP groups.

2) It was found that the FFS participants achieve higher yields than other farmers. It was found that for beans, the highest average yield was 1.25 t/ha for non-tr.52 t/ha for FFS farmers, 1.26 t/ha for FP farmers and the average yield of all the farmers was worked out to be 1.39t/ha. Similar trend is noted for other crops like cassava, maize, rice, soya and wheat also. Hence, it is concluded that the FFS farmers perform better than FP farmers and non-trained farmers. It was found that on an average, FFS farmers produced 37.45% more than non-trained farmers while farmers trained by Farmer Promoters produced 10.78% more than non-trained farmers.

3) It was found that the cassava crop provides additional income of 560 Rwf/ha for the FFS farmers and 330 Rwf/ha for FP farmers. It was also found that rice crop, provideD additional income of 172.50 Rwf/ha for the FFS farmers and a marginal negative effect of -12.5 Rwf/ha for FP farmers. This negative trend was not because of training of FP farmers. The rice yield was affected by the season, rainfall, irrigation, weeding and other crop husbandry aspects. Thus, it was concluded that the self-sustaining extension system used in Rwanda caused the increased gross revenues of the agricultural households. The increased income is not only due to training efforts but also due to application of land, family labors, livestock, financial capital used to purchase of inputs like fertilizers and pesticides applied.

It was found that an average of 37.8% of farmers applied Good Agricultural Practices (GAP) among the non-trained farmers, 73% of FFS farmers used the GAP and 68.3% of the FP farmers adopted the GAPs to get higher yield from their farms. It was found that there was a difference of 4.7% between the FFS farmers and FP farmers. Hence, it is concluded that there is small difference between the FFS trained farmers and FP trained farmers in self-sustaining extension system used in Rwanda.

4) It was found that there were increased capabilities of farmers due to the activities initiated by FFS groups. Some of the high lights of the changes made in farmers are increased knowledge from the experimental plots, decision making capacities, increased crop production capabilities, improved crop storage, handling and marketing, improved access to agricultural inputs, financial services and extension systems. The self-sustaining extension system improved the relations with other stakeholders, group activities and acquiring knowledge in areas other than farming.

5) It was found that there is 52% of women membership in FFS groups. It was found that 68% of the FFS group activities were towards saving and credit development. It

was also found that 20% of the FFS group activities were towards various income generating activities. It was found out that both FFS groups and FP groups undertook collective activities pertaining to group savings and credits schemes stand out. Both FFS groups and FP groups undertake collective procurement of agricultural inputs and marketing of products. The most important benefits of being a FFS group member are having more food on the table and members helping each other. The most important benefit of being a FFS group work is that the members were able to sell more agricultural produce to the market. Older groups have more group income generating activities and often they have become a formal cooperative.

6) It was found that the percentage yield difference of principal food crop of Rwanda is high for the FFS members started since 2009 to 2014 compared to the recently joined FFS member. The recent FFS members since 2015 recorded lesser yields because they acquired lesser knowledge, understanding and practices of GAP. It was found that the soya crop yield for older FFS members was 133.6% whereas it was 56.9% for members that joined in 2015. Similarly for maize crop also, there was wider gap between the yields of older FFS members (114.7%) compared to recent FFS member (26.2%). The differences in yield between older FFS members and recent FFS members may be due to the facts like education levels and experience between older FFS members and recent FFS members. It indicates that the self-sustaining extension system works well in Rwanda.

7) It was found from the household survey conducted during 2012 and 2015 in Rwanda, that 31.7% and 31.0% of the households accessed the benefits of self-sustaining extension system respectively. There is no appreciable difference of accessing benefits of extension system between 2012 and 2015. It was also found that 68.30% of households during 2012 and 69% of households during 2015 did not access the extension services. Hence, there is a need to increase the FFS and FP members for better extension. There is a need to increase the number of trainings, quality of trainings, field visit and share the experiences of demonstrations farms for increased benefits to households by accessing the self-sustaining extension system.

This research concludes that there was appreciable improvements in the spheres of crop productivity, increased revenue, applying GAP, differences in yield due to application of GAP, increased capabilities of farmers due to improved activities, group dynamics, membership of groups and access to extension services because of implementation of self-sustaining extension system. The most important implication studied from the study are 1) to continue the self-sustaining extension system in Rwanda for increased crop production, 2) to increase the knowledge base and capacity of farmers in crop productivity and 3) better organization of farming communities to meet the climate change and market dynamics etc.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

REFERENCES

Alston JM, Wyatt TJ, Pardey PG, Marra MC, Chan-Kang C (2000). A Meta-Analysis of Rates of Return to Agricultural R&D – Ex Pede Herculem, IFPRI, Washington DC.

Anderson JR, Feder G, Ganguly S, (2006). The Rise and fall of Training and Visit Extension: An Asian Mini-drama with and African Epilogue, World Bank Policy Research Working Paper 3928, World Bank, Washington DC.

Anderson JR, Feder G (2003). Rural Extension Services, World Bank Policy Research Working Paper 2976, World Bank, Washington DC.

Bertus W, Remco M (2016). Capitalization of the experiences with and the results of the Twigire Muhinzi agricultural extension model in Rwanda, Royal tropical Institute, Kigali.

Birkhaeuser D, Evenson RE, Feder G, (1991). The Economic Impact of Agricultural Extension: A Review, Economic Development and Cultural Change 39:607-650.

Chambers R, Ghildyal BP (1984). Agricultural Research for Resource-poor Farmers: The Farmer First and Last Model, Paper for the National Agricultural Research Project Workshop, Hyderabad, India.

FAO (2003). Statement at the Ministerial Conference of the WTO - Circulated in the Fifth Session, Cancun, 10-14 September, Doc No: WT/MIN(03)/ST/61.

Van den Berg H (2004). IPM Farmer Field Schools: A synthesis of 25 impact evaluations, Prepared for the Global IPM Facility, Wageningen University, the Netherlands.

Van den Berg H, Jiggins J (2007). Investing in Farmers – The Impacts of Farmer Field Schools in Relation to Integrated Pest Management, World Development 35(4):663-686.

Van den Berg H, Jiggins J (2008). Investing in Farmers – The Impacts of Farmer Field Schools in Relation to Integrated Pest Management – A Reply, World Development 36(10):2107-2108.

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Full Length Research Paper

On-Farm Demonstration of Improved Varieties of Faba bean (*Vicia faba*L.) in Gemechis, Chiro and Tullo Districts of West Hararghe Zone, Oromia National Regional State of Ethiopia

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The experiment was carried out in Gemechis, Chiro and Tulo districts of West Hararghe Zone with the objectives of enhancing production and productivity of faba bean on farmers' fields and to improve linkage among stakeholders and create awareness on improved faba bean varieties. Three kebeles were selected purposively based on faba bean production potential. Accordingly, Walenso Defo kebele from Gemechis, Arbarakate from Chiro district, and Terkanfata kebele from Tulo district were selected. Seven farmers and one Farmers Training Center were included participated depending on their interest to the technology, managing the experiment, have appropriate land for the experiment and taking the risk of experiment. Two improved varieties namely Hachalu and Tumsa with local variety were shown and evaluated. The experiment was demonstrated on 100 m^2 demonstration plots and DAP 100 kg/ha at the time of sowing applied to each demonstration plot with recommended seed rate. Both quantitative and qualitative data was collected through observation, group discussion on field day and data recording sheet. Descriptive statistics like mean and tabulation were used to analyse the crop performance concerning yield of the experiment harvested from demonstration plot. Improved varieties along with local variety were also analysed through independent t-statistics. While qualitative data were analysed through simple ranking and summarization. Partial budget analysis was also used to analyse the economic benefit gained from the experiment. The result of the study indicated that Hachalu was ranked first in terms of yield, seed color and disease resistance. As discussed from partial budget analysis, Hachalu variety has more economic advantage than both Tumsa and local variety. Therefore, Hachalu variety was recommended for further popularization and scaling up in study area and similar agro ecology.

Key words: Faba bean, demonstration, varieties, yield advantage.

INTRODUCTION

Pulses are important food crops due to their high protein and essential amino acid content. The seeds of pulse crops are typically made up of 20 to 25% protein as compared to 6 to 10% protein content in major cereal crops. Pulses are also rich in dietary fiber and usually have only small amounts of oil. The protein of pulse

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seeds is high in the amino acids lysine and methionine, making pulses nutritionally complementary to cereals, which are deficient in these two essential amino acids. Pulses are the main source of protein in the diet of vegetarians, and feature prominently in the traditional cuisine of virtually every region of the globe (Sitou and Mywish, 2011).

The main faba bean producers are China (1.65 Mt), Ethiopia (0.61 Mt), France (0.44 Mt), Egypt (0.29 Mt) and Australia (0.19 Mt) (FAOSTAT, 2009). It is a hardy crop and can withstand rough climates, especially cold ones. China is the largest producer of faba beans which gives East Asia the largest share in world total area harvested (38%) and total production (42%). The next largest faba bean growing regions are sub Saharan Africa and MENA, each covering 19 and 18% of world area, respectively (Sitou and Mywish, 2011). Faba bean is a valuable protein-rich food that provides a large sector of the human populations in developing countries with a cheap protein source, thus partly compensating for the large deficiency in animal protein sources. It is one of the earliest domesticated food legumes and is now cultivated on large areas in many countries due to its high nutritive value in terms of energy and protein contents (24 to 30%) (Sahile et al., 2009).

Grain legumes occupy about 13% of cultivated land in Ethiopia and their contribution to agricultural value addition is around 10%. Pulses are the third-largest export crop of Ethiopia after coffee and sesame, contributing USD 90 million to export earnings in 2007/2008 (IFPRI, 2010). In total, the area cultivated with the selected legumes is more than 1 million hectares but production/ha is low and far below the potential production (USAID, 2011). Common bean and chickpea are major legumes, with both a production of more than 200,000 MT grain. On the world market, Ethiopia ranks 6th in chickpea production and 14th in production of common bean. Among African countries, Ethiopia is the largest producer of both chickpea and common bean (ICRISAT, 2011).

In Ethiopia, faba bean is the crop that has the highest absolute production and the largest area cultivated. Ethiopia is also the second largest producer of faba bean in the world after China (Ronner and Giller, 2012). Faba bean is the most important pulse crop in terms of area coverage and total annual production in Ethiopia. This crop has manifold advantages in the economic lives of the farming community in the high lands of the country. It is a source of food, feed, cash to farmers and also play significant role in soil fertility practices. However, currently its share in the countries pulse export is small. Faba bean covers 427,696.80 ha leading the pulse category in area and production (CSA, 2017). The productivity of faba bean varieties under traditional farming system is found to be around 0.7 ton/ha, which is very small. However, there is a possibility to improve the situation using improved varieties, which can give a better yield than the one's widely used now. Mechara Agricultural Research Center has conducted participatory variety selection of different improved varieties which are developed by different research centers. Therefore, McARC recommended two varieties namely, Hacalu and Tumsa for further promotion on farmers' fields. Thus, this study was initiated to enhance production and productivity of faba bean on farmers' fields and to improve linkage among stakeholders and create awareness on improved faba bean varieties.

METHODOLOGY

Description of the study area

The study was conducted in Chiro, Gemechis and Tulo districts of the West Hararghe zone of the Oromia National Regional State. Chiro which is the capital town of the zone, is located in West Hararghe zone of the Oromia national regional state at about 324 km east of Finfine, the capital city of Oromia regional national state. Normally, the district is divided into three major agro-ecological zones. These are lowland with 22 kebeles, mid land with 13 kebeles and highland altitude with 4 kebeles. The district bordered with Miesso in the north, Gemmechis in the south, Guba-koricha in the west and Tulo in the east. The district is mainly characterized as steep slopes and mountains with rugged topography, which is highly vulnerable to erosion problems (Figure 1). It has a maximum and minimum temperature of 23 and 12°C, respectively and the maximum and minimum rainfall of 1800 and 900 mm, respectively (Gosa, 2016). Rainfall type is bimodal and erratic in nature. Main rainy season is from June to September for the highland and midland areas and from March to April for the lowland. Short rainy season is from March to May for highland and midland and for that of lowland around July. The amount of the rainfall is relatively adequate in the highland and midland than the lowland.

Gemechis district is one of the fourteen districts in West Hararghe zone, which is located at 343 km east of Addis Ababa and about 17 km south of Chiro, which is the capital town of the zone. The district is situated at the coordinate between 8° 40'0" and 9° 04'0" N and 4° 50'0" and 41° 12'0" E. The soil of the study area was dominantly loamy soil (Desalegn et al., 2016). Gemechis town is located on the top of a hill and its climate is 70% cold and cloudy. The woreda has many small cities located at 20 to 45 miles away from each other. Sogid, Sire, Metadhab, and Degaga are the major ones. Transportation for commuting is a major problem of the woreda (Encyclopedia).

Tulo district has 45,670 ha of land area and located at 370 km southeast of Addis Ababa. The altitude of the district is 1750 m above sea level with mean annual rainfall of 1850 ml and mean annual temperature of 23°C. The production system is mixed type in which extensive husbandry management of livestock have been practiced (Tulu and Lelisa, 2016).

Farmers and site selection

The activity was conducted for one year in Gemechis, Chiro and Tulo districts of West Hararghe zone. Walenso Defo *kebele* from Gemechis district, Arbarakate *kebele* from Chiro district and Terkanfata *kebele* from Tulo district were purposively selected depending on their faba bean production potential. Seven farmers and One FTC were selected based on their interest to the technology, model farmers, managing the experiment and have appropriate land for the experiment.

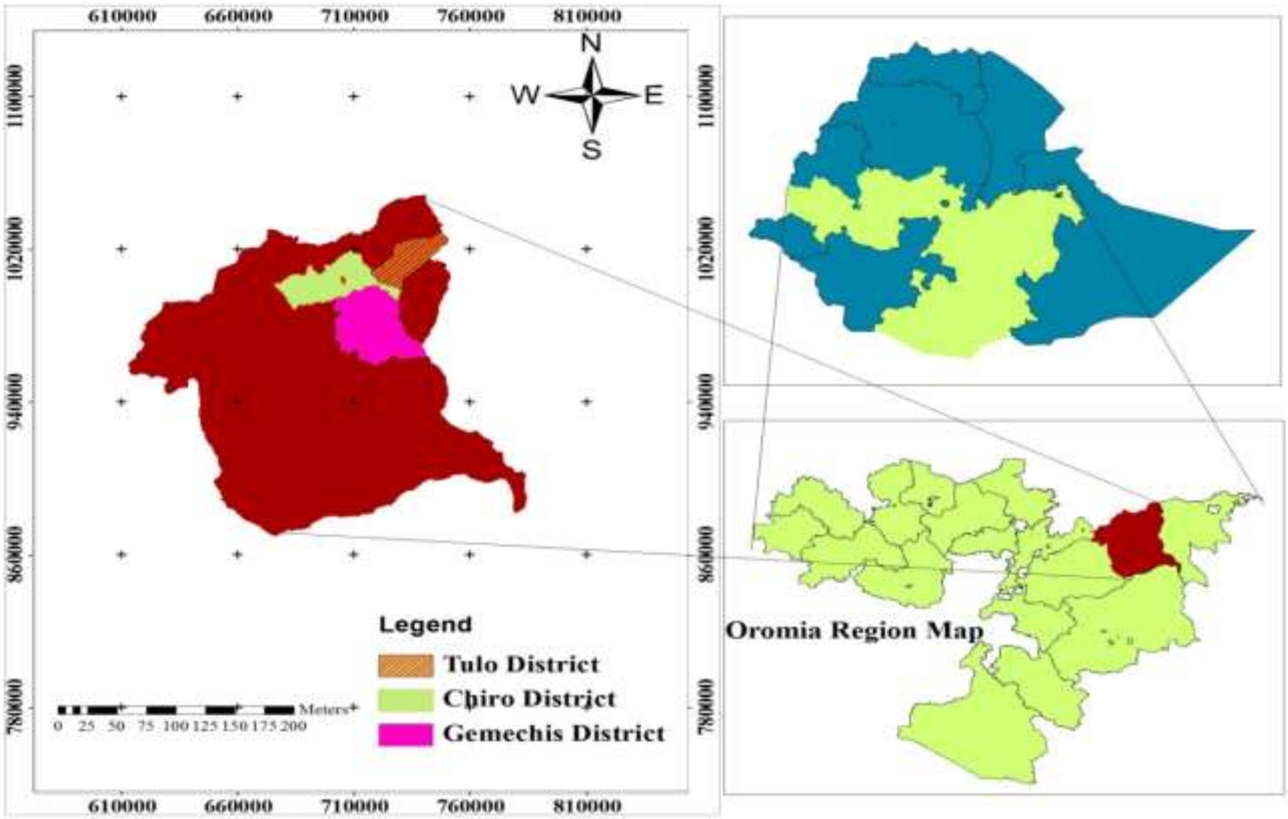

Figure 1. Map of study area.

Experimental design (Single plot side by side design)

Two improved faba bean varieties namely Hachalu and Tumsa were demonstrated and evaluated with local variety. The experiment was demonstrated on 10 m × 10 m (100 m^2) demonstration plots and DAP 100 kg/ha at the time of sowing applied to each demonstration plot with recommended seed rate. Row sowing methods were applied with 10 cm between plant and 40 cm between rows. The required management like weeding, thinning out application at the growing stage was done.

Data collection methods

Both quantitative and qualitative data were collected through observation, group discussion on field day and data recording sheet. Data like farmer preference on disease and pests resistance, early maturity, drought tolerant, grain color, and yield data were collected through the prepared data collection sheet/record sheet by organizing mini field day and observation on farmer's field.

Data analysis

Descriptive statistics like mean and tabulation were used to analyse the crop performance concerning yield and yield components of the experiment harvested from demonstration plot. Improved varieties along with local variety were also analysed through paired t-statistics. While qualitative data were analysed through simple ranking and summarization. Partial budget analysis was also used to analyse the economic benefit gained from the experiment

RESULTS AND DISCUSSION

Crop performance on the farmer's field

The mean yield of Hachalu and Tumsa were 20.14 and 16.45 qt/ha with standard deviation of 17.88 and 12.20, respectively and the mean and standard deviation of the local variety were 19.83 and 16.73, respectively (Table 2). The mean yield of Hachalu variety was greater than both Tumsa and local varieties.

Yield advantage of the crop Varieties

Yield difference of Hachalu from local is 20.14 - 19.83 = 0.31

Yield difference of Tumsa from local is 16.45 - 19.83 = -3.38

Percent of yield increase over local is given by yield of improved variety minus yield of local variety divided by yield of local variety and multiply by 100.

Thus, percent of yield increase of Hachalu over local check is (0.31 / 19.83) × 100 = 1.56%

The result in Table 2 indicated that maximum yield were

Table 1. Shows experiment location, trials and varieties used.

Location	*Kebele*	No. of trail farmers	Varieties	Area covered (m^2)
Gemechis	Walenso Defo	3	Hachalu, Tumsa and Local varieties	300
Chiro	Arbarakate	3	Hachalu, Tumsa and Local varieties	300
Tulo	Terkanfata	2	Hachalu, Tumsa and Local varieties	200
Total	-	8	-	800

Source: Own Computation (2017).

Table 2. Yield summary of the faba bean varieties on farmers field (N=8).

Variety	Min.	Max.	Sum	Mean (qt/ha)	Std. Dev.
Hachalu	7.02	51.47	161.09	20.14	17.88
Tumsa	5.47	39.44	131.63	16.45	12.20
Local	5.52	49.91	158.63	19.83	16.73

Table 3. Statistical comparison of faba bean varieties (N=8).

t-test	Hachalu and Tumsa	Hachalu and Local	Tumsa and Local
Difference	-3.690	-0.310	3.380
Standard error	7.653	8.657	7.321
95% CI	-20.1038 to 12.7238	-18.8780 to 18.2580	-12.3212 to 19.0812
t-statistic	-0.482	-0.036	0.462
DF	14	14	14
Significance level	P = 0.6371	P = 0.9719	P = 0.6514

scored from Hachalu variety (51.47 qt/ha). Yield increased in percentage of improved variety of Hachalu over local check were 1.56%. This indicated that using improved variety of Hachalu were relatively more productive than local variety with the same area and management. The minimum yield was scored due to insufficient rainfall encountered in the area cropping season 2016. It was concluded that Hachalu variety has more yield advantage than Tumsa and local variety.

Statistical implication of experiments

There is no statistical difference between the yield of improved varieties and local check on farmer's field at 5% significance level (Table 3).

Capacity building and experiment evaluation

Mini field day was organized on faba bean technology with consideration of different stakeholders (Farmers, DAs and Experts of the district) at Arbarakate kebele of Chiro district. Thus, 26 male and 5 female households participated on field day organized at Chiro (Arbarakate PA). Extension personnel (one male) and three male development agents also participated with farmers to evaluate the experiment. For variety selection on field, researcher has divided farmers into three groups with combination of DAs and extension personnel (SMS). The group of farmers and DAs led by SMS put their own criteria to evaluate the technology by observing on field. Each group has given his own value to the experiment on demonstration plot (Figure 2). As shown in Table 4, the values given by group of farmers were summarized and its average was ranked by their participation.

Table 4 shows that farmers, development agents and experts have selected Hachalu and Tumsa varieties as the first and second, respectively based on overall averages of selection criteria.

Economic benefit gained

Costs incurred and benefit gained from the project is discussed in detail as follows. The result of Tables 5 and 6 indicated that maximum gross margin (30,204.38 Birr/ha) and net benefit of (14,394 Birr/ha) were gained from Hachalu variety with same inputs and costs incurred to it with Tumsa during the project life time. Minimum gross margin (24680.63 Birr/ha) and least net benefit (8,871 Birr/ha) were recorded from Tumsa variety (Tables

Figure 2. Technology evaluation and selection on field day prepared at Chiro district.

Table 4. Participants preference of the variety selection on mini field day.

Variety	PE	SS	NB	SS	DR	DrR	EM	PH	TS	Rank
Hachalu	4.7	4.3	4	4.17	4.3	4.3	3.5	4.5	33.77	1st
Tumsa	3.5	3	3.7	3.5	4.3	4.7	3.5	3.7	29.9	2nd
Local	3.58	4	4.4	4.3	2.5	2.83	4.5	3.7	29.81	3rd

5=Excellent, 4=very good, 3=good, 2=Fair, 1=Poor. PE=Plant establishment, SS=stem strength, NB=number of branches, SS=seed size, DsR= disease resistance, DrR=drought resistance, EM=early maturity, PH=plant height and TS= total score.
Source: Own Result (2016).

Table 5. Cost incurred to the projects.

Variety	Cost of inputs (ETB)				
	Plough	Sowing	Seed	Fertilizer	Total
Hachalu	6670	5340	2500	1300	15,810
Tumsa	6670	5340	2500	1300	15,810
Local	6670	5340	2300	1300	15,610

Source: Our Result (2017).

5 and 6). It can be concluded that using improved variety of faba bean (Hachalu) was economically profitable than Tumsa variety at the study area.

CONCLUSIONS AND RECOMMENDATIONS

From the result of the study Hachalu variety have maximum mean yield and 1.56% more yield advantage than local variety. From the demonstrated varieties, Hachalu and Tumsa varieties were selected based on overall averages of selection criteria. From the result of the study, there was yield advantage of Hachalu over Tumsa and local check. There is no statistical difference between the yield of improved varieties and local check on farmer's field at 5% significance level. Even if there is no significant difference between mean yield of improved varieties and local check, Hachalu variety has relatively more yield advantage than local variety. From partial budget analysis, Hachalu variety has more economic

Table 6. Net benefit gained from the project.

Variety	Average yield (kg/ha)	Market price of output Birr/kg	TR (P*Q)	TC	Net benefit
Hachalu	2013.625	15	30,204.38	15,810	14,394
Tumsa	1645.375	15	24,680.63	15,810	8,871
Local	1982.875	15	29,743.13	15,610	14,133

Source: Our Result (2017).

advantage than local variety. Therefore, Hachalu variety was recommended for further scaling up and popularization in the study area and similar agro ecology by concerning body.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

REFERENCES

Central Statistics Agency (CSA) (2017). The Federal Democratic Republic of Ethiopia Central Statistical Agency Agricultural Sample Survey. Report on Land Utilization. Statistical Bulletine Vol. IV, Addis Abeba, Ethiopia.

Desalegn M, Zebene A (2016). Assessment of farmers' management activities on scattered trees on crop fields at Gemechis district, West Hararge Zone, Oromia, Ethiopia.International Journal of Agriculture 1:1-15. Mechara Agricultural Research Center, Mechara, Ethiopia.

Ethiopian Export Promotion Agency (EEPA) (2012). Ethiopian Pulse Profile; Product Development & Market Research Directorate, May 2012.

Gosa A (2016). Characterization and Analysis of Farming System in Chiro District, West Hararghe Zone. Journal of Natural Sciences Research Vol.6, No.19. Mechara Agricultural Research Center, Mechara, Ethiopia.

Food and Agriculture Organization of the United Nations (FAOSTAT) (2009). Food and Agriculture Organization. http://faostat.fao.org/site/567/default ancor. United Nations

International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) (2011). Bulletin of Tropical Legumes, August 2011.

International Food Policy Research Institute (IFPRI) (2010). Pulses Value Chain Potential in Ethiopia: Constraints and opportunities for enhancing exports. Pulses Diagnostics. IFPRI.

Ronner E, Giller KE (2012). Background Information on Agronomy, Farming Systems and ongoing Projects on Grain Legumes in Ethiopia.

Tulu D, Lelisa K (2016). A Study on Major Gastro-Intestinal Helminths Parasites of cattle in Tulo District, West Hararghe Zone, South-Eastern Ethiopia. Journal of Veterinary Medicine and Animal Health 10(7):165-172.

Sahile S, Chemeda F, Sakhuja PK, Seid A (2009). Evaluation of Pathogenic Isolates in Ethiopia for the Control of Chocolate Spot in Faba Bean. African Crop Science Journal 17(4):187-197.

Sitou A, Mywish M (2011). Global and Regional Trends in Production, Trade and Consumption of Food Legume Crops;Department of Agricultural, Food and Resource Economics of Michigan State University,Report Submitted to SPIA, March 27, 2011.

United States Agency for International Development (USAID) (2011). AGP-AMDe First Annual Strategy and Work Plan.

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