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Effects of Cluster Farming and Crop Technology Dissemination on the Livelihoods of Farmers: The Case Chobi District West Shewa Zone of Oromia, Ethiopia

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Abstract: Enhancing productivity among smallholder farmers is widely perceived as a key strategy that is achieved through promoting an agricultural cluster farming approach. The adoption of improved agricultural production technologies is central to increasing production and productivity. This study was conducted in the Chobi district of the West Shewa zone with the objectives of this study to introduce improved crop technologies and to enhance crop productivity. In the Chobi district, six types of crop technologies were promoted in the 2019/20 production season. The district is a previously unaddressed area in improved crop production technology and a total of 234 farmers (197 male and 37 female) benefited with a total of 68.97 quintals disseminated improved seed. In the information-sharing field days held a total of 499 stakeholders participated. From the 13 improved varieties that cover 164.3 hectares of land, a total output of 3753 quintals of grain was harvested. The yield effect of different crop varieties in the Chobi district scores higher yield in barley 32 Qt/ha and maize 80 Qt/ha than the national and regional average. The yield from linseed is 11 Qt/ha higher than the national average and the productivity of potato 120 Qt/ha is higher than the regional mean yield. Therefore, the study recommends a cluster farming with a full crop production package is crucial to enhance the income gains of smallholder farmers and the concerned stakeholders have to engage in the dissemination of climate-smart and resilient crop production technologies and extension services.

Keywords: Cluster farming, Crop production technology, Adoption, Chobi, Yield.

Research Paper

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1. INTRODUCTION

Agriculture in Ethiopia continues to be a vital sector and is largely dominated by smallholder farmers. Ethiopian smallholder farmers grow various crops for their own consumption and/ or economic benefits. Grain crops are mainly used for consumption and as a source of income in many households. The report on the area and production of major crops showed that the grain crop took 12.19 mill hectares and contributed about 327.9 mill quintals of production (ESS, 2021/22). Cluster farming is explained as the use of geographically interconnected farms or plots of land for selected crops with a focus on market orientation. It is an agricultural cultivation practice where smallholder farmers who lack sufficient production resources for modern production technologies can use modern crop production packages through physically grouped farms (Dejene Mamo, 2019).

Cluster-based farming allows farmers to share production resources and joint marketing of their crop produce with the advantage of collective bargaining which enhances the income gains of farmers operating in clusters. Ethiopian governments and development organizations are increasingly encouraging agricultural clusters to increase smallholders' incomes and ensure comprehensive rural development (Martin and Guyo, 2023). Crop production packages in cluster farming systems include seeds, fertilizers, agrochemicals, irrigation, mechanization, and advisory services. The agricultural extension system has to improve the efficiency and effectiveness of the extension service provision by employing different encouraging rewarding and sanctions activities at the grassroots level and being familiar with different actors can improve awareness about the change and enable farmers to access its benefits (Mekonnen *et al.,* 2020). Different cropping systems and production situations can influence the technology adoption and production intensity of crops. The effects of adoption may be restricted to certain production situations, locations, and seasons and the adoption of technologies requires an understanding of how these interrelated factors lead to production.

Despite the suitability of the climatic conditions for crop production smallholder farmers are still food insecure. Agricultural research institutions introduced to the farming communities many improved crop varieties in different agro-ecology but still most of the farmers are exploiting their own saved seed. To ensure sustainable agricultural production, attention must be paid to the seed improvement and seed system (Solomon *et al.*, 2021). Therefore, considering the high potential of the study area for crop production the introduction of crop technology is vital. Hence, this study aims to introduce an improved crop technology to the Chobi district which is a previously unaddressed area, and to enhance the crop productivity and livelihoods of farmers.

2. RESEARCH METHODOLOGY

2.1. Description of the study areas

This study was conducted in Chobi districts, West Shewa zone of the Oromia region, Ethiopia. Chobi district is one of the newly established districts of the West Shewa zone and is located 138 km from the capital city Addis Ababa. The district has eleven rural kebeles and one rural town. The total population size of the district was 65,482 out of which 32,085 were male and 33,397 were female. The agroecological zone of the district comprises highland 31.7%, midland 24.3%, and lowland 43.9% with an altitude ranging from 1000-2600 m.a.s.l. The district is characterized by a mixed farming system i.e. crop-livestock mixed farming system and the major crops grown in the district are cereals, horticultural crops, and oil crops.

2.2. Types of data and methods of data collection

This study used both primary and secondary data to compute the yield advantage and effect of cluster farming. Here, quantitative and qualitative data were collected using appropriate data collection methods: Agronomic data, grain yield, and technological needs assessment were also evaluated. Basic information was collected from farmers participating in the cluster using a semi-structured questionnaire. Secondary data from both published and unpublished documents were used in the study.

2.3. Procedures to select participant farmers

An interdisciplinary team of researchers, district office experts, and development agents were involved in selecting a participant farmer's suitable location for cluster farming and crop technology dissemination. Then, eleven kebeles administrations suitable for the production of selected crops were purposively selected in the district. Finally, farmers who were willing to participate in cluster farming were selected.

2.4. Methods of data analysis

Descriptive statistical tools were used as data analysis methods to process the data collected from farmers in the study areas. From descriptive statistical tools mean values were used to examine the data collected and tables and graphs were used to display the research output.

3. RESULT AND DISCUSSION

3.1 Training provided for the cluster farming participants

For the appropriate promotion and dissemination of the selected crop technology training is essential to build the capacity of farmers, development workers, and agricultural experts. At the implementation of this activity 234 farmers, 7 development workers, 8 agricultural experts, and 1 government official were trained on the operation of cluster farming, the agronomic practices, and the entire crop production package on the selected crop types.

3.2 Dissemination of crop production technology in Chobi districts

The activity was conducted at Chobi districts to evaluate the performance of improved technologies in the 2019/20 cropping season about six different crop technologies were disseminated (*tef*, highland maize**,** food barley, malt barley, linseed, and potato) varieties along with their management practices under farmer's circumstances. In the 2019/20 cropping season a total of 68.97 quintals of improved seed were distributed to the selected farmers and about 164.3 hectares of land was covered (Table 1). In these crop technologies, a total of 234 farmers (197 male and 37 female) participated in cluster farming in the study area.

Table 1: Technologies disseminated in cluster farming with the support of the AGP-II project

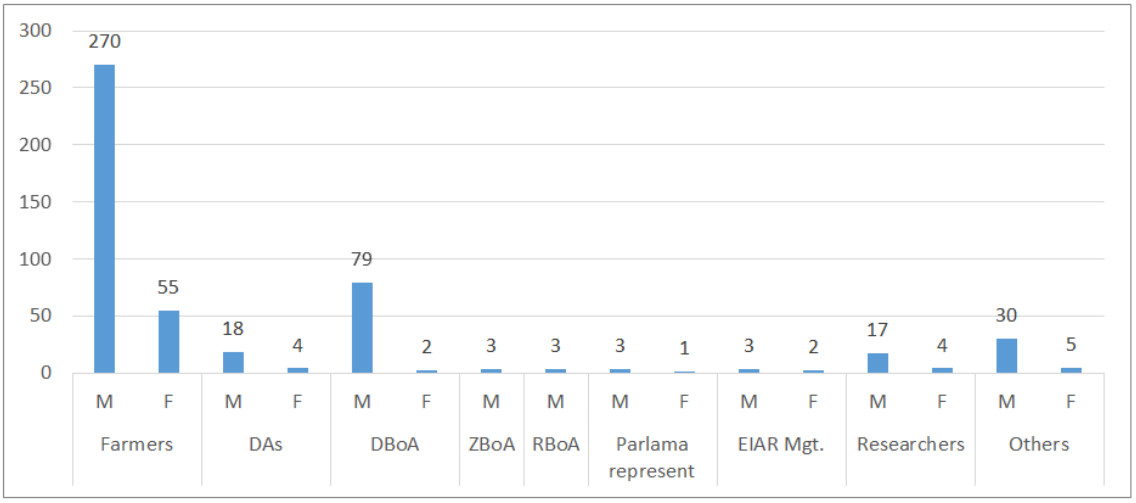
Crop	Varieties	Amount of seed dist. (Qt)	Area covered (Ha)	Beneficiaries	
				Male	Female
Tef	Kuncho, Kora, boset, dagem,	17.85	119	75	21
Highland maize	BH546, BH547, BH 660	2.52	10.1	35	5
Food barley	HB 1307	19	18.2	42	7
Malt barley	IBON	6.6	4	6	1
Linseed	Belay 96, Kulumsa	3	12	38	3
Potato	Gudene, Belete,	20	1	1	0
Total		68.97	164.3	197	37

Source: Own computation result

All agricultural inputs including improved seeds, fertilizers, fungicides, insecticides, bio-fertilizers, and lime technologies were used in the cluster farming. These inputs applied except lime ware was supplied by the Ethiopian Institute of Agricultural Research.

3.3 Field days conducted in the Chobi district

To show the crop technologies for the large communities' interactive field days were organized at the crop maturity stages and stakeholders participated. The implementation of cluster farming was visited by different stakeholders. The growth stands of the technologies were evaluated focusing on agronomics performance and yield by a total participant of 499 (429 male and 73 female) including farmers, DAs, agricultural experts, administrators, higher officials, parliament representatives, institution and project leaders like EIAR and AGP-II and development partners, and researchers (Figure 1). From the discussion, farmers explain that they are happy with the crop technology they got from the Ethiopian Institute of Agricultural Research, and the district is addressed by improved crop production technology this year and this effort has to be strengthened to enhance productivity and livelihoods of smallholder farmers.



Graph 1: Field day participants in the Chobi district
Source: Computation result

3.3 Effects of Cluster Farming on Crop Yield and the Livelihoods of Farmers

The approach of cluster farming is increasing in many parts of Ethiopia and has contributed to better adoption of production inputs (seeds, fertilizers, chemicals, etc.) and extension advice. The cluster farming system is now served with increasing extension and water infrastructure which support agricultural development, and intensification, such as increased use of organic fertilizers and improved seeds. In most parts of the country oxen are the sole providers of draught power for tillage, while cattle and other livestock supply manure for soil fertility maintenance and fuel, there is strong interdependence between the crop and livestock components in the farming system. Chobi district is far from all-weather roads and previously distribution of adaptable crop verities has yet not been done through a formal extension system. This study is an eye breaking that disseminates thirteen improved varieties of *tef*, highland maize, food barley, malt barley, linseed, and potato. From the total cultivated areas of 164.3 hectares, a total of 3,753 quintals of output was harvested.

As observed from Table 2 in the cultivated crop there is an increment in productivity. The average yield recorded from *tef* was 16.42 Qt/ha. The mean grain yield result of highland maize recorded in the district was 80 Qt/ha. The third crop technology demonstrated was food barley and malt barley variety HB 1307 and IBON. The average grain yield of food and malt barley was 34 Qt/ha and 30 Qt/ha, respectively. Dawit (2022) reported as compared to the local varieties the yield increment was observed from the adoption of improved varieties. The fourth crop cultivated in the district was linseed was the fifth crop technology promoted by youths organized in groups to produce improved crop varieties. The average yield harvested from linseed was 11 Qt/ha. Finally, from the introduced two improved potato varieties (Gudene and Belete) average yield of 120 Qt/ha was harvested (Table 2). This yield per hectare is an indicator that the district has a potential for crop production and a need to introduce adaptable crop varieties into the areas. According to Araya and Sung-Kyu (2019), cluster farming through its benefit in acquiring and using full packages, proper inputs, and agronomic practices improves productivity. The yield achieved by agricultural cluster participants in the Chobi district is an encouraging result and lesson for the rest of the farming communities that an increment of income and improvement of livelihoods can be achieved through using improved crop production technologies.

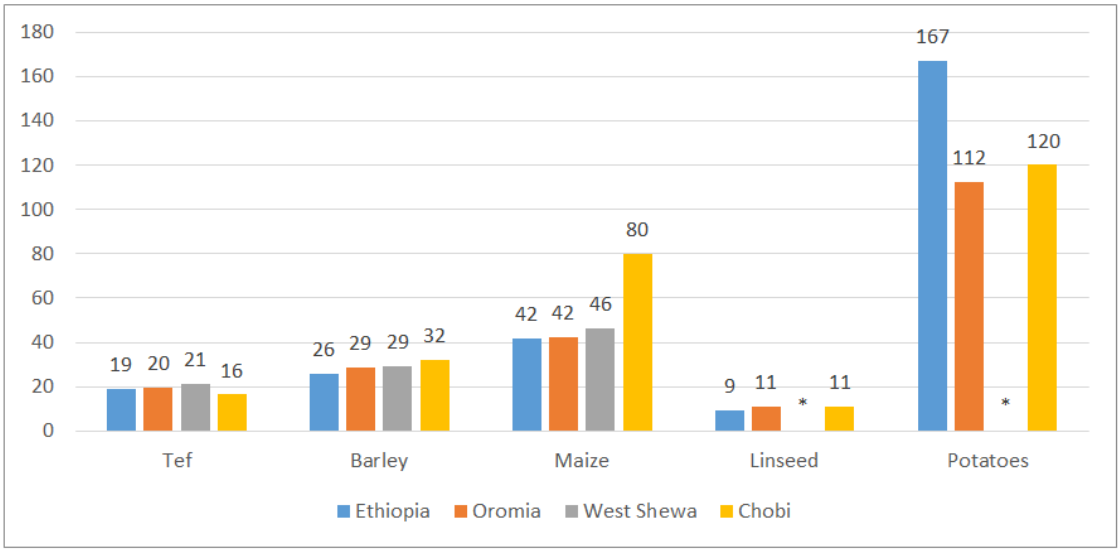
Table 2: The yields harvested from different crop varieties in the Chobi district

Crop	Variety	Area ha.	Mean grain yield qt/ha	Total seed produced (Qt)
Tef	Kuncho, Kora, boset, dagem,	119	16.42	1954
Highland maize	BH546, BH547, BH 660	10.1	80	808
Food barley	HB 1307	18.2	34	619
Malt barley	IBON	4	30	120
Linseed	Belay 96, Kulumsa	12	11	132
Potato	Gudene, Belete	1	120	120
Total		**164.3**		**3753**

Source: Computation result

For the success of cluster farming different crop rotations such as legume-cereals, potato-cereals, or oil crops-cereals have been widely practiced in the rain-fed production system for the various known advantages including improving soil fertility by fixing atmospheric nitrogen, enhancing water use efficiency (WUE), diversification, and breaking the cycle of weeds, insect pests, and diseases (Shiferaw 2013, and Braun *et al.*, 2010). The studies by Getachew *et al.*, (2023) showed that the average production per household in the cluster farming area is by far greater than the national average production. The proportion of the mean wheat yield of the cluster participants' households was 64.7 quintals, whereas the mean wheat yield of non-cluster participants was 50.1 quintals.

In the Chobi district, the outputs from cluster farming had an amazing effect on the average yield of different crop types. The ESS (2021/22), data revealed the effect of cluster farming in Chobi district is encouraging compared to the national and regional average yields. Out of the crop technologies disseminated the district yields higher than the national and regional mean output in barley 32 Qt/ha, and maize 80 Qt/ha (Graph 2). The district is also better in productivity of linseed than the national average and better in potato production than the regional mean yield which is 11 Qt/ha and 120 Qt/ha, respectively. The yield obtained through the use of improved crop technology through cluster farming was an engine for the improvement of farmers' livelihood in the study areas.



Graph 2: Average yield of different field crops
Source: Own computation result

The studies by Regasa and Degye, 2019 and Leta *et al.*, 2018 stated that the adoption of new farming practices had a favorable effect on smallholders' asset holdings and the results of the research indicate that smallholder who participates in cluster farming have better asset holding status which is worth of ETB 8374.29 (about 155.37 dollars) as compared to non-participants. According to Bozarth *et al.*, (2007) and Niu (2009), clustering increases in the cluster members' productivity. Based on the findings, the study recommends that strengthening and scaling cluster farming will have a significant role in improving yield. Jr Tabe-Ojong, *et al.*, (2023) find that the income gained from agro-clusters reduces poverty by about 2.0 percent. Getachew *et al.*, 2023 found the positive effect of participation in cluster farming improved smallholders' income by ETB 8374.29 (155.37 $) for cluster member households as compared to non-participating households.

4. CONCLUSIONS AND RECOMMENDATIONS

An agricultural cluster is a farming system implemented as part of employing a full crop production package. The adoption of improved agricultural production technologies is central to increasing

production and productivity. This research was done with the objectives of disseminating improved crop technologies in the Chobi district which is an unaddressed area in improved crop production technology and enhancing productivity and livelihoods. In the implementation of this activity, a total of 234 farmers, 7 development workers, 8 agricultural experts, and 1 government official were trained. The six crop technologies disseminated are (*tef*, highland maize**,** food barley, malt barley, linseed, and potato) along with their management practices. In the 2019/20 production season, a total of 68.97 quintals of improved seed were distributed to the selected farmers, and about 164.3 hectares of land was covered. In this cluster farming activity, a total of 234 farmers (197 male and 37 female) were benefited in the study area. To increase the visibility of the technologies an interactive field day was organized at the crop maturity stages and a total of 499 stakeholders participated.

In cluster farming areas the 13 improved varieties distributed to farmers covers a cultivated area of 164.3 hectares and a total of 3753 quintals of grain output was harvested. The yield effect of different crops in the Chobi district is encouraging as compared to the national and regional average yield. Out of the crop technologies disseminated the district scored a higher yield in barley 32 Qt/ha and maize 80 Qt/ha than the national and regional yield. The yield of linseed is 11 Qt/ha higher than the national average and the productivity of potato 120 Qt/ha is higher than the regional mean yield. Therefore, the study recommends that future growth of crop production needs to come from the adoption of climate-smart and resilient crop production technologies and the quiet application the advisory services.

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