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Improved Highland Sorghum on-farm demonstration using cluster farming approach at Chiro districts of West Harerghe Zone, Eastern Ethiopia

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ABSTRACT

Aim: The main objective of this study was on-farm demonstration of high yielding improved highland sorghum variety through cluster farming approach and to assess farmers' feedback**.**
Materials and Methods: It was executed at Chiro district located in West Hararghe Zone in main cropping season of 2020. Regular visits and field days were conducted to provide for interaction among researchers, extension workers and farmers. During life span of the activity data like yield of the crop and farmers perceptions towards the crop and cluster farming approach were collected through supervision and by organizing farmers' field day.
Results: Accordingly, both clustered and those invited uncluster households jointly showed special interest to high grain yield, large grain size and resistance to different fungal and bacterial diseases, brown seed color and early maturing characters of improved sorghum Jiru variety.
Conclusion: It was concluded that disseminate the preferred improved highland sorghum variety (Jiru) technologies to a large number of neighboring district farmers of studied area through cluster farming approach to enhance diffusion and adoption of the variety to increase sorghum production and secure food self sufficiency.

Keywords: Cluster Farming, Demonstration, Ethiopia, Highland sorghum variety.

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Introduction

Sorghum bicolor (L.) Moench is predominantly a self-pollinating C4 crop belonging to the family Poaceae. Sorghum is the fifth most important cereal crop in the world (FAOSTAT, 2018). In Ethiopia, it ranks third in area coverage after maize and teff and fourth in total grain production preceded by maize, teff and wheat. In the country sorghum is produced by 5 million smallholder farmers with an estimated total grain production of 5.2 million tonnes, 52,655,800.59 quintals, from an estimated area of 1,828,182.49 hectares of land. This provides a national average grain yield of around 2.8 t ha^{-1}. Sorghum covers 14.21% of the total area allocated to grain crop production (cereals, pulses, and oil crops) and 15.71% of the area covered by cereals in Ethiopia (CSA,2019/20).

Sorghum is the first leading food crop produced in large amount in Chiro district. The reason for high production of this crop is; it is used both for human and animal consumption (stalk and leaf), for food, fodder, fuel consumption and construction purpose and are widely adaptable to weather condition of the area (Bediru and Belete, 2020).

A challenge of sorghum production in the highland and intermediate parts of the country is lack of tolerant sorghum varieties to diseases, stable and adaptable varieties, poor adoption of improved varieties by farmers, due to poor farmers participatory during selection (on-station) and inadequate knowledge of farmers about the varieties. To overcome the challenges of both local adaptation and local farmers' end use the development of locally adapted and farmers preferred improved sorghum varieties to a particular environment is one solution (Begna *et al*., 2020).

The cluster farming approach aims to stimulate economic growth by increasing the benefits to farmers of being located in a certain geographical region, where 30-200 farmers group together on adjacent land to farm as one on shared interests and towards a common goal. These groups of farmers are required to adopt the latest full-package farm recommendations including use of improved seeds, fertilizer application and other farming best-practices (Addisuand Dawit,2021).

Many findings have been reported on the performance of the released highland sorghum varieties in different agro-ecologies by including farmers' traits of interest (Zigale *et al*., 2020, Begna *et al*., 2020) and they reported high yielding and adaptable as well as farmers' preferred , based on yield, plant biomass, head compactness, seed size, and seed color, Jiru sorghum variety was identified and recommended for Chiro and its similar agroecologies of the country.

Therefore, this study was conducted on major sorghum growing areas of Western Harerghea Zone, particularly, in Chiro with the objective of on-farm demonstrating best high yielding improved highland sorghum variety through cluster farming approach and to assess farmers' feedback to strengthen the partnership and networking with sorghum growers.

Materials and Methods

Description of the study area: The activity was carried out in Arberekete kebele of Chiro district located in West Hararghe Zone of the Oromia National Regional state at about 328 km East of Addis Ababa. The area is characteried by bi-modal type of rain fall. Arberekete is located at $09^{0}05'$N latitude and $40^{0}88'$E longitude at an altitude of 2227m.a.s.l. and where the highland sorghum is intensively and extensively produced by farmers. The area has the average minimum and maximum temperature of 12^{0} c and 23^{0} c respectively and receives 950 mm annual rainfall. The soil type of the experimental station is classified as black Vertisols (Gosa, 2016).

The location was purposively selected based on potential in sorghum production. It was implemented 2020main cropping season. It was conducted on 20 hectares of land and 40 farm households participated on clustered crop production. The woreda agricultural office experts and Development Agents (DA) had also taken part in the implementation process.

Experimental material, Design and Trial Management:

The trial was carried out on 20 hectares of clustered farmers field, which occupies 40 participating farmers, using Improved highland sorghum Variety, Jiru. Each farmers allocated an average of 0.5 hectare of land. During planting, the seeds were manually drilled at the seed rate of $12kgha^{-1}$and spaced 0.75m between rows. At approximately twenty-one days after planting, the seedlings were thinned to 0.25 m distance between plants. All the standard agronomic packages and fertilizer rates of 100 kgha-1 DAP was applied to the basal at the time of planting whereas 50 kgha-1 Urea was applied in the form of split application, half of which was applied together with DAP during planting and the remaining top dressed before heading at knee stage. Hand weeding was practiced as frequently as needed.

Data Collection and analysis

During life span of the activity data like yield of the crop and farmers perceptions towards the crop and cluster farming approach were collected through supervision and by organizing farmers' field day. The collected data were analyzed by using average and frequency distribution

Results and Discussion

During each visit discussions were made with the farmers and DAs right on the trial field in order to jointly evaluate the performance of the varieties on the field. During the visit both farmer's and DAs' data recording format were checked to observe how they handled the information gathering process.

Mean grain yield performance and Farmers' opinion/ perception:

The mean grain yields obtained from clustered farmers of Jiru sorghum variety was from 6000kg/hr to 8000kg/ha and it took from 170 to 980 days to mature. Based on average grain yield, large grain size and resistance to different fungal and bacterial diseases performance, farmers' accepted Jiru as the best variety and showed special interest and promised to use for their future production.

Proportion of sampled households:

The data was collected from the Chiro district of the West Harerghea zone, where 70 sampled

households were interviewed. The data had revealed 57.14% (n=40) households participated in cluster crop production while the remaining 42.86%(n=30) households were not invited house holds (Table 1). Tariku (2021) also advocated similar findings to the study.

Table 1**:** Sampled households participated on interview.

House Hold Participated in Cluster production	**Frequency**	**Percent (%)**
Yes	40	57.14
No	30	42.86
Total	70	100

Many farmers were participated both clustered and those invited uncluster households allowed to give their feedback about the variety and the cluster crop production approach during farmers' field day. Both groups jointly agreed on high grain yield, large grain size, resistance to different fungal and bacterial diseases ,brown seed color and early maturing characters of Jiru variety was farmers' accepted for their future use and farmers were motivated and decided to participate on cluster farming on the studied area (Table 2). Begna T (2021) also corroborated with the findings of the study.

Table 2: overall farmers perception on the variety and clustering approach (N=70)

Traits	**HH Clustered(N=40)**		**HH Unclustered(N=30)**	
	Frequency	**Percent (%)**	**Frequency**	**Percent (%)**
High grain yield	37	92.5	25	83.3
Resistance to disease resistance	35	87.5	20	66.7
Large grain size	34	85	26	86.7
Brown seed color	33	82.5	27	90
earliness	38	95	28	93.3
Clustering importance	38	95	29	96.7

Challenges on cluster crop production in the study areas:

Under similar agroecology augmented with similar crop production, cluster production is advantageous. During data collection, smallholder farmers were requested through the question format about challenges related to cluster crop production to raise inefficiencies of available opportunities.

Limitation of land size is the major problems of smallholder farmers, where 85.7 %(N=60) were indicated. Next, 81.4% (N=57) confirmed the problem of insufficiency extension services on market development. On the hand, 80% (N=56) of households indicated lack of market linkage to agro-processing industries. This is true that, in West Harereghe zone, almost no food-processing industries available. More importantly, 78.5%(N=55) farm house holds indicated shortage necessary inputs such as improved seed, fertilizer and chemicals. Here cluster production requires homogenous crop production; however, farm household's decision may be heterogeneous in deciding what to produce due to on time unavailability of required inputs. About 77.1% (N=54) households mentioned the insufficiency of training in sustaining cluster production system to make the program more suitable and linking to potential agro-processing industries (Table 3).

Table 3: Challenges of cluster crop production in the study areas (N=70)

Characterstics	**Frequency**	**Percent (%)**
Lack of basic inputs(improved seed, fertilizer and chemicals)	**55**	**78.5**
Lack of market linkage to agro-processing industries	**56**	**80.0**
In sufficient training in sustaining cluster production	**54**	**77.1**
Limitation of land size	**60**	**85.7**
unsuitable topography	**50**	**71.4**
Insufficience extension services on market development	**57**	**81.4.**

Conclusions

In Ethiopia, sorghum ranks third in area coverage after maize and teff and fourth in total grain production preceded by maize, teff and wheat. it is the first food crop and largely produced in West and East Hararghe zones. However, shortage of widely adapted and high yielding improved sorghum variety is one of the major bottlenecks for production and productivity of the highland areas. The improved sorghum technologies are not properly and widely addressed Eastern part of Ethiopia.

The cluster farming approach aims to stimulate economic growth by increasing the benefits to farmers by grouping together on adjacent land to farm as one on shared interests and towards a common goal which helps to adopt the latest full-package farm

recommendations including use of improved seeds, fertilizer application and other farming best-practices.

Finaly, It is recommended and better to disseminate the preferred improved highland sorghum variety (Jiru) technologies to a large number of neighboring farmers of studied area through cluster farming approach to enhance diffusion and adoption of the variety to increase sorghum production and secure food self sufficiency.

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