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Large Scale Demonstration of Irrigated Wheat Production Technologies in Bedeno District of Eastern Hararghe Zone, Oromia National Regional State, Ethiopia

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Abstract: Increasing wheat production and productivity depends on the use of improved technologies as well as producing during rainy and offseason using irrigation. The aim of this study is to promote improved varieties of wheat under irrigation in the study area. The activity was conducted at Hara Deneba kebele of Bedeno district. Farmers were selected based on their interest, land ownership, willingness to share experiences for other farmers and clustered according to their land adjacent to each other. 195 farmers were directly benefited from the technology. The number of participants on training and field day organized were 57 and 67 respectively. Ogolcho and Pavan -76 wheat varieties were used for demonstration purpose. The seed rate and urea fertilizer rate were 150kg/ha, while 100kg/ha NPS was used. Training and field day were organized to evaluate performance of the varieties and shared the lessons with different stakeholders. The average productivity of Ogolcho and Pavan-76 in quintal per hectare was 40.73 and 33.51 respectively. There was significant mean difference between Ogolcho and pavan-76 varieties in terms of mean yield in quintal per hectare at 1% significance level. The improved Ogolcho variety yield in the study area is profitable as compared to the yield potential of the Pavan-76 variety as well as locally produced wheat. Therefore; the concerned body should work on the sustainability of the recommended improved wheat variety for Bedeno and similar agro-ecologies.

Keywords: Large Scale, Irrigated Wheat, Production Technologies, Descriptive Statistics, Bedeno District

1. Introduction

The world's top three wheat producers are China, India and Russia; whereas Ethiopia is the largest wheat producer in Sub-Saharan Africa [8, 11]. Sub-Saharan Africa produced a total of 7.5 MT on a total area of 2.9 Mha accounting for 40 and 1.4 per cent of the wheat production in Africa and at global levels respectively [9]. The global annual wheat production is 731.6 million metric tons from an area of 215.87 million hectares giving an average yield of 3.39 metric tons ha^{-1} [15]. Wheat has played a fundamental role in human civilization and has contributed to improving food security at global and regional levels [16]. Wheat is a vital staple food crop in Ethiopia and since 2005 the country has been the largest producer of wheat in sub-Saharan Africa [10].

Ethiopia is the only country in sub-Saharan Africa where smallholder wheat production meets more than 70% of the national consumption demand [14]. In Ethiopia, wheat is one of the major staple and food security crop with an average annual production and productivity of 4.64 million tones and 2.73 tons' ha^{-1} respectively [7]. Numerous studies have revealed that irrigation agricultures have had positive and considerable impacts on increasing agricultural production, productivity and livelihood improvement of smallholder farmers by increasing their income [1, 4]. Regional production shares are as follows: Oromia (57.4%), Amhara (27%), South Nation Nationality and People (8.7%) and Tigray (6.2%). Wheat has great nutritional value and contains starch (60-90%), protein (11-16.5%), fat (1.5-2%), inorganic ions (1.2-2%) and vitamins [2]. In Ethiopia, wheat grain is used in the preparation of different traditional as well as modern processed food

products such as injera & other industrial processed products like pasta and macaroni [13].

Cereal production and marketing provide a source of income for millions of smallholder households, accounting for 60 percent and an average productivity of rural employment, 80 percent of total cultivated land, over 40 percent of typical household food expenditures, and more than 60 percent of total caloric intake [5]. Currently, wheat is produced mostly under rainfed conditions and with relatively low inputs [3]. The current productivity of bread wheat in Ethiopia is 3tha^{-1} [6]. This is very low as compared to world average. Since the importance of the crop and its growing import burden, the government of Ethiopia gives a high priority to promote wheat productivity and improves wheat marketing efficiency [12].

Producing wheat in the area is not commonly known both under rainfed and irrigation. In the study area farmers are producing local sorghum which takes 7-8 months to mature and maize year after year. Fedis agricultural research center takes initiative of producing wheat under irrigation to disseminate new practice of the technologies for the study area. Therefore, this activity was undertaken to disseminate the improved varieties through large scale demonstration under wheat irrigation project support to increase production and productivity to alleviate food shortages farmers facing.

Specific objectives

1) To evaluate productivity and profitability of the technologies
2) To popularize irrigated wheat production technologies and practices in the study area
3) To build local capacity for wider adoption of irrigated wheat production technologies
4) To strengthen linkage and create awareness among different development practitioners on improved wheat production technologies

2. Materials and Methods

2.1. Description of the Study Area

The study was conducted at Bedeno district of Eastern Hararghe zone during 2020/2021 offseason under farmers' condition. Bedeno district is located at about 118 km from Harar town. The altitude of this district ranges from 1200 to 3100 meters above sea level. Khat, fruits, Coffee and vegetables are important cash crops produced in the study area. In addition, Sorghum, maize, sweet potato, and banana are grown in the area. The study site is characterized by drought and erratic nature of rainfall which are challenging crop production in general.

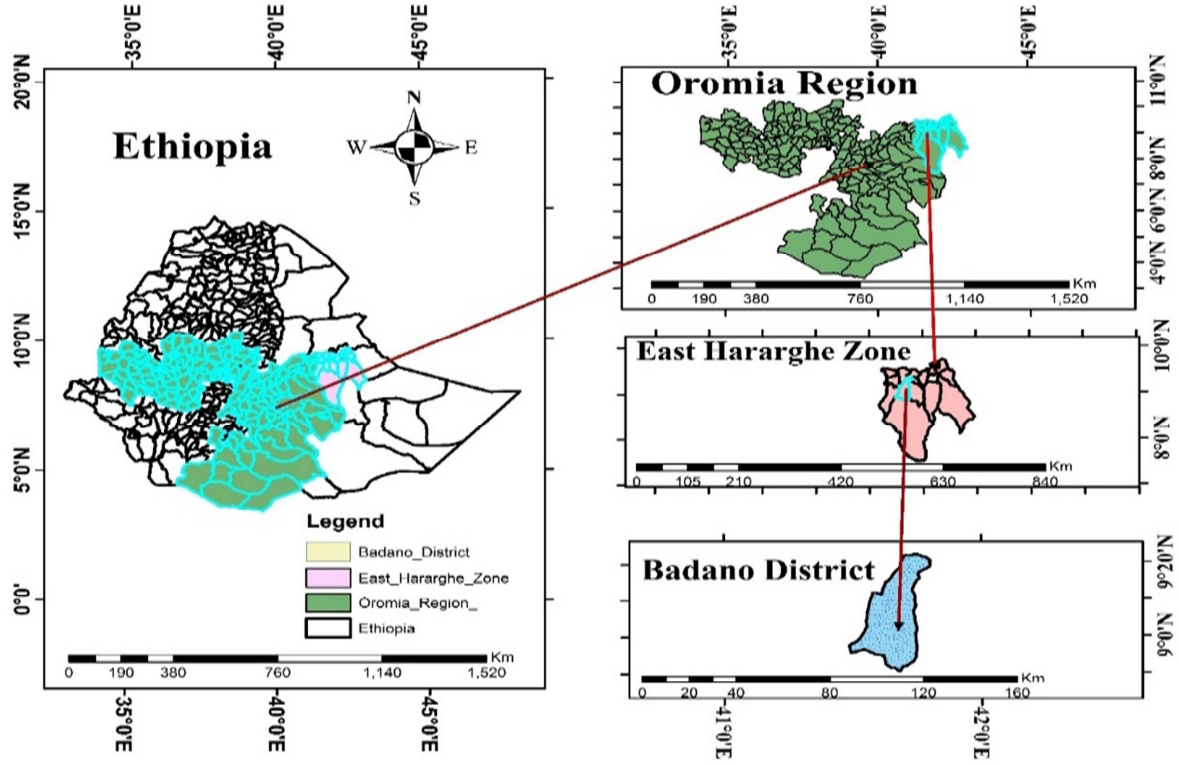

Figure 1. *Map of the study area.*

2.2. Site and Farmers' Selection

Bedeno district of Eastern Hararghe zone was selected purposively based on irrigation potential for wheat production. From the district, Hara Deneba kebele was selected purposively. Farmers were selected in collaboration with experts from district agriculture and natural resource office and development agents based on their interest, land provision for this activity and willingness to share experiences for other farmers.

Table 1. *Summary of sites and farmers selected for target commodity in the study area.*

Target Commodity	Variety	Target area	Number of beneficiaries		Area covered in ha
		District	Men	Women	
wheat	Ogolcho and Pavan-76	Bedeno	186	9	50

Source: Own computation, 2021

2.3. Cluster Formation

The selected farmers were organized into irrigation water user association (IWUA) based on their land adjacent to each other. Cluster formation (IWUA) in targeted kebele was in consideration of gender issues (women, men and youth). A total of 195 farmers were addressed within one year duration of this project and beneficiaries were organized in to three clusters. These clusters are Abdi Badhadhina, Hawi Gudina and Maxa.

2.4. Extension Events and Communication Methods Used

As part of the intervention activities, training on agronomic practices and post-harvest handling were given to farmers, DAs and experts before plantation, during harvest and post harvesting time. Field day was organized on the fields of beneficiary farmers in order to evaluate the performance and final outputs of the variety and shared the lessons with different stakeholders. Famers, DAs, experts from district agriculture and natural resource office, researchers and other relevant stakeholders had attended the field day. Field visits conducted at vegetative and crop maturity stage while field day was organized at crop maturity stage. Extension materials such as leaflet, banner, OBN radio and OBN TV were used as communication methods to reach information for other stakeholders for wider popularization. This publicity helps in experience sharing and wider awareness creation.

2.5. Input Procurement and Distribution

Fedis agricultural research center delivered full package technologies for the beneficiaries in the study area. The full packages used were basic seeds, fertilizers, fungicide chemicals and others.

Table 2. *Inputs distributed.*

No	Zone	No of district	Area (Ha)	Seed delivered			Fertilizer		Fungicide chemical	
				Class	Variety	Seed (Qt)	NPS (Qt)	Urea (Qt)	Tilt (Lit) 250EC	Conazole25% EC
1	East Hararghe	1	50	Basic	Ogolcho and Pavan-76	75	50	75	2	3

Source: Own data, 2021

2.6. Crop Managements Applied

Planting of wheat was done on farmers' field by researchers, DAs and farmers. Field managements such as weeding, thinning, watering and others were done. Fields were managed by participant farmers with close supervision of researchers and DAs. Frequent field visits to farmers land, monitoring, and follow up actions were done based on knowledge and technical needs. The improved wheat varieties called Ogolcho and Pavan-76 were used for the study. Seed rate of 150 kg/ha was used. Space between ridges was 20cm and furrow length ranges from 20-30m for uniform water irrigation purpose. 150 kg ha^{-1} Urea fertilizer (in split: one third during planting and the rest at tillering stage) while 100kg/ha NPS was applied at time of planting.

Figure 2. *Measuring furrow width and length at Hara Deneba Kebele.*

2.7. Methods of Data Collection

Field observation, household interview and focus group discussion were used as methods of data collection.

2.8. Data to Be Collected

Number of farmers benefited from the technologies by age and sex, plot size covered with each variety and amount of input used, yield data of the varieties across all plot, Cost incurred and farmers' perception related to attributes of the varieties were collected using checklist.

2.9. Data Analysis

The Quantitative raw data were subjected to analysis of SPSS software version 26. Descriptive statistics such as frequency, mean, maximum, minimum and standard deviation were used and presented in tabular form. T-test was used to analysis the mean yield difference between two improved wheat varieties. Cost benefit ratio was used to evaluate profitability of the technologies under irrigation. Qualitative data were analyzed using narrative explanation and argument.

3. Results and Discussion

3.1. Stakeholders' Roles and Their Responsibilities

Table 3. *Roles and responsibility of different stakeholders.*

Stakeholders involved	Role played by stakeholders
Zonal agriculture and natural resource office	Experts' mobilization
FARC	Input supply, chemicals, black plastic and capacity building for different stakeholders
District administration office	Community mobilization
Afran Kello union	Source of input access
District agriculture and natural resource office	Motor pump supply, technical support for farmers and field supervision

Source: own computation, 2021

3.2. Descriptive Results

3.2.1. Farm Household Characteristics

Of the total 195 direct beneficiaries of the technologies 95.4 % (186) of the farmers were male while 4.6 % (9) were female farmers (Table 4). The mean age of the farmers benefited from the technology was 38.74 in year (Table 4). The maximum and minimum age of the farm household was 58 And 28 in year respectively. The above explanation summarized in the following table.

Table 4. *Demographic characteristics of the farmers directly benefited from the technologies.*

Age of farmers benefited from the technology in a year			Sex of farmers benefited from the technology			
Mean	**Maximum**	**Minimum**	**Male**		**Female**	
38.04	58	28	Frequency 186	Percentage 95.4	Frequency 9	Percentage 4.6

Source: Own computation from own data, 2021

3.2.2. Descriptive Result on Capacity Building (Training and Field Day)

A total of 50 farmers (40 males and 10 females), 3 development agents and 4 experts have participated on training. Likewise, a total of 60 farmers out of which 50 are males and 10 are females have participated on field day organized at Hara Deneba.

Table 5. *Descriptive result on capacity building for different stakeholders.*

S. N	Participants on training	Sex of participants on training			Participants on field day organized	Sex of participants		
		Male	**Female**	**Total**		**Male**	**Female**	**Total**
1	Farmers	40	10	50	Farmers	50	10	60
2	DAs	2	-	2	Das	2	-	2
3	Supervisor/DA	1	-	1	Supervisor	1	-	1
4	Experts/SME	4	-	4	Experts/SME	4	-	4

Source: Own calculation from own data, 2021

Figure 3. *Pictures captured during training for farmers about irrigated wheat production at H/Deneba.*

Figure 4. *Pictures captured during field day organized.*

3.2.3. Wheat Production and Productivity at Hara Deneba Kebele of Bedeno District

The crop used for production was wheat varieties called Ogolcho and Pavan-76. The wheat covered plot size of 50 hectares. Average yield obtained per hectare for Ogolcho was 40.73 while that of Pavan-76 was 33.51 in quintal respectively. The maximum and minimum yield recorded per hectare for Ogolcho was 48 and 32 in quintal respectively. The following table summarizes the above description (Table 6).

Table 6. *Summary of minimum, maximum and average yield for Ogolcho and Pavan-76.*

No	Variety	Yield in quintal per hectare			Area covered in ha	Total production in quintal
		Maximum	Minimum	Average		
1	Ogolcho	48	32	40.73	30	1221.9
2	Pavan-76	40	28	33.51	20	670.2
Total		44	30	37.12	50	1892.1

Source: Own computation from own data, 2021

3.2.4. Mean Yield Difference Between Two Varieties

Table 7. *Independent sample t- test for mean yield difference for 2 varieties.*

	Varieties used by farmers	N	Mean	Std dev.	t-value
Yield obtained in quintal/ha	Ogolcho	102	40.73	3.31	16.26***
	Pavan-76	93	33.51	2.89	

Source: Own computation from own data, 2021
Note: *** Shows significance level at 1%

From the above table there was significant mean difference between Ogolcho and pavan-76 varieties in terms of mean yield in quintal per hectare. There was significant mean difference between two varieties at 1% significance level.

Figure 5. *Yield of wheat at Hara Deneba.*

3.3. Profitability of the Technologies

Cost benefit ratio was used to evaluate the profitability of the technologies in the study area. All the costs incurred and benefits gained listed in the table refers per hectare.

Table 8. *CBA of wheat irrigation technologies at Hara Deneba kebele of Bedeno district in 2021 G. C under irrigation.*

No	Variables	Varieties	
		Ogolcho	Pavan-76
1	Yield (in qtl/ha)	40.73	33.51
2	Price (ETB/qtl)	2,650	2,650
3	Gross returns (1*2)	107934.5	88,801.5
4	Seed purchase (1.5 qtl/ha) ETB/ha	2,700	2,700
5	Fertilizers purchase (1.5 qtl/ha Urea)	2,878.5	2,878.5
6	Fertilizers purchase (NPS)	1,924	1,924
7	Fungicide purchase (Littre/ha)	1,350	1,350
8	Fuel purchase (ETB/ha)	4,000	4,000
9	Labour for weeding	2,000	2,000
10	Land preparation (ETB/ha)	4,000	4,000
11	Total variable cost (∑4-10) for ETB/ha	18,853	18,853
12	Fixed costs (Costs of land) in ETB/ha	7,000	7,000

No	Variables	Varieties	
		Ogolcho	Pavan-76
13	Total cost (∑11+12) ETB/ha	25,853	25,853
14	Net return (3-13)	82,081.5	62,948.5
15	Benefit cost ratio (14/11)	4.35	3.33

Source: own data computation, 2021

3.4. Farmers' Feedback

All beneficiary farmers were interested to produce Ogolcho variety than pavan-76 under irrigation in the study area. Farmers preferred Ogolcho variety than Pavan-76 due to its early maturity, high yielder, morphologically attractive that gives higher stalk for animal feed. They were motivated in producing wheat during offseason that helped them to reduce chronic food insecurity facing the farmers.

3.5. Challenges Encountered and Suggested Solutions

Lack of irrigación infrastructure, lack of experience on use of irrigation water appropriately, lack of experience regarding harvesting and threshing wheat, farmers dependence, lack of soil levelling machineries, reluctance of farmers for newly introduced technologies, weeds, yellow rust, desert locust and birds attack, lack of car and problem of road accessibility. The following table summarizes the challenges encountered and suggested solutions.

Table 9. *Challenges encountered and suggested solutions.*

Challenges and problems encountered	Suggested solutions	Remarks
Lack of experience on use of irrigation water appropriately	Creating awareness on water utilization	
Lack of irrigation infrastructure	Using locally available materials	Needs government support for improved infrastructure
lack of experience regarding harvesting and threshing wheat	Supply harvesting machine and threshing machine (Combiner)	Supplying harvesting machine and threshing machine (Combiner) needed
Farmers dependence	Awareness created	
Reluctance of farmers for newly introduced technologies	Awareness created	-
Weeds	Manually weeding by hands	-
Yellow rust	Fungicide chemicals used	-
Desert locust	Smoking (fire), Keeping	-

4. Conclusion and Recommendations

The improved technologies contribute to improve the production and productivity of farmers that helps to enhance the living standard of farmers. Improved variety is one of the elements of input that plays crucial role in increasing both production and productivity of the farmers. The improved wheat technologies introduced to the study area helps farmers to reduce chronic food insecurity status in the study area. The mean yield of Ogolcho and Pavan-76 was 40.73 and 33.51 in quintal per hectare respectively. There was significant mean difference between Ogolcho and Pavan-76 in terms of mean yield in quintal per hectare. Producing wheat under irrigation boost production and play crucial role in import substitution. In addition, producing wheat under irrigation in the area is profitable with appropriate managements. It is important to promote Ogolcho variety in wider in the study area and similar agro-ecology. The district agriculture and natural resource bureau and research center should work on the sustainability of improved variety of wheat technologies to boost the production and productivity in order to improve food security of farmers in the study area.

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References

[1] Abraham, B., Gebrehiwot, Nata, T., K. Bheemalinges wara and Mokennen, H. (2015). Suitability of Groundwater Quality for Irrigation: A Case Study on Hand Dug Wells in Hantebet Catchment, Tigray, Northern Ethiopia. Journal of American Science, 7 (8): 191-199.

[2] Ali, H., Tahir, M. and Nadeem, M. A. 2014. Determining Critical Period of Weed Competition in Wheat under Different Tillage Systems Life, 12 (2): 74-79.

[3] Anteneh A, Asrat D (2020) Wheat production and marketing in Ethiopia: review study. Cogent Food Agric 6: 1778893. https://doi.org/10.1080/23311932.2020.1778893

[4] Astatike, A. A. (2016). Assessing the Impact of Small-Scale Irrigation Schemes on Household Income in Bahir Dar Zuria Woreda (Master's thesis), Haramaya University, Harar, Ethiopia. [Google Scholar].

[5] CSA (Central Statistical Agency of Ethiopia), 2017. Agricultural Sample Survey. Report on Area and Production of Major Crops.

[6] CSA. 2021. Agricultural Central Statistics Agency: Report on area and production of major crops (Private peasant holdings, Meher Season). Volume I Statistical Bulletins 590, Addis Ababa, Ethiopia.

[7] CSA. 2018. Agricultural Sample Survey Series, 2017/18: Report on Area and Production for Major Crops (Private Holdings, Main Season). Statistical Bulletin No. 586. Centeral Statistics Agency of Ethiopia, Addis Ababa, Ethiopia. Pp. 15-30.

[8] FAO. 2016. Ethiopia. www.fao.org/ag/agp/agpc/doc/counprof/ethiopia/ethiopia (accessed August 2021).

[9] FAO. 2017. FAOSTAT FAO, Rome, available at: http://faostat.fao.org (accessed August 2021).

[10] Hodson, D. P., Moti Jaleta, Kindie Tesfaye, Chilot Yirga, Habtamu Beyene, Kilian, A., Carling, J., esfaye Disasa, Sisay Kidane Alemu, Teshale Daba and Yared Alemayehu. (2020). Ethiopia's transforming wheat landscape: tracking variety use through DNA fingerprinting. Scientific reports, 10 (1): 1-13.

[11] MoANR (Ministry of Agriculture and Natural Resources). 2016. Crop Variety Register Issue No. 18, Addis Ababa, Ethiopia.

[12] Nicholas M. James W. and Solomon L. (2015). Wheat in Ethiopia: Production, marketing, and consumption Prepared for the Ethiopian Agricultural Transformation Agency (ATA). Markets, Trade, an international Journal.

[13] Nigussie, A., Kedir, A., Adisu, A., Belay, G., Gebrie, D., & Desalegn, K. 2015. Bread wheat production in small scale irrigation users' agro-pastoral households in Ethiopia: Case of Afar and Oromia regional state. Journal of Development and Agricultural Economics, 7 (4): 123–130. https://doi.org/10.5897/JDAE2014.0589.

[14] Shiferaw, B., Negassa, A., Koo, J., Wood, J., Sonder, K., Braun, J-A., Payne, T., 2011. Future of wheat production in Sub-Saharan Africa: analyses of the expanding gap between supply and demand and economic profitability of domestic production. Paper presented at the Agricultural Productivity-Africa Conference 1–3 November 2011, Africa Hall, UNECA, Addis Ababa, Ethiopia.

[15] USDA, 2019. World Agricultural Production and Agricultural projections. Oxford University Press. pp. 32.

[16] Usman Kedir, 2017. The Effect of Climate Change on Yield and Quality of Wheat in Ethiopia: A Reviewing. Journal of Environment and Earth Science. ISSN 2224-3216 Vol. 7, No. 12. www.iiste.org ISSN 2225-0948 (Online).