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Enhancing the Production and Productivity of Irrigable Land through Pre-extension Demonstration of Intercropping of Cowpea with Maize in the Case of the Central Zone of Tigray, Ethiopia

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Authors' contributions

This work was carried out in collaboration among all authors. Author GB did proposal writing, action plan preparation, demonstration execution, data collection, follow-up, and scientific report writing. Author MR writing, proposal, follow up and manuscript writing. Author NT did data collection; editing manuscript and fellow up, author DM did data collection and manuscript editing. Author BG follow up and manuscript editing. Author KF under searching and editing manuscript. Author SS disease inspection and data collection. Author DT data collection and funder searching. All authors read and approved the final manuscript.

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ABSTRACT

One of the major constraints that strongly limit livestock production in the Tigray region is the unavailability of both sufficient quantity and quality of feeds. Despite the huge animal feed problem, the smallholder farmers have no experience on growing forage crops due to a shortage of cultivable lands and knowledge. To mitigate the existing challenge, intensification of irrigable land through maize cowpea intercropping becomes so crucial. That's why the demonstration of intercropping cowpea with maize to enhance the quality of forage production without reducing grain yield was designed. Agbe Tabia' was selected purposefully based on the potential of irrigation water, poor farmers experience in livestock feed production, and project interest. A total of 20 farming households were selected purposefully based on their interest in trying new technology and interest to share his/here experiences with fellow farmers. All the necessary input was prepared and distributed timely. Before executing the demonstration training on intercropping technique and farmers' research group concept was given to participants. Each farmer planted the sole maize with the maize cowpea intercropped to compare their performance. The average grain yield obtained from sole maize and intercropped maize cowpea was 38.87 and 36.14 quintal per hectare respectively. The T-test output indicates that without significant grain and biomass yield reduction of maize, the improved practice has a mean yield advantage of 52.62 and 7.21 quintal per hectare of cowpea at 50% flowering and air-dried stage respectively. Therefore, it is recommended that to further demonstrate and scale out the practices under similar agro ecology.

Keywords: Demonstration; intercropping; farmers' perception; Tigray Region.

1. INTRODUCTION

The lack of high-quality and quantity feeds is one of the main factors severely limiting livestock output in tropical nations [1]. On the other hand, the lack of arable land in nations like Ethiopia makes it challenging to grow forage crops as the only crop used to feed animals. Ethiopia with diverse agro ecology permits different agricultural systems and production of different crops especially grain legumes which are critical to smallholder livelihoods [2].Intercropping of cereals with legumes has been popular in tropics [3]. In the study area, irrigable land limitation was a major problem for forage production therefore intensification through intercropping of maize with cowpea is amongst the few feasible alternatives to increase both production and productivity of food grain and animal forage. Intercropping involves growing two somewhat compatible crops together at a certain planting pattern for the duration of a season. These crops are often leguminous forage species and cereal crops [4].

Intercropping enables to improve quality and quantity of food and feed [5]; increase efficiency of resource use [6] and [7]; improve soil fertility [8,9] released an improved cowpea variety, namely 'Temesgen', with a high biomass yield of 11.9 t/ha DM basis for low-land agro ecology. Intercropping resulted in higher maize forage quality, because of more N supply for maize, induced by complementary interaction between maize and cowpea in intercropping for N consumption [10] and [11]. Additionally intercropping supports organic farming by the reducing application of herbicide for weed controlling, because of living mulches suppress weeds by competing for the use of growth resources, and changing environmental factors that affect weed germination and establishment [12].

The Abergelle Agricultural Research Center is dedicated to carrying out research on improving livestock feed production and productivity via forage technology generation, adaptation, selection, and demonstration. Higher total fodder and maize grain yields were seen in Tanqua Abergelle district as a result of a study including the intercropping of cowpea following the emergence of maize [13]. Demonstrating maize cowpea intercropping, particularly with enhanced cowpea cultivars (Temesgen) alongside maize, becomes crucial for the widespread application of such systems. The benefits of intercropping are promising at station level, but evaluating crop performance in specific agro ecological contexts at farmers' practice is needed. The study aimed to evaluate farmers' opinions regarding intercropping cowpea with maize and show how doing so can improve the quality of fodder production without lowering crop productivity.

2. MATERIALS AND METHODS

Tanqua Abergelle Woreda is located in the central zone of Tigray Regional State. The study area is located about 120 km west of Mekelle, the capital city of the Tigray region, and at a distance of 900 km far away from Addis Ababa, the capital city of Ethiopia. According to the current administrative division, the wereda is subdivided into 19 rural kebele and 1 urban kebele administration. The bordering areas of the wereda are Kola-Tembien wereda in the north, Saharti-Samre wereda in the south, Degua-Tembien wereda in the east, and Amara Region to the west. Topography classification of Tanqua Abergelle Woreda is about 95% of the total land area and is estimated to be in the Kola topographic region, while the remaining 5% lies in the Weina Dega. Tanqua Abergelle is located at latitude N 130 14' 06" and longitude E 380 58' 50". The woreda has a total population of 93430, of which 47636 are male and the rest 45794 are female [14]. The map of the study area is shown in Fig. 2.

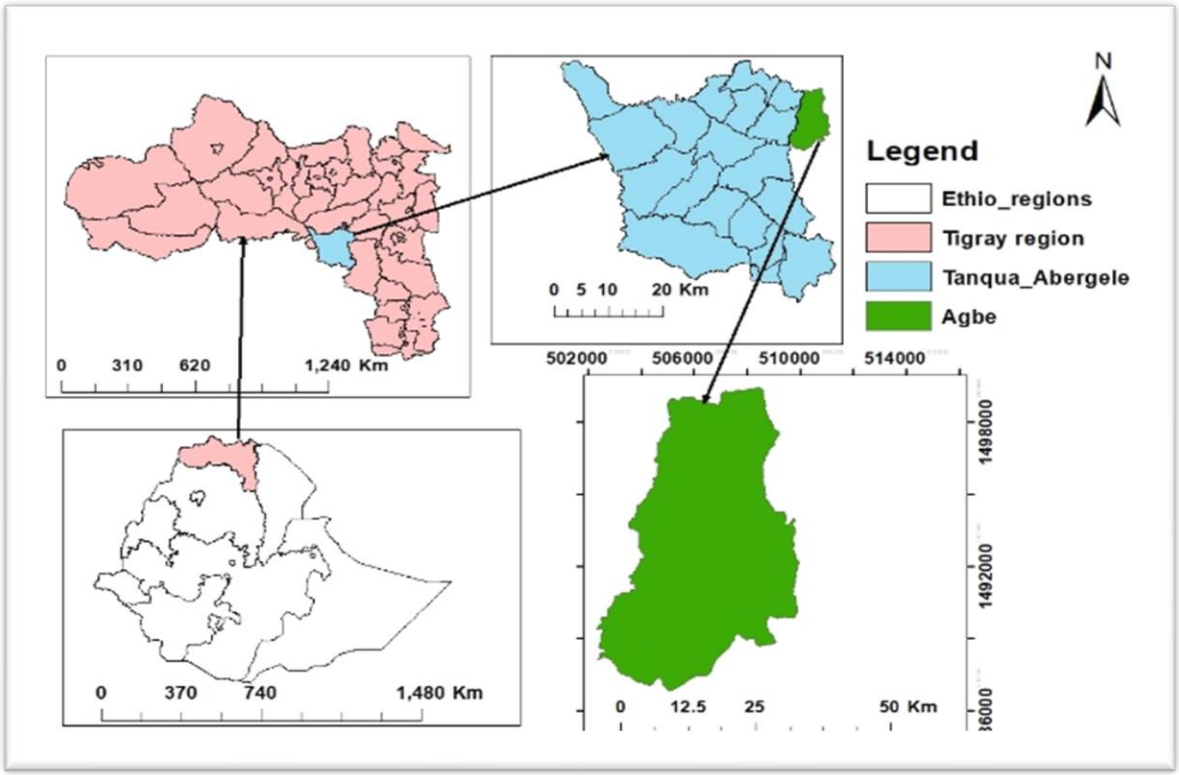

Fig. 1. Map of the study area

2.1 Implementation Procedure

Agbe Tabia' was selected purposefully based on the potential of irrigation water, poor farmers experience in livestock feed production, and project interest. A total of 20 farming households were selected purposefully based on the following criteria: innovative/model farmers; diligent and active; honest and credible; open to trying new practices; higher community acceptance; eager to share knowledge and skills with fellow farmers; willing and able to bear operation costs; availability of irrigable land; and experience in growing maize. Each farmer who took part prepared 400 m2* (a demonstration plot measuring 20 m by 20 m) of land for the intercropping of solo maize and maize cowpea. Inputs like improved maize variety (Melkasa-2), improved cowpea variety (Temesgen) fertilizer, and pesticides were prepared and distributed timely. Farmers, DA, SMS specialists, Tabia, and wereda leaders received training on the FRG idea, planting, management, and use of cowpea and maize fodder for livestock feed prior to the commencement of the demonstration. Each farmer who took part prepared a 400 m2* (or 20 m x 20 m demonstration plot) parcel of land for the intercropping of solo maize and cowpea.

The land was plowed two times. The maize was planted at 30 cm and 75 cm between plants and rows, respectively, while cowpea was sown 10-20 days after the emergence of maize with 10 cm intra spacing among rows of maize. Strict weeding follow-up was done. Moreover, pests and diseases were checked regularly, and necessary action was applied. The study used both primary and secondary data. The quantitative data (grain and biomass yield) were collected using quadrants from solo maize and maize cowpea intercropped. The qualitative data (farmers' perceptions) were collected by interviewing the producers using a checklist. The data on cowpeas was harvested at 50% flowering and air-dried, while the grain yield of maize was taken by taking samples in quadrants during harvesting. Secondary data were also collected from different sources, such as published (journals) and unpublished reports. The collected data on grain and biomass yield were analyzed using simple descriptive statistics such as mean, range, percentage, and T-test. Additionally, for the analysis of farmers' perceptions, the study used percentage and narrative analysis.

Picture taken during implementation:

3. RESULTS AND DISCUSSION

A production comparison between the two maize production techniques (sole maize and maize cowpea intercropped) was made. The sole maize production technique was selected because it is the most commonly practiced in the study area. As it is described in result Table 1, an average grain yield of 38.87 qlh1 and 36.14 q per ha were obtained from the sole maize and maize cowpea intercropped, respectively. The T-test output indicates that the maize cowpea intercropping technique has no significant influence on reduction of maize grain and biomass yield. The average biomass gained from sole maize and maize cowpea intercrop was also 198.07 q per ha and 187.87 q per ha, respectively, which has no significant biomass yield loss when we compare the technological advantage of 52.62 q per haof cowpea at 50% flowering stage and 7.21 q per ha of air-dried cowpea, which is a higher source of protein for livestock, the study result is similar with [15]. Additionally, the participant farmers perceive that maize cowpea intercropping practices play a garter role in getting highly palatable forage and increasing milk production, and the technology criticizes in its additional labor need. The study has clearly brought out the beneficial effects of maize cowpea intercropping for forage yield and quality. Intercropping is more productive than sole maize cropping [16]. Our results are in different with the findings of [11] it might be due to the different intercropped cultivar usage. The results obtained from the improved practice (maize cowpea intercropped) as well as the sole maize production in the study areas are described in Table 1 as follows:

Table 1. Yield comparison of sole maize Vs cowpea intercropped maize

Commodity	Types of yield	Measurements	Irrigation practice	
			Sole maize	Maize cowpea intercropped
Maize	Grain	Mean inqlh[1]	38.87	36.14
		Range in qlh[1]	21.30-58.10	25.18-47.19
		%ATin qlh[1]	-1.98%	-
		T-value	0.246	-
		Sig(2-tailed)	0.814	-
	Biomass	Mean in qlh[1]	187.86	198.07
		Range in qlh[1]	136-260	142-310
		T-value	-1.164	-
		Sig(2-tailed)	0.289	-
Cowpea	50% flowering	Mean in qlh[1]	-	52.62
		Range in qlh[1]	-	16.03-89.87
		AT qt/ha	-	52.62
	Airdry mater	Mean in qlh[1]	-	7.21
		Range in qlh[1]	-	2.89-10.57

Source: Computed from field data taken in quadrant from 1mby1m plot size (2020/21)

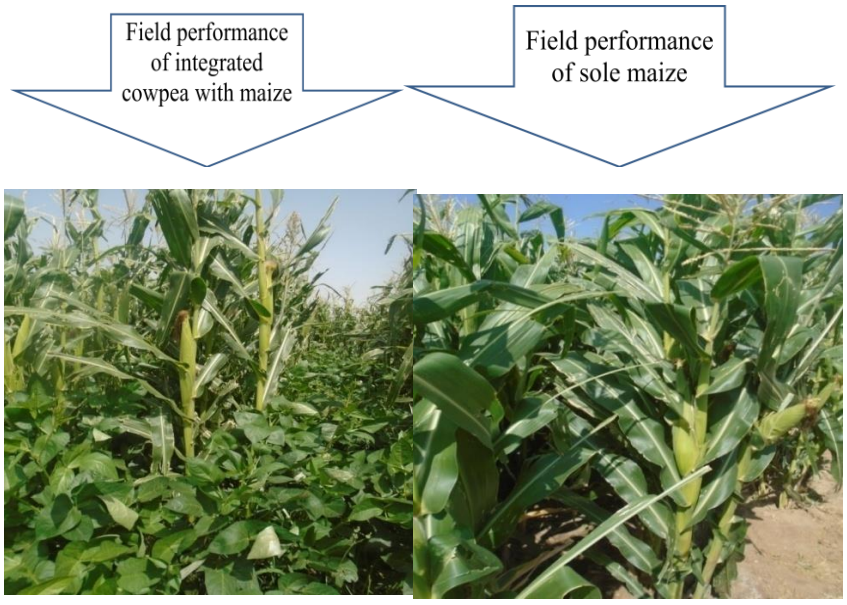

Fig. 2. Filed performance of sole maize and maize cowpea intercropped

4. CONCLUSION AND RECOMMENDATION

Coupling maize cowpea at a space of 75cm and 30cm between row and plant respectively for maize, while cowpea was sown 10-20 days after the emergence of maize with 10 cm intra spacing among rows of maize versus monoculture maize had no significant influence on the grain yield loss. By producing grain and fodder in the same production season, intercropping cowpea and maize offers the opportunity to increase the productivity and production of irrigation water and irrigable land, diversify the revenue streams for farmers, and improve soil fertility. Therefore, the study recommended that in order to benefit a sizable number of farmers and bring about the necessary attitudinal change, the agricultural extension service, agricultural college, agricultural research, and nongovernmental organizations work to further demonstrate and scale out the practices to other agro-ecologically similar irrigation potential areas.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies have been used during the writing or editing of this manuscript.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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