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Research Article

Cluster based Oat-vetch mixtures for forage production in Dodola district of West Arsi Zone, Ethiopia

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Abstract

The present activity was conducted at Keta Berenda kebele of Dodola district of West Arsi Zone of Oromia in 2019 cropping season with the objectives to evaluate cluster-based pre-scaling up fodder oat mixture with vetch, collect farmers' opinion on the performance of the technology, improve farmers' knowledge and skill of application of the improved technology through training and increase local capacity for future scaling-up. Keta Berenda kebele was purposively selected from the district based on the livestock population potential and accessibility. Thirty-one farmers (24 males and 7 females) who had the willingness to accept and disseminate the technology and possess adequate land for forage production were selected in cluster form and established as 1 FREGs in collaboration with development agents of the Kebele. Fourteen trial farmers were nominated from the members for forage establishment. The technology was established on a land size of 2.945 ha with all recommended agronomic practices. The training was given for 20 farmers and 3 development agents on; forage production, management, and utilization practices. 8.01 t ha^{-1} biomass yields were obtained from an oat-vetch mixture. Hence, the technology should be further promoted on a wide scale to address the feed shortage scarcity of the study area.

Introduction

In the central highlands of Ethiopia (2500-3000 meters above sea level), grasses, and cereals straw are major sources of animal feed. However, these feed resources are characterized by high fiber (>55%), low digestibility, low crude protein (<7%) contents, and poor mineral composition [1]. One way to optimize utilization of available feed resources is strategic supplementation of crop residues with plant protein sources such as leguminous forage crops, which have the potential for alleviating some of the feed shortages and nutritional deficiencies experienced in the dry season on smallholder farms [2].

Oat is the most important well-adapted cereal fodder crop grown in the midland and highlands of Ethiopia mainly under rain fed conditions. Oats are important in feeding ruminant animals for their high Dry Matter (DM) production and low cost, are very palatable (softness), good in protein as compared to the other grains, and considered as an excellent feed for all livestock. Regarding to high feed costs of protein supplementations, legumes can be used in livestock nutrition for their high protein content and, thus, providing cost saving. Since legumes have a low DM yield, acceptable forage yield and quality and yield can obtained from mixing of oat and vetch as compared with their sole. Vetch is one of the most important improved forage legumes, which are a high nutritional quality as animal feed containing between 25.8 and 26.0% crude protein as well as an excellent source of vitamins and minerals [3].

Intercropping of cereals and legumes is widely used in low-input agriculture because the mixture of nitrogen (N)-fixing and non-N-fixing crop species provide complementarities in the utilization of resources [4]. Intercropping cereals and legumes also significantly increased protein levels and reduced fiber concentrations [5]. Combinations of forage produce high yields, forage quality, and minerals when planted along with other legume crops [6]. Previous studies have shown that intercropping of vetch with oats have a great potential

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for improving nutritive value and high total biomass yield of the forage as compared to sole cropping, this farming system practically protects soil from erosion, improve the nutritive (protein) and limit weed population. Association of Vetch and Oat produce 8.93 t ha^{1} and pure stand oat of produced 8.01 t ha^{1} [7]. Farmers show an enormous interest to exercise further this cheapest technology as the view of the farmers collected indicated during the demonstration of this technology.

Hence, this technology is very essential for small-scale farmers to produce high-quality forage with high biomass yield in a cluster to solve the feed scarcity that affects livestock production and productivity of the district and increase grain yield from this farmland in the succeeding cropping years. The objectives of this study were to evaluate cluster-based pre-scaling up of Oat-vetch mixture, to collect farmers' opinion on the technology, to improve farmers' knowledge and skill on oat-vetch mixture technology usage through training, and to increase local capacity for future scaling-up or out of the technology.

Methodology

Description of the study sites

The study was carried out at Keta Berenda kebele of Dodola district of West Arsi Zone Oromia National Regional State at Keta Berenda kebele. Dodola is a town in southeastern Ethiopia. Located in the West Arsi Zone of the Oromia Region, this town has a latitude and longitude of 06°59′N 39°11′E, with an elevation ranging from 2362 to 2493 meters above sea level. Keta Berenda kebele is found between Dodola and Adaba districts Figure 1.

Farmers selection and FREG establishment

One livestock potential rural Kebele from Dodola district was selected with the participation of livestock expert and development agents in the district. Farmers who have willingness to accept and disseminate the technology and possess adequate farmland in cluster for forage scaling up were purposely selected. Farmers Research and Extension Group

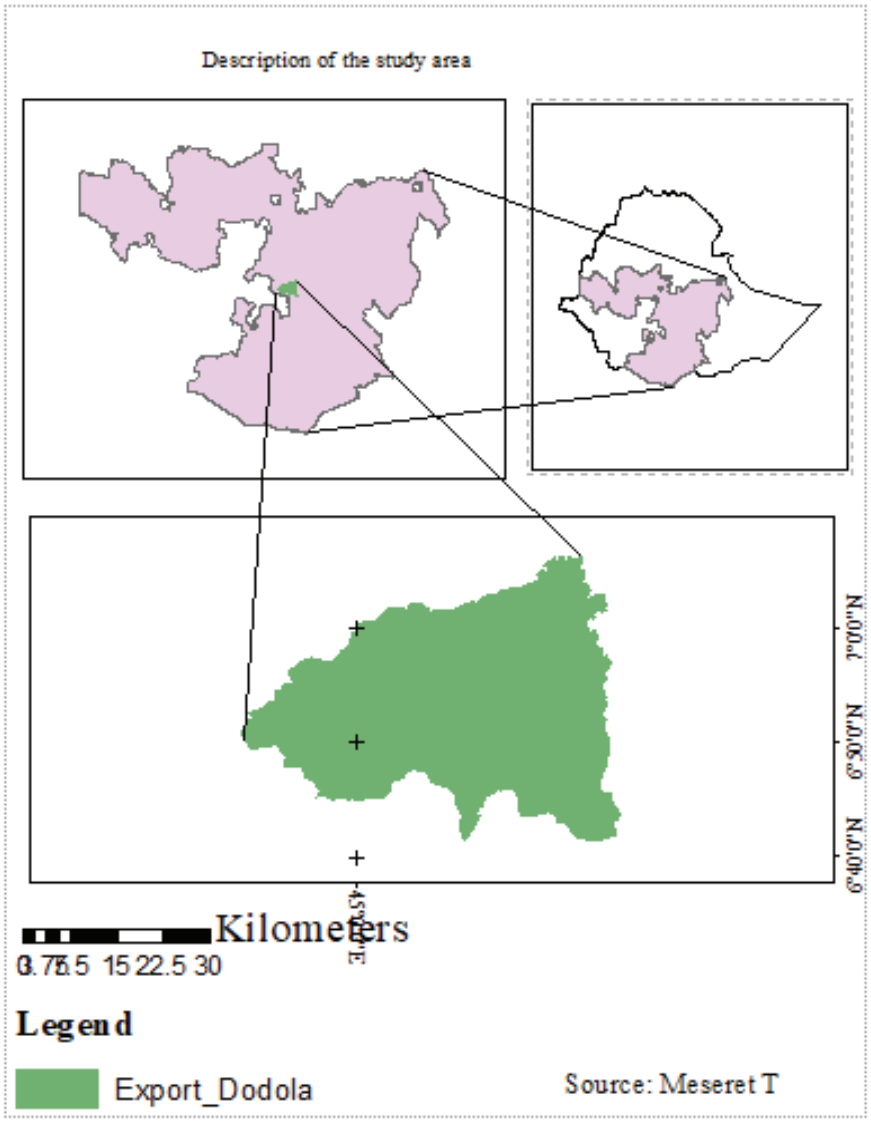

Figure 1: Map of Study Area.

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(FREGs) were established in collaboration with development agents of the district.

Capacity development

On clustering approach oat-vetch mixture for quality feed production, important training was provided before and after beginning the activity. Extension events such as field visits, field days and experience sharing were also provided for farmers and other stakeholders.

Developing forage

Improved forage of Oats (Bonsa) and Vetches *(Vicia vilosa)* was established on farmer's fields. The seed rate used was 40 kg ha^{1} for oats and 15 kg ha^{1} for vetches with a spacing of 25 cm and Fertilizer (DAP) was applied at a rate of 100 kg ha^{1}.

Biomass yield determination

Forage samples were taken to estimate the biomass yield from the center of experimental land at the dough stage for oats and at about 50% flowering for vetch. The harvested forage samples were manually chopped into small pieces using a sickle and a sub-sample of 250 gm fresh weight was taken and oven-dried at 65°C for 72 hrs for herbage dry matter yield determination.

DM yield (t/ha) = (10 x TFW x SSDW) / (HA x SSFW) [8].

Where 10 = constant for conversion of yields in kg/m^2 to tone/ ha;

TFW = total fresh weight from harvesting area (kg);

SSDW = sub-sample dry weight (g);

SSFW = sub-sample fresh weight (g).

The data collected including agronomic parameters, herbage dry matter yield, farmers' perception towards the technology, and the total number of participants on the field day/training, challenges, possible solutions, and opportunities of the technology were organized and summarized by excel sheet.

Result and discussions

Farmers Research and Extension Group (FREG) establishment

As indicated in the Table 1, about 20 farmers (15 males and 5 females) have participated in training about cluster-based oat-vetch mixtures technology for forage production. Accordingly, farmers who were willing to accept and disseminate the technology and possess adequate farmland in clusters for forage scaling up were purposely selected, and 12 farmers were established as FREGs in collaboration with development agents of the district.

Training of farmers and development agent

The training was given to all participating farmers, Development Agents (DA), the expertise of the respective districts, stakeholders, and other concerned bodies on how to produce high biomass yield and high-quality forage, management practices like weeding, time of harvesting, way of curing for quality hay production, method of curing, place of conserving and feeding. According to the opinion of trained farmers, they have appreciated this cluster-based Oat-vetch technology for quality forage production Picture 1.

Forage developing

Improved forage oat-vetch mixture was established in a cluster form at farmer's field on a land size of 2.945ha for quality forage production with high total biomass yield Table 2.

Forage agronomic performance

Forage agronomic parameters and dry matter yield of oat-vetch mixture for fodder production collected were shown in Table 3. For quality forage production by cluster-based oat-vetch mixtures technology, a total of 8.01 tha^{1} dry matter yields were produced. The current result was similar to Lithourgidis, et al. [9] that reports simultaneous cultivation of two or more

Table 1: Number of participant on training.

Name of district	Name of kebele	Participants								Total
		Farmer		DAs		Experts		Others		
		M	F	M	F	M	F	M	F	
Dodola	Ketaberenda	15	5	2	1	1	-	8	2	34

Picture 1: Farmers training on cluster based forage production from oat-vetch mixture at Keta Berenda kebele of Dodola district in 2019 cropping season.

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species on the same physical space, presents some possible benefits including increased biomass yield (8.93 tha^{1}) and improved forage quality and soil fertility [7]. The other agronomic parameters were indicated in Table 3, Picture 2.

Field days

Field days is used for creating awareness about oat-vetch mixture technologies for quality forage production with better biomass yield for participants specially farmers with new interests and new concepts of what is possible after seeing what their neighbors have been able to accomplish in their line of work. This helps the participants for conducting the activity on the method of sowing, time of utilization for animals, method of production, feeding methods, and curing methods. Thus, a total of 45 Participants attended field day in the course of implementing the activity [10,11] Table 4.

Participants' feedback

All participants were interested on the performance of the technology for solving feed shortage which affects livestock production and productivity. Draft power animal (oxen) are mostly affected at the time of cropland cultivation due scarcity of feed. This problem was solved if this quality forage was established and prepared as hay.

Table 2: Land size and input used.

Number of cluster	land size (ha)	Seeds kg/ha		Fertilizer kg/ha	Number of participants	
		Vetch	Oat	DAP	M	F
1	2.945	15	40	100	10	2

Table 3: Agronomic performances oat-vetch mixture practices.

Practices	Plant height (m)		Number of tiller/plant		Leaf to stem ratio		Dry matter yield (t/ha)
Oat-vetch mixture	Oat	Vetch	Oat	Vetch	Oat	Vetch	8.01
	1.202	1.294	13	18	1.93	1.02	

Picture 2: Cluster based forage production from oat-vetch mixture at Keta Berenda kebele of Dodola district in 2019 cropping season.

Table 4: Number of field day participants and their role.

Name of district	Name of kebele	Participants								Total
		Farmer		DAs		Experts		Others		
		M	F	M	F	M	F	M	F	
Dodola	Ketaberenda	27	4	2	1	1	-	8	2	45

Lessons learned

The development of grass and legume mixed is one of the recognized strategies to enhance feed resource development in quality and quantity. Integration of legumes and grass forage improves forage quality and lowers the cost of production and also improves soil fertility of the farmland. Participants were learned about the importance of oat-vetch mixture, the importance of clustering improved forage, method of sowing, feeding methods, curing methods, conservation methods, and place of conservation. The better performance observed from oat-vetch mixed practice attracts the smallholder farmers to choose and further endorse the technology.

Challenges encountered

1. Forage was not harvested at an appropriate time for curing and storing due availability high of rain for a month in the study area
2. Budget shortage, starting from establishing of the technology, due to this forage quality parameters part was not analyzed.
3. Absence of cropping land in cluster form.

Possible solutions given

- The first problem was natural phenomena. Forage was harvested, cured, and stored by farmers after the end of the rain
- Forage was established by our currency and
- Agronomic parameters which were numerically designed were presented.
- Technology was established in a disconnected form by some farmers.

Conclusions and recommendations

The experiment was conducted during the growing seasons of 2019 in Keta Berenda rural kebele of Dodola district on 2.945 ha. Training and experience sharing was provided for 79 participants and the technology was appreciated by participants. From oat-vetch mixture forage productions practices, 8.01 t ha^{1} biomass yields were obtained. The better performance observed from oat-vetch mixed practice attracts the smallholder farmers to choose and further endorse the technology. Hence, the technology should be further promoted in a wide scale to address feed shortages escalating from time to time with dairy and fattening as a commodity in the study area. Moreover, strengthening the linkage among forage producers and other stakeholders is also paramount to addressing feed shortages.

Exit strategy

Farmers who participated have seen different options of practices theoretically and technically from the cluster-based scaling up of quality feed production from an oat-vetch mixture. Therefore, the others should be learning from them by

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the direct visiting of the technology on the field and the close follow-up and monitoring should be done by development agent and expert as to reach into other farmers.

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