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Research Article

Pre-scaling up of Desho Grass Production and Utilization Technologies for Sheep Fattening in Central Gondar Zone, Ethiopia

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ABSTRACT

Pre- scaling up of Desho grass production and utilization was conducted in mid and highland areas of central Gondar zone for 2018 and 2019 consecutive years. The main objective of the study was to create a wider demand and assess farmer's perception on Desho grass production and Desho grass hay utilization as basal diet for the fattening of yearling sheep. Two kebeles from each two districts namely Amba Giorgis zuria and Chira were purposively selected based on their suitability for Desho grass and sheep production. From each kebele a total of 39 farmers were selected, trained and allowed to prepare land for Desho production. Depending on the land available farmers allocated from 250 to 300m^2 of land for Desho grass plantation and sufficient amount of Desho root splits was provided considering the land allocated. Planting was done at the beginning of the rainy season during 2018 on well prepared seed bed and planted at a spacing of 40cm between rows and 20cm between plants. To maintain best establishment fertilizer at a rate of 46 kg per hectare Nitrogen was applied at planting. After care operations were done as required. Desho grass hay was harvested and properly cured when the Desho grass shows a sign of heading. A total of 16 yearling sheep with similar age and body condition were selected for the study from 16 volunteer participant farmers. Desho grass hay as a basal diet and 300g $head^{-1}$ day^{-1} concentrate was used as a supplement comprised of 74% Noug seed cake, 25% Wheat bran and 1% salt on dry matter (DM) basis. Feeding experiment was done for 105 days including 15 days acclimatization period. The analytical result showed that remarkable amount of biomass yield (13.59t ha^{-1}) was recorded with 63.33% yield advantage over the local grass. Significant daily weight gain (91.67g/d) was achieved by wogera yearling lambs fed on Desho grass hay as basal diet and supplemented with concentrate. The partial budget analysis result also showed that sheep fattening by using the above method of feeding was profitable with average net benefit of 691.73 ETB. The sensitivity analysis result showed that if the price of output becomes constant and the price of the inputs rise by 20%, sheep fattening using Desho grass hay as basal diet and concentrate supplement has a positive return. Farmers reported that Desho grass production and utilization technologies were found very appreciable and they are willing to continue with the technology.

Key words: Basal diet, Kebele, Participant farmer, Supplement, Yearling sheep

INTRODUCTION

Ethiopia has the largest cattle population in Africa with an estimated population of 30.70 million sheep, 30.20 million goats and 59.5 million heads of cattle (CSA, 2017). Despite its large livestock population (CSA, 2017), the production and productivity is very low. The average carcass weight for Ethiopian sheep is 10 kg which is lower than the values for neighboring countries (CSA, 2016). Low productivity of animals stems from poor feed resources available to all classes of animals which lead to under performance of the sub-sector (ILRI, 2009).

To combat these nutritional constraints, the use of locally available forage species which are adaptable to the local agro-ecological conditions and used as feed resources are globally as well as locally recommended as they are familiar with the smallholder farmers grown with low inputs (Abebe Mekoya, 2008). Among locally available multipurpose and potential feed resource in the country, Desho grass (*Pennisetum pedicullatum*) is the most appropriate one (EPPO, 2014). It has the potential to meet the challenges of feed scarcity as it not only provides more forage per unit area, but also ensures regular forage supply due to its perennial nature. The grass has the ability to

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recover after water stress even under severe drought conditions (Noitsakis *et al.,* 1994). Desho is a perennial grass and is palatable to cattle, sheep and other herbivores (FAO, 2010).

Though Desho grass is an excellent and widely used grass in southern and some other highland areas of Ethiopia as livestock feed, it was not yet introduced and used as animal feed in Central Gondar Zone. To introduce and utilize the potential of this grass Gondar Agricultural Research Center tried to test its adaptability and yield potential in different agro- ecologies and animal evaluation work was done for the last two years. In this regard promising results were obtained related to its biomass production and its potential in improving the performance of sheep when used as basal diet. However, no efforts were made to introduce and utilized the potential of this grass at a large scale in the area. Therefore, considering its potential to diffuse the technology at large scale pre scaling up of Desho grass production and utilization technologies were conducted to popularize Desho grass production and utilization to sheep producer farmers so as to use for sheep fattening, to assess the farmer's perception on the technology and to create linkage with possible actors in production and utilization of Desho grass.

MATERIALS AND METHODS

Description of study areas: The study was conducted at L/Armachiho district of Chira kebele and A/Giorgis zuria kebele of Wogera district. Chira kebele is located between 12^0 17'42.18''N latitude and 37^0 13' 25'' E longitude, at an elevation of 2148m.a.s.l and A/Giorgis zuria kebele is also located at 12^0 44' 42''N latitude and 37^0 35' 53'' E longitude, at an elevation of 2913m.a.s.l.

Participant farmer's selection: Discussions were made in both districts and kebeles with livestock experts for selection of participant farmers. From the two districts, a total of 45 farmers of which 39 male and 6 females were purposively selected based on their willingness to allocate land for Desho grass production and able to prepare sheep for feeding and willing to share cost with the research center which can be used for concentrate feed purchase.

Extension methods used to disseminate the technology: To disseminate and diffuse the technology farmers research and extension group (FREG) was organized and used as group extension methods. Participatory theoretical and practical training was given to 52 farmers (6 female), 7 development agents and 6 district level experts (2 female) before Desho planting and at the start of feeding. The content of the training was focused on Desho grass production, Desho hay preparation, sheep selection for fattening, animal health management and record keeping. Besides to the training, to increase their awareness about the technology a total of 95 two pages Desho grass production and utilization flayer were prepared and distributed for all the farmers and extension workers. Field days were organized at the farmer's field and a set of farmers, kebele extension workers, district and zonal level livestock experts and multidisciplinary team of researchers were participated and invited to conduct a result demonstration and create linkage for further scaling of the technology. In field days organized 50 farmers (10 female), 4 kebele extension workers (1 female), 20 district and zonal level livestock experts (1 female), and 11 researchers from Gondar Agricultural research Center (2 female) were participated. Joint field visit and experience sharing with farmers, extension workers and researchers was done to hold method demonstration especially on Desho grass plantation and hay preparation, Sheep selection for feeding and feeding methods and record keeping.

Desho grass establishment and hay production: The popularization activity was a continuation of previous Desho grass adaptation experiment conducted in 2016 and 2017 cropping seasons. Popularized technologies were three improved adaptive Desho grass varieties namely Areka DZF# 590, Kulumsa DZF# 592 and Kindu Kosha 2 DZF# 591 with their improved production and utilization packages. A total of 39 volunteer farmers were hosted to plant Desho grass in 2018 cropping season and they were allocated from 250 to 300m^2 areas of land for Desho production. Desho grass root splits were delivered by the research center. The root splits were planted at the beginning of the rainy season on well prepared seed bed. Planting was done at a spacing of 40cm between rows and 20cm between plants. To maintain best establishment of Desho grass fertilizer at a rate of 46 kg ha^{-1} Nitrogen was applied at planting around the root splits planted. All farm operations were carried out by farmers based on the recommendation with close assistance and supervision from development agents and researchers. Desho grass hay was harvested and properly cured when the Desho grass shows a sign of heading and used as basal diet.

Concentrate preparation and feeding: Supplement feed ingredients like Noug seed cake and Wheat bran were purchased from the surrounding market. The concentrate was formulated at least to contain CP and energy to meet the recommendation for intensive feeding (i.e. 18% CP and 9 MJ ME/ kg DM) (Flint, 2005). Desho grass hay as a basal diet and 300g $head^{-1}$ day^{-1}concentrate were used as a supplement comprised of 74% Noug seed cake, 25% Wheat bran and 1% salt on DM basis.

Experimental animals and their management: A total of 16 yearling Wogera sheep were used for the study. Age of the animals was eleven months and the age of animals was determined directly by asking information from the owners. The experimental animals were examined for their health and treatments were given for internal and external parasites using broad spectrum antibiotics and anithelmintics before commencement of feeding trial. For each sheep, assuming 300g $head^{-1}$ day^{-1}concentrate was given as supplement with Desho grass hay as basal diet; water was provided ad libitum. The feeding experiment was done for 105 days including 15 days acclimatization period.

Feed intake and body weight measurements: Daily weights of concentrate and hay offered and refused were recorded to derive daily feed intake. All animals were weighed every 10 days before morning feeding. The initial weight (IW) and final weight (FW) were recorded and the average was taken as a net gain. Average daily gain (ADG) was calculated as the difference between final body weight

and initial body weight of the sheep divided by the number of feeding days. Feed conversion efficiency (FCE) which is the measure of feed utilization and was calculated as unit of body weight gain per unit of feed consumed.

Data collection and analysis: Biomass yield data was collected using one meter by one-meter quadrant from seven randomly selected participant farmers' field and expressed as dry matter yield (t ha^{-1}). Body weight changes of the animals, input cost used for sheep feeding (sheep purchasing and feed, medicament and labor cost) and benefit gained from sheep feeding were collected. Perception of farmers towards the technology was collected by using semi-structured questioner at the forage production phase and after the end of feeding period during the field day. The collected data was coded and entered into the computer Excel and analyzed using Statistical Package for Social Sciences (SPSS, 2002; ver. 22.0). Simple descriptive statistics were employed to analyze the collected data. Likert scale analysis also used to measure the framer's perception. Partial budget and sensitivity analysis were conducted to compute the variable cost of fattening, income from selling of fattened animals and cost benefit ratio. Sensitivity analysis was also calculated by considering the price of input increases and the price of output is constant.

RESULTS

Household characteristics: As indicated in Table 1, the sex of the participant households was 97.83 and 2.17% male and female, respectively. The number of female farmers was very small because the female headed farmers in the selected villages are small. All the participant farmers were married. The educational status of the participants was 50% illiterate, 23.91% from grade 1 to 4^{th}, 8.7% from grade 5 to 8^{th}, 13.04% from grade 9 to 12^{th} and the remaining 4.35% participants has college and university level.

Household assets: On average, one participant farmer owned 1.26 oxen, 2.34 cows, 0.76 heifer, 0.54 bulls, 0.25 calves and 1.83 small ruminants (Table 2). The average land holding for an individual participant was 1.28ha, with a maximum of 2.56 and a minimum of 0.38ha. On the other hand, farmers had an alternative to produce crop through renting land from people that do not have oxen or human resource to cultivate their own land. The average ranted amount of land by individual participant was 0.5 ha.

Mean Desho grass biomass yield harvested (t ha^{-1}): Improved Desho grass production and utilization has been popularized to Wogera and L/Armachiho farmers in 2018 cropping season. It was intended to popularize Desho grass varieties which were more productive than local grasses which are widely being used by farmers in the area. Biomass yield data collected from randomly selected participant farmer's field is illustrated in Table 3.

Daily feed intake, body weight change and feed conversion efficiency: The daily feed intake, body weight (BW) parameters and feed conversion efficiency of yearling Wogera ram lambs supplemented with concentrate are presented in Table 4.

Table 1: Household characteristics of the participant farmers

Variables	Attributes	Percent (%)
Sex	Male	97.83
	Female	2.17
Marital status	Married	100
	Single	-
Education status	Illiterate	50.00
	1-4 grade	23.91
	5-8 grade	8.70
	9-12 grade	13.04
	College and university	4.35

Table 2: Average livestock holding of participant farmers

Livestock class	Livestock holding (TLU)
Ox	1.26
Cow	2.34
Bull	0.54
Heifer	0.76
Calf	0.25
Small ruminant	1.83

TLU = Tropical livestock unit.

Partial budget analysis: As indicated in Table 5, sheep fattening by feeding on Desho grass hay as a basal diet and supplemented with 300 g $sheep^{-1}$ d^{-1} formulated concentrate for 90 days was profitable with an average net benefit of 691.73 ETB. The sensitivity analysis result showed that if the price of output become constant and the price of the inputs rose by 20% sheep fattening still had a positive return.

Marketing of fattened sheep: The average distance on foot for the livestock market was 0:38 and 5:30 h for A/Giorgis and Gondar town livestock markets, respectively. All fatteners (100%) sold their fattened sheep directly at a market. A majority of participant farmers (56.25%) sold their fattened sheep for traders, while 25.00 and 18.75% farmers sold their sheep for individual consumers and hotels, respectively. None of the participant farmers had gotten formal livestock market information rather getting information from their relatives and friends for their decisions. There was no any fattening cooperative around the study area which can assist the fattening operation (Tables 6 and 7).

Farmers' perception: During the field days conducted, most of the participant and non-participant farmers demanded to continue with the Desho grass production and utilization technologies as an option for sheep fattening. As indicated in Table 8, Likert scales result showed that sheep fattening was highly profitable, profitable and not profitable which accounts for 81.25, 12.5 and 6.25%, respectively. Desho grass hay was highly palatable and palatable (87.5 and 31.25 %, respectively) for their sheep.

Desho grass production can easily be done by majority (87.50%) of farmers and it can also be conducted at by 12.50% of farmers. All (100%) of the farmers strongly agreed that concentrate feed was palatable and use full for sheep fattening and 56.25% of farmers responded that by taking the formula and raw materials, they can prepare the concentrate feed at home. Almost 81.25 % of respondent farmers strongly agreed that fattening activity can be managed by women easily at home, and the remaining 18.75 % farmers agreed next to the above. Among the farmers, 50 % of agreed that there is no market problem for

Table 3: Estimated mean Desho grass biomass yield (t/ha) harvested from pre- scaling up participant farmers field at Wogera and L/Armachiho districts in 2018 growing season

District	Number of samples	Desho grass varieties used	Biomass yield harvested (t ha^{-1})	Biomass yield from local grass field (t ha^{-1})	Yield advantage (t ha^{-1})	Yield advantage (%)
Wogera	2	Areka DZF# 590	22.45	4.00	18.45	82.18
L/Armachiho	3	Kulumsa DZF# 592	11.28	4.00	7.28	64.54
L/Armachiho	2	Kindu Kosha 2 DZF# 591	7.05	4.00	3.05	43.26
		Mean	13.59	4.00	9.59	63.33

Table 4: Mean daily feed intake; initial, daily and final body weight of yearling Wogera ram lambs supplemented with concentrate feed at Wogera and L/Armachiho districts

Parameter	Mean value
Dry matter intake	
Hay DM intake (g day^{-1})	591.19
Supplement DM intake (g day^{-1})	300.00
Total DM intake (g day^{-1})	891.19
Initial body weight (kg)	18.25
Final body weight (kg)	26.50
Net gain (kg)	8.25
Average daily gain (g day^{-1})	91.67
Feed conversion efficiency (FCE)	0.09

DM= dry matter**.**

Table 5: Costs benefit analysis

Variables	Partial budget analysis (ETB)	Sensitivity analysis (ETB)
Fattened sheep selling price	1975.00	1975.00
A. Total Benefit	1975.00	1975.00
Purchase price of sheep	1100.00	1320
Concentrate purchase	151.88	182.25
Price of medicaments	4.80	5.76
Labor for chopping hay	26.60	31.92
B. Total Cost	1283.28	1539.93
Net benefit (A-B)	691.73	435.07
Benefit/Cost ratio (A/B)	1.54	1.28

ETB= Ethiopian birr.

Table 6: Marketing information on sheep fattening.

Parameter		N	Frequency
Where is the livestock market for you	"A/Giorgis" and "Gondar "	16	100
How did you sell your fattened sheep	Directly at a market	16	100
For what type of buyer did you sell your fattened sheep	Individual consumer	4	25.00
	Traders	9	56.25
	Hotels	3	18.75
Did you get livestock market information formally	Yes	0	0
	No	16	100
Is there any livestock fattening cooperative around	Yes	0	0
	No	16	100
What are the market problems do you faced	Selling price was not attractive	10	62.5
	No alternative buyer	6	37.5

N= sample

fattened sheep but few of participant farmers (12.5 %) disagreed and believed that if the fattening activity is not linked with the hotels and restaurants, there will be high market problem especially after holidays.

DISCUSSION

Household characteristics: Based on the educational status data half of participant's was illiterate; this shows that the demonstrated Desho grass production and utilization technologies can be simply done by farmer's indigenous knowledge without having formal education.

Mean Desho grass biomass yield harvested (t ha^{-1}): From the pre- scaling, up of Desho grass varieties in Wogera and L/Armachiho districts the highest biomass yield (22.45 t ha^{-1}) was obtained from Areka DZF# 590 variety while Kindu Kosha 2 DZF# 591 and Kulumsa DZF# 592 varieties gave biomass yield of 7.05 and 11.28 t ha^{-1}, respectively. Variations in biomass yield could be attributed to the differences in plot cover, plant height and number of tillers as a result of genetic difference observed between the varieties. This result was in line with the result of Alemu Tarekegn *et al.* (2019) who reported biomass yield of 22.33t ha^{-1} form varieties Areka DZF# 590 at Wogera and Dembia districts in 2016 and 2017 growing seasons. Generally, more than the forage quality that Desho grass hay had 63.33% biomass yield advantage was obtained from the local grass hay harvested.

Daily feed intake, body weight change and feed conversion efficiency: Compared to the present study a lower mean total dry matter intake of 711.73 g/d was reported by Mulu Moges *et al.* (2008) for Wogera yearling ram lambs when they were fed on grass hay and supplemented with 300g/d brewery dry grain. A higher dry matter intake achieved may be due to increasing level of crud protein in Noug seed cake and Wheat bran mixtures since higher dietary protein supplementation is known to improve intake by increasing the supply of nitrogen to the rumen microbes. The average weight of fattened sheep changed from 18.25 to 26.50 kg with a final body weight gain of 8.25 kg by feeding Desho grass hay as a basal diet and supplemented with 300 g/d formulated ration. The higher average daily gain achieved in the present study might be due to the body weight gain tended to increase for the higher crud protein intake as a result of higher protein concentration in Noug seed cake and wheat bran mixtures. The feed conversion efficiency result in the present study was in agreement with the results of Mulu Moges *et al.* (2008) who reported a FCE of 0.11 for the same sheep breed when they were fed on grass hay and supplemented with 300g/d brewery dry grain.

Conclusion and Recommendation: Generally, the present study indicated that an average 13.59t ha^{-1} biomass yield was obtained from the Desho grass varieties used for the scale- up with 63.33% yield advantage over the local grass. Use of Desho grass hay as basal diet with a minimal concentrate supplementation can help to improve daily weight gain (91.67g/d) of wogera yearling lambs. From the partial budget and sensitivity analysis results it can be concluded that use of Desho grass hay as basal diet and supplemented with concentrate was found profitable in generating additional income for smallholder farmers. According to the Likert scales analysis result, the fattening technique was accepted by the farmers and the extension

Table 7: Average livestock market distance in hour from participants' residence

Parameter	N	Min	Max	Mean	SD
How far A/Giorgis livestock market from your residence in hour	16	0.30	0.45	0.38	0.09
How far Gondar livestock market from your residence in hour	16	5.00	6.00	5.30	0.44

N = total sample, Min = minimum, Max = maximum SD = standard deviation.

Table 8: Farmer's perception on the technology scaled

Questions/variables		Strongly agree	Agree	Neither	Disagree	Strongly disagree
The sheep fattening sector was profitable	N	13.00	2.00			1.00
	%	81.25	12.5			6.25
The Desho grass hay was useful and most palatable to sheep	N	14.00	2.00			
	%	87.50	12.50			
Desho grass production was easy to me	N	11.00	5.00			
	%	68.75	31.25			
The concentrate was useful and most palatable to sheep	N	16.00				
	%	100.00				
The concentrate can be prepared by my self-using the formula	N	2.00	9.00	2.00	3.00	
	%	12.50	56.25	12.50	18.75	
sheep fattened by feeding concentrate and Desho grass hay was preferable by the consumers than the traditional one	N	12.00	4.00			
	%	75.00	25.00			
There is no any market problem on the fattened sheep at nearest livestock market	N	4.00	8.00	1.00	2.00	1.00
	%	25.00	50.00	6.25	12.50	6.25
Sheep fattening can easily be managed by women at home	N	13.00	3.00			
	%	81.25	18.75			
There is no labor shortage in participating in sheep fattening at household level	N	7.00	6.00	1.00	2.00	
	%	43.75	37.50	6.25	12.50	

N= total sample.

linkage was created with the respective actors. Therefore, Desho grass production and utilization technologies as a means for sheep fattening should be highly promoted especially in areas where suitable for Desho production.

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