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Monitoring On-Farm Sheep Fattening Performance in Fogera District, Amhara National Regional State, Ethiopia

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Abstract
The study was conducted in Fogera district with the objectives to monitor on-farm fattening performance, and to determine profitability of sheep fattening farmers. A partial budget analysis method was employed to determine profitability. Twenty lambs with initial body weights of 27.1±0.71kg (mean ±SE) were used to monitor farmers' sheep fattening performance for 90 days feeding. These experimental sheep were randomly assigned to four dietary treatments which were T1 = grazing + hay + grass pea straw as basal fed; T2= T1+ (201g atela and 99g rice bran); T3= T1+ (99g atela and 201g rice bran); T4= T1+300g rice bran. On-farm fattening sheep weight changes were regularly monitored in Quhar Michael kebeles. Feed dry matter (DM) intake of sheep was determined on daily basis. Data analyses were carried out using SAS software. On-farm monitoring result showed that sheep assigned in supplement diet had significant ($P<0.05$) average body weight change and daily gain than the control (T1). However, no statistical difference ($P>0.05$) was observed among supplemented groups. Moreover, there was no difference in supplement DM intake among T2, T3, and T4. Similarly, all supplemented groups were similar ($P>0.05$) in feed conversion efficiency. Economically all sheep in supplemented treatment groups (T2, T3, and T4) had returned a higher net income (390.25 ETB) as compared to the non-supplemented once (T1). This indicates that supplementary feeding of rice bran and atela could have significant contribution to the development of sheep fattening business in the study area. As an opportunity, however, at present sheep population are at increasing rate and farmers are also looking for the availability of seasonal feed resource like grass pea residue, rice bran and other crop residues. Hence, detail studies on suitable sheep breed, chemical composition and digestibility of the major available supplement feeds are further required to plan a sustainable sheep fattening program at smallholder level.
Keywords: agro-industry by product, live weight change, profit analysis, dry matter intake

INTRODUCTION

Livestock perform multiple functions in the Ethiopian economy by providing food, cash income, promoting saving, social functions, and employment. Feed shortage is one of the limiting factors for increasing production and productivity of small ruminant in most of the agro-ecological zones in Ethiopia (IPMS, 2010). As demand for livestock products increases (FAO, 2009) and agricultural intensification gaining a momentum, livestock, particularly small ruminant, became an important agricultural enterprise in Ethiopia (Awgichew Ayalew, 2000).

The major available feed resources in Ethiopia are natural pasture, crop residues; aftermath grazing, agro-industrial by-products, to a lesser extent improved pasture, and cultivated forage crops (Alemayehu Mengistu, 1987; Seyoum Bediye and Zinash Sileshi, 1989). However, these livestock feed resources contribution is varying from place to place (Firew Tegegne and Getnet Assefa, 2010). Like other groups of farm animals, sheep thrive on natural pasture, crop residues, traditional brewers by product (*atella*), browse species and agro-industrial by-products (Alemayehu Mengistu, 1987; IPMS, 2010). Indeed the use of agro-industrial by-products that are locally available and complement each other is an advantage in utilization of nutrients, and thereby improving animal performance especially as a supplement to grazing animals (Shapiro *et al.,* 2004).

Concentrate feed supplementation is one strategy, which can increase digestibility, nutrient supply and intake and consequently muscle growth (Preston and Leng, 1987). However, concentrate feed resources especially grains are expensive and highly valued as human food. In addition, other energy and protein source agro-industrial by-products are very expensive and they are not accessible to smallholder farmers. Therefore, it is imperative to look for other alternative feedstuffs which are from locally available agro-industrial by-products such as rice bran and non-conventional feed like ''*atella''* to sustain and improve sheep fattening activities of the smallholder farmers. Fogera district is very well known by Fogera cattle breed, emerging sheep fattening practice and cereal crop production (mainly rice production) and the resulting crop-residues could be used as potential feed source for sheep fattening. Although Fogera district has large resource of sheep population and lack of management practices. This study was designed to monitor on-farm fattening sheep performance and to determine the profitability of sheep fattening practices at smallholder level in Fogera district.

MATERIALS AND METHODS

The Study Area

The research was conducted in Fogera district north western Ethiopia. It lies between 110° 41' to 110° 53' north

latitude and 370° 41' to 110° 53' east longitude and at altitude of 1802 meters above sea level (m.a.s.l.). and with annual rainfall range from 1,000–1,500 mm. The mean maximum and minimum temperature are 11^0C and 27^0C, respectively.

Sampling Methods and Sample Size

In the current study, information was first gathered from Fogera district agricultural office about traditional sheep fattening activity in each kebele of the district. Considering the 28 *kebeles* under each traditional agro-ecological zone classification using secondary data obtained from FWARDO; mountain and valley bottom (22 *kebeles*) and plain area (6 *kebeles*) agro-ecology were categorized Using purposive sampling procedure twenty sheep from eleven households each having one and above local male sheep were monitored (on-farm) between January 2013 and April 2013 in one *kebele* (Quhar Michael) based on fattening practices and accessibility.

Data Collection

Data collection formats were developed for on-farm sheep fattening performance. Fattening sheep performance such as feed (dry matter as sundry base) intake and body weight change were recorded for each experimental animals on the format. Daily feed offered and refusals were recorded by the farmers/fatteners and weights of each animal were undertaken by the researcher every ten days after overnight fasting.

Monitoring Fattening Animals and Their Management

Twenty intact male sheep with 27.1±0.71kg (mean ± SE) body weight selected from eleven farmers at quhar michael kebele. To know the initial body weight of sheep for fattening were measured by using weight balance. The selected farmers had at least one sheep in fattening program and they would have a good collaboration to undertake the monitoring and data collection of supplement feed intake and body weight measurement. Animals were dewormed with albendazole and ivermectin against internal and external parasites during the 15 days quarantine period, respectively.

Monitoring Design and Treatment

The monitored animals were arranged in completely randomized block design. Monitored sheep were assigned on the basis of their initial live weight into five blocks of four sheep per block for 90 days feeding program. Based on farmers fattening practices and feed resource availabilities, simply by adjusting treatments consisted of locally available feed resources as T1 basal diet (grazing + grass hay + grass pea residue), T2 supplemented (T1+dried *atela* 67%+ rice bran 33%), T3 supplemented (T1+dried *atela* 33%+ rice bran 67%) mixtures and T4 supplemented (T1+rice bran 100%) alone. The basal diet (grazing, grass hay, grass pea residue) was available *ad libitum* to all treatments, was not measured, whereas the daily supplement per animal was limited to 300 gram DM**.** All animals also had a free access to common salt and drinking water. The daily supplement of dried *atela*, rice bran mixtures and rice bran alone were offered in two equal portions at 9:00AM and 7:00 PM G.C after fed the basal diet. The total time of grazing was about 4 hours per day (2:30 before and 1:30 afternoon). Farmers' sun dried their own atela on plastic sheet for about three days.

Table 3.1: Experimental treatment

Trt Nº	Basal diet	Supplement proportion (DA: RB) (%)	quantity
T1	Grazing + hay+ grass pea (lathyrus sativus) straw *adlib*	-	-
T2	Grazing + hay + grass pea (lathyrus sativus) straw *adlib*	67:33	300g/day
T3	Grazing + hay + grass pea (lathyrus sativus) straw *adlib*	33:67	300g/day
T4	Grazing + hay + grass pea (lathyrus sativus) straw *adlib*	0:100	300g/day

DA= dried *atela;* RB= rice bran; T=treatments

Supplement Feed Intake and Body weight gain

The sun dried supplement feeds were weighed by using a weighting balance. Daily supplement feed intake was calculated on DM bases as the difference between the amounts of feed offered and refused. Intake of supplement DM was also determined for each animal.

Figure 3.2: Mixing of local dried brewery residues (locally known as *atela*) and rice bran fed to fattening at farmers' door

Average daily BW gains were calculated as the difference between final BW and initial BW divided by number of feeding days. The feed conversion efficiency of experimental animals was determined by dividing the average daily BW gain to the amount of feed consumed.

Figure 3.3: Body weight measurements by using weight balance

Partial Budget Analysis

For the determination of the potential profitability of new technology by partial budget analysis purchasing and selling prices of sheep, and the total quantity of supplement feed and its purchasing prices were recorded. However, other costs like basal diet and labor were common for all monitored animals and not considered. At the end of the monitoring the price difference of sheep in each treatment purchasing price before and selling price after the experiment was considered as total income in the partial budget analysis. Therefore, the selling price of each monitored animal was determined after selling of fattened sheep during the Easter holiday market.

Variable cost partial budget was determined as a difference between the feed, medicament costs and selling price of sheep. Net income (NI) was calculated as the amount of money left when total variable costs (TVC) were subtracted from total returns (TR).

$NI = TR - TVC$

The change in net income (ΔNI) was calculated as the difference between change in total return (ΔTR) and the change in total variable costs (ΔTVC).

$\Delta NI = \Delta TR - \Delta TVC$

The marginal rate of return (MRR) measures increases in net income (ΔNI) associated with each additional units of expenditure (ΔTVC).

$MRR = \Delta NI / \Delta TVC \times 100$

Statistical Analysis

Data from supplement feeding trials were subjected to analysis of variance (ANOVA) using the General Linear Model of SAS (SAS, version 9.1, 2002). When treatment effect is found significant, least significant difference (LSD) was employed to detect differences among treatment means. The model for supplement feeding trials data analysis was:

$Y_{ij} = \mu+T_i+B_j+E_{ij}$

Where: Y_{ij} = the response variable/observation in j^{th} block and i^{th} treatment
μ = the overall mean
T_i= the treatment effect/ the i^{th} treatment effect
B_j = the block effect/the j^{th} block effect
E_{ij} = the random error

RESULTS AND DISCUSSION

On-Farm Fattening Performance

In the current study, traditional sheep fatteners used the rice bran and local brewery (*atela*) mix supplementation due to the accessibility of rice bran in the district. This indicates, they may consider the CP content of the diet that used to increase the live weight gain of fattening animals. Similarly, several improved traditional systems are in use, but they are not widespread. For example, systems of sheep fattening exist in the Adillo area of the southern region where conditioned animals are fattened by feeding sweet potatoes and other high value ingredients (ESGPIP, 2012). One of the major limiting factors for productivity of animal in the mixed crop livestock system, in general, is low proportion of Crud Protein (CP) in the diet (Preston, 1982) and lack of understandings of constraints governing the utilization of low protein feed by ruminants. Low productivity on these diets can usually be related to low voluntary intake even if feeding is *adlibitum* and the latter defines the rate of productivity (e.g. weight gain).

Supplement Feed Intake and Body Weight Change

The result of mean daily supplement feed intakes and body weight change of monitored sheep are presented in Table 4.21. Supplement diet DM intake was not statistically significant (P>0.05). However, numerically sheep fed on T2 (dried *atela* + rice bran mix) 291.1g/ day consumed more supplement DM than those supplemented on T3 (rice bran + dried *atela*) 283.1g/day and T4 (rice bran) 278.7g /day. The result was comparable to that reported by Gizat Teshale (2012) ranges 276.1-281.8g/day. This result indicates that high ratio of supplementation of dried atela increases the DM intake of fattening sheep due to high CP content. In comparison, the supplement feed intake of treatments had no significant difference (P>0.05) among monitored animals. The feed conversion efficiency of supplemented sheep had no significance difference (P>0.05) among each treatments. The similarity in efficiency of feed conversion was probably the result of high energy intake and because of high crude protein content of the diet that the net efficiency use of metabolizable energy might have been increased.

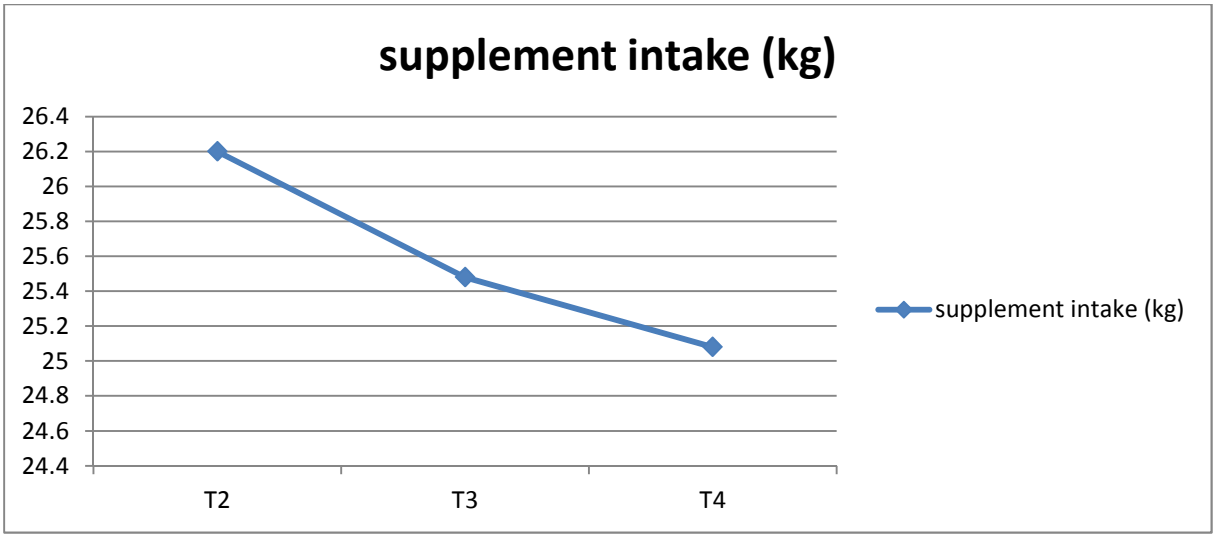

Figure 4.8: Supplement feed intake of treatments (T2, T3, and T4)

During monitoring the mean live-weight of sheep before and after fattening period was about 27.1± 0.71kg and 31.22±0.31kg, respectively and resulted in mean live-weight change of about 4.12kg per fattened sheep over 90 days of feeding length, which is equivalent to 45.73gm daily weight gain in the study *kebele*. Mean initial and final body weight and average daily gain (ADG) of the experimental animals are presented in

Table 4.21. Initial body weights of analysis by covariance had no significance difference (P>0.05); whereas final body weight had significance difference (P<0.05) among treatments.

The body weight changes and average body weight gain data are presented in Table 4.21. The ANOVA of body weight change and average body weight gain had no significance difference (P>0.05) of 90 days monitoring period. There was no significance (P>0.05) difference in the supplemented treatments. The final body weight and average daily weight gain of treatment groups had no significance difference (P>0.05) in the supplemented group. However, the effect of *atela* and rice bran on body weight gain should be evaluated under well controlled and designed on-station experiment. The average daily body weight gain of 30.9, 51.6, 51.1and 49.3 g/sheep/day was recorded for sheep in T1, T2, T3, and T4 groups, respectively and the body weight gain tended to increase for the higher CP intakes. The mean final body weight result of T2 and T3 was better than the supplement group T4 and unsupplement (T1) was observed. Similarly, Supplemented sheep had higher (P<0.001) daily BW gain, final BW, and better feed conversion ratio compared to the non- supplemented sheep reported by Fentie Bishaw and Solomon Melaku (2008). Rice bran (T4) supplemented treatment daily BW gain, and final BW was lower. This may be due to the lower CP content of rice bran, and consequently low digestible CP intakes of the sheep as compared to other supplemented treatments. Hence, the similarities of different feed supplemented group of body weight change may be due to the basal diet feed intake, free grazing or animal walking, mating of rams and may also poor husbandry (housing, watering). Therefore, fluctuations of body weight lose were observed. The coefficient variations were 11.72% and 4.42% for initial and final body weight, respectively. The results of average daily gain of the supplemented treatments of this study were comparable to those reported by Bimerew Asmare (2008) which were in the ranges 37.8-72.2g/day, but lower than the findings of Fentie Bishaw and Solomon Melaku (2008) which were 70.11, 70.88, 82.44 and 73.44g/day for T2, T3, T4, and T5, respectively.

Table 4.21: Body weight change of sheep fed on (grazing, hay, and grass pea residue), supplemented with dried *atela* and rice bran mixture; and rice bran alone

Parameters	T1	T2	T3	T4	MSE	P	SL
Initial weight (kg)	26.10^{a}	26.80^{a}	27.5^{a}	28.0^{a}	0.71	0.3270	ns
Final weight (kg)	28.88^{b}	31.44^{ab}	32.1^{a}	32.44^{a}	1.38	0.0062	**
BWC (kg)	2.78^{b}	4.64^{a}	4.60^{a}	4.44^{a}	1.35	0.1431	ns
ADG (g)	30.9^{a}	51.58^{a}	51.1^{a}	49.34^{a}	15.05	0.1434	ns
Supplement Intake(kg)	-	26.2^{a}	25.48^{a}	25.08^{a}	0.92	0.2127	ns
FCE	-	0.18^{a}	0.17^{a}	0.17^{a}	0.06	0.9946	ns

*ab Means with different superscripts in the same row are significantly different at P < 0.05; ns= values are none significance at (P>0.05): **= values are significance at (p<0.05); ADG=average daily gain; SEM=standard error of mean; FCE= feed conversion efficiency; SL= significance level; T1 = grazing + hay + grass pea straw basal fed; T2= T1+ (*atela* 201g and rice bran 99g); T3= T1+ (*atela* 99g and rice bran 201g); T4= T1+300g rice bran.

Partial Budget Analysis

Partial budget analysis of on-farm sheep fattening practices are presented in Table 4.22. The results of the current study indicated that, supplemented sheep had returned a higher net income (390.25 ETB) as compared to the non- supplemented sheep (140.65ETB).

Table 4.22: Partial budget analysis sheep fed on basal and *atela* and rice bran supplement

Variables	Treatments (Mean)				
	T1	T2	T3	T4	Group Mean
Sheep cost (ETB/head)	530	670	641	678	629.75
Supplement feed cost (ETB/head)	-	29.75	18.35	8.1	14.05
Medicament cost (ETB/head)	1.35	1.35	1.35	1.35	1.35
Total input cost (ETB/head)	531.35	701.1	660.7	687.45	645.15
Sheep sold price/GI (ETB/head)	672	1100	1034	1086	973.0
Total return/TR (ETB/head)	142	430	393	390	343.25
NI /NR	140.65	398.9	373.3	398.55	327.85
ΔTVC	-	29.75	11.4	10.25	5.95
ΔNI	-	258.25	25.6	25.25	70.7
MRR (ΔNI/ΔTVC)	-	8.68	2.21	2.46	11.88

GI=gross income; NR =net return; MRR= marginal rate of return; ΔNI = change in net income; TR =total return; TVC = change in total variable cost; ETB = Ethiopian birr; T1 = grazing + hay + grass pea straw basal fed; T2= T1+ (*atela* 201g and rice bran 99g); T3= T1 + (*atela* 99g and rice bran 201g); T4= T1 +300g rice bran

The net return from the supplemented treatments was ranging from 373 to 398 ETB and 398.55±24.02for ETB/head with marginal rate of return (MRR) of 8.68, 2.21, and 2.46 for T2, T3 and T4, respectively. Hence, this reveals that each additional unit of one ETB per sheep cost increment resulted in one

ETB and additional 8.68, 2.21, and 2.46 ETB benefit for T2, T3 and T4, respectively. Supplementation has been a big concern both for extending and for adopting of new research findings or technologies in animal production. However, supplementation on *atela* 201g and rice bran 99g (T2) returned a higher net income (398.9±24.02) as compared to the other treatments. To suggest the options of utilization of this research result, conditions of the production environment has to be looked into. Hence, if capital available for sheep farmers to make use of the potential of new technology, 300g DM concentrate mix (DA: RB in 2:1 ratio) supplementation (T2) and 300g DM rice bran alone (T4), which resulted in the highest net profit. In this study; supplementation improved body weight change of sheep and correspondingly increased the net income from the sale of sheep at the end of the feeding trial. This is because the difference in net return per animal was obviously the reflection of difference in the body weight change and feed conversion efficiency of the animal. Hence, in the present study, it was concluded that supplementation of dried *atela* and rice bran 300 g DM/day / head concentrate is biologically efficient and potentially profitable in feeding sheep.

Conclusion

Sheep fattening practice is an important farming activity in the study area. Supplement brewery byproduct (atela) and rice bran mixture to the basal grass hay and grass pea residues diets farmers practice improved performance of the animals as well as the profitability.

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