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Research Paper

COMPARATIVE EVALUATION OF THE FATTENING PERFORMANCE OF FOGERA AND ADET OLD OXEN AT ANDASSA LIVESTOCK RESEACH CENTER, ETHIOPIA

Adebabay Kebede[1]*, Addisu Bitew[1], Tewodros Bimrew[1], Asresu Yitayew[1], Yihalem Denekew[1], Yeshiwas Ferede[1] and Getinet Zeleke[2]

*Corresponding Author:**Adebabay Kebede,** ✉ adugsen@gmail.com

This study was conducted at Andassa Livestock Research Center to evaluate the fattening potential of two breeds of cattle in Amhara region and evaluate the economic feasibility of feed treatments. Twenty four (12 Adet and 12 Fogera) old oxen were evaluated for a period of 90 days allotted to three different feeding levels. The experimental oxen were blocked by weight and randomly assigned to the different concentrate feeding levels. Analyses were involved 2 by 3 factorial arrangements with breed and feed level groups respectively. Hay was provided as a basic ration adlibitum. Dry matter intake, body weight, and body condition were recorded. Analysis of results showed that except for total acid detergent fiber intake and total neutral detergent fiber intake, least square means were significant between treatments ($P<0.01$; $P<0.001$). Total TDMI per day was also highly significant between breeds and feeding levels ($P<0.01$). The feed conversion efficiency of the experimental animals were not significantly different ($P>0.05$) consistently between breed, treatment and the interaction between breed and feeding level. Final body weight and weight gain and average daily gain of experimental animals were highly significant between breeds ($P<0.01$). The Net return (ETB head^{-1} per 90 days) for Fogera oxen was 2811.92, 4474.84 and 4799.76 for 2 kg, 4 kg and 6 kg concentrate feeding levels respectively. The Net return (ETB head^{-1} per 90 days) of Adet oxen were 2849.92, 2561.84 and 1949.76 for 2 Kg, 4 kg and 6 kg concentrate feeding levels. The study indicated that the economical fattening period for fogera cattle is 10 weeks. The results of this study indicated that Fogera oxen has higher fattening potential compared to Adet oxen in terms of weight gain, average daily gain and economics of fattening(gross return, net return and marginal rate of return. From the results of this study it is wise to recommend 2 kg and 5.1 kg of concentrate ration supplementation per day for Adet and Fogera cattle breed respectively. Besides, given the same feeding regime, it is recommended that Fogera cattle should be fattened for 75 days excluding the adaptation period than the conventional 3 months.

Keywords: Adet, Amhara Region, Fogera, Fattening Performance and Total Dry Matter Intake

[1] Andassa Livestock Research Centre, P.O.Box 27, Bahir Dar, Ethiopia.
[2] Amhara Regional Agricultural Research Institute, P.O.Box 1790, Bahir Dar, Ethiopia.

BACKGROUND

Cattle fattening has gained prominence as an important business project of the livestock industry in Ethiopia to make use of cheap, plentiful farm by-products (Habitamu *et al.*, 2008). Even though there is ample potential, beef production in Amhara region is characterized by its minimum investment and by the use of the indigenous cattle breed in mixed smallholder system. The potential to produce enough beef for the population and the neighboring countries is high. This potential is however, has remained unexploited for a number of reasons. Very low technology for beef enterprise, poor feeding and production system, endemic diseases and pests, poor marketing channels and lack of effective extension service have hindered increased production of beef in quantity and quality.

In few areas of the region there are remarkable fattening practices however, the fattening performance and economically fattening period for the defined breeds is not determined. For instance, Smallholder cattle fatteners of Tana corridor believe that Fogera cattle have low fattening potential than other highland zebu breeds despite it has never been approved through research. Besides, most fatteners of the region have little or no information about the minimum shortest period of fattening. Therefore, collecting information on animal performance on the farm makes it possible to identify production prospects, as well as different management variables and their effects on the production process. It is also helpful in identifying problem areas enquiring more in-depth assessment of cause-effect relationships and production aspects in which improvements can be made. The objectives of the study were to evaluate the fattening potential of two breeds of cattle in Amhara region and evaluate the economic feasibility of feed treatments.

MATERIALS AND METHODS

Location and Study Area Description

This study was conducted at Andassa Livestock research center. The center is found about 22 km south of Bahir Dar city on the road to Tis Abay. It is located 11029'N latitude and 37029'E longitude with an elevation of 1730 m above sea level. The area has variable topography, which varies from a river valley plain to gentle slope grassland. In general, the area is characterized by dark clay soil, which is seasonally water logged in the rainy season and cracked when dry. The area receives about 1434 mm of rainfall annually. The mean annual temperature vary from a maximum of 29.5^{o}C in March to a minimum of 8.8^{o}C in January. The dominant vegetation of the area includes *Cyndon* spp., *Hyperrhenia* spp., *Palspalum* spp., *Pennisetum* spp., *Setaria* spp., *Elusine* spp., *Eragrostis* spp., *Sporobolus* spp., and *Andropogon* spp. and local *Trifolium* species (Yihalem, 1994).

Experimental Design and Treatments

Experimental animals were systematically grouped into two breeds/cattle types and three treatment groups based on their initial live weight, and were randomly assigned by ordering the initial weight of animals from lowest to highest and bringing similar or closest weights together and grouped into four replications using lottery method to the treatments resulting in Split Plot Design. The average weights of experimental animals under each feeding level/treatment were more or less similar. After two weeks of adaptation period, each animal were weighed using heart-girth measurement at the beginning

of the experiment and fortnightly thereafter. Average daily gains (g/d) were calculated as differences between final and initial body weights divided by 90 days of feeding period. Four animals of both cattle types were allotted to each of the following three levels of dietary treatments:

1. Hay + 2 kg formulated ration
2. Hay + 4 kg formulated ration
3. Hay + 6 kg formulated ration

Experimental Animals, Feeding and Health Management

A total of 24 draught oxen (12 Fogera and 12 Adet) were used for this experiment. Experimental animals were placed in loose tie barn with concrete floor and individual pen. These experimental animals were physically examined as apparently healthy and treated against internal and external parasites using broad spectrum anthelmintics and vaccinated against bovine pasterolosis before the commencement of the trial. All experimental animals were individually fed their corresponding rations for 15 days of adaptation followed by a 90 days experimental period (Tesfaye *et al*., 2007). Concentrate ration was formulated using a win feed computer program comprising of 58% sub-graded maize grain, 40% noug cake and 2% salt. Experimental feeds were selected based on their availability in the area. Weight, initial price, input costs (feeds, medication, and labor) and selling price data were collected. Hay was offered adlib as a basic ration. Fattening old oxen was also offered water ad libitum. The feed conversion efficiency of experimental animals was calculated as kg gain/ kg DMI. Body conditions of experimental cows were scored from 1 to 5 monthly (Richard, 1993).

Chemical Analysis

Offered hay and concentrate samples were taken daily, bulked on a weekly basis and oven dried at 65 °C for 72 h and analyzed for DM, N (Kjeldahl-N) according to AOAC (1990) procedures. Neutral Detergent Fiber (NDF) and Acid Detergent Fiber (ADF) were determined by the methods of Van Soest and Robertson (1985). Hemi cellulose was calculated from the difference between % NDF and % ADF.

Partial Budget Analysis

The partial budget analysis was based on the calculation of the total cost of the basic ration (hay) and supplemented feed levels (concentrate) and considering initial and final livestock purchasing and selling price incurred during the entire experimentation process. Partial budget analysis was employed to compute variable cost of concentrate feed ingredient /treatment, gross return per treatment, gross income from sale of animals/ treatment, net profit/treatment and marginal rate of return. Sensitivity analysis was calculated provided that the price of input increases and the price of output decreases.

Statistical Analysis

Analyses involved 2 by 3 factorial arrangements with breed and feed level groups respectively. Analyses were conducted with the model that included feeding level (2, 4, 6 kg) and breed (Fogera and Adet Highland Zebu) as main effects. During preliminary analysis interaction effect between breed and feed level groups was found significant except for dry matter and nutrient intake and hence included in the model. The initial body weight was also included as covariate in the model to adjust weight gain during experimental period. Data from feed intake, weight gains and income were subjected to GLM analysis of

variance (ANOVA) procedure of SAS (1999). Means were separated using Duncan's Multiple Range test (alpha=0.05). Covariates in the model are evaluated at the following values: initial weight = 328.88. The statistical model used was:

$$Y_{ijk} = \mu + a_i + f_j + (af)_{ij} + b + (Inwt_{ij} - Inwt) + e_{ijk}$$

where

Y_{ijk} = individual observation,

μ = Over all mean,

a_i = effect of i^{th} feeding level (i =2, 4, 6 kg)

f_j= effect of j^{th} breed of the animal (Fogera and Adet Highland Zebu)

af_{ij} = Interaction effect of the i^{th} feeding level and j^{th} breed of the animal

b = linear regression of initial body wt (Inwt) on subsequent body weight gains

e_{ijk} = residual error

RESULTS AND DISCUSSION

Chemical Composition and Organic Matter Digestibility of Experimental Ration

The DM and OM content of supplemented concentrate in this study has comparatively lower than the experimental concentrate feed composed of 75% maize grain, 24% Noug cake and 1% salt and supplemented for local dual purpose cows for milk production (Adebabay *et al.*, 2010, while, it has a bit higher CP (175 g/kg), NDF (219 g/kg, NDF (219 g/kg, and ADF (116 g/kg) and HC (103 g/kg) (Table 1).

DM and Nutrient Intake

Total dry mater and nutrient intake of experimental oxen are presented in Table 2. Except for total acid detergent fiber intake and total neutral detergent fiber intake, least square means were significant between treatments ($P<0.01$; $P<0.001$). Total TDMI per day showed significant difference between breeds and feeding levels

Table 1: Chemical Composition and Digestible Organic Matter Digestibility of Experimental Feeds (g/kg DM)

Measurements	Livestock Grade Maize Grain	Noug cake	Hay		Concentrate Mix
			Offered	Refused	
DM	883	923	915	93.3	892.5
OM	988.2	912.8	912.2	914.9	870
CP	111	349	58.2	52	175
ADF	34.6	296	419	466	116
NDF	156	358	668	665	219
Lignin	29.2	113	44.5	52.9	44.6
Ash	11.8	87.2	87.8	85.1	130
Hemi-cellulose*	121.1	62	249	199	103
DOMD	975	645	413	387	812

Note: Hemi-cellulose = % NDF – % ADF.

Table 2: Estimated Daily Total Nutrient Intake of Adet Highland Zebu and Fogera Oxen

Parameters	Treatments			LS	Breed		LS
	2 Kg	4 Kg	6 Kg		AHZ	Fogera	
TDMI hay	5.4a	5.22a	4.02b	*	4.11b	5.65a	***
TDMI Conc.	1.83c	3.53b	4.53a	***	3.54	3.05	NS
TDMI/day	7.23[b]	8.75[a]	8.53[a]	*	7.65[b]	8.70[a]	*
OMI conc.	1.59[c]	3.07[b]	3.92[a]	**	3.07	2.65	NS
OMI Hay	4.92[a]	4.76[a]	3.67[b]	**	3.76[b]	5.15[a]	***
TOMI	6.51[b]	7.83[a]	7.59[a]	*	6.83[b]	7.79[a]	*
CPI conc.	0.32[c]	0.62[b]	0.79[a]	***	0.62	0.53	NS
CPI hay	0.31[a]	0.30[a]	0.23[b]	**	0.24[b]	0.33[a]	***
Total CPI	0.63[b]	0.92[a]	1.02[a]	***	0.86	0.86	NS
ADFI conc.	0.21[c]	0.41[b]	0.52[a]	***	0.40	0.35	NS
ADFI Hay	2.26[a]	2.19[a]	1.69[b]	**	1.73[b]	2.36[a]	***
Total ADFI	2.47	2.60	2.21	NS	2.13[b]	2.71[a]	**
NDFI conc.	0.40[c]	0.77[b]	0.97[a]	**	0.77	0.67	NS
NDFI Hay	3.61[a]	3.49[a]	2.69[b]	**	2.75[b]	3.77[a]	***
Total NDFI	4.01	4.26	3.67	NS	3.52[b]	4.44[a]	**
FCE	0.074	0.11	0.10	NS	0.09	0.10	NS

Note: Means followed by different superscript letters within rows are significantly different (P<0.01, P<0, 05); NB: NS=P>0.05; ***=P<0.001; **=P<0.01; *=P<0.05; LS=Level of significance.

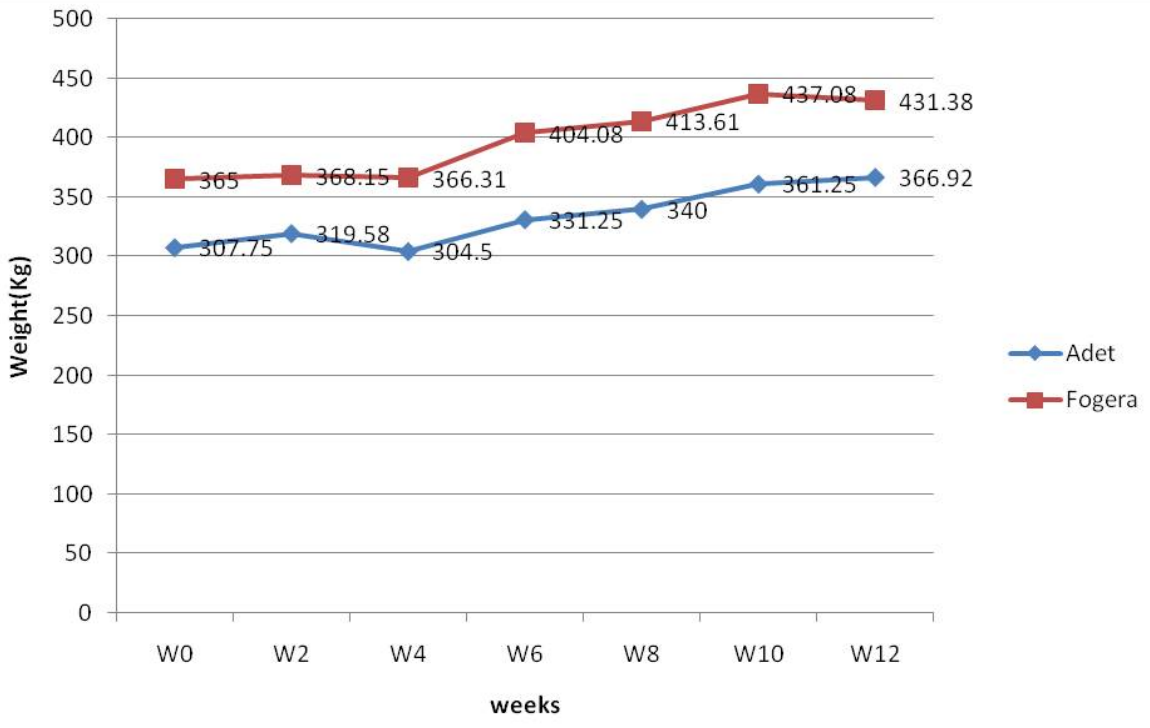
(P<0.01). The variation in total kg DMI per day between the two breeds was largely the result of better intake of hay per day of Fogera breed than Adet highland zebu which might be due to better body size and weight of the former breed. Nega *et al*., 2002 in Adami Tulu Agricultural Research Center have also reported lower dry matter intake per day between Arsi (2.38 kg) and Boran (3.37 kg) breeds fed on a ration composed of teff starw (42%), nougseed cake (25%), maize grain (32%) and Salt (1%) during restrictive phase. In contrast, higher dry matter intake was reported than the current study for Boran (5.8 kg) and Arsi (4.58 kg) fed on a ration composed of teff (29%), wheat bran (53%), Noug cake (17%) and salt (!%) during the re-alimentation period. Total acid detergent fiber intake and total neutral detergent fiber intake was highly significant difference between the two breeds of cattle (P<0.001). Total crude protein intake were not significantly different between both breeds (P>0.05), while, it was highly significant between feeding levels (P<0.001). The interaction between feeding level and breed had consistently showed that total dry matter and nutrient intake were not significantly different (P>0.05). The feed conversion efficiency of the

Table 3: Body Condition, Weight and Average Daily Gain of Experimental Oxen

Parameters	Treatments			LS	Breed		LS	TRT*breed
	2 kg	4 kg	6 kg		AHZ	Fogera		
Initial heart girth (cm	159.4	159.4	158.9	NS	159.4	159.0	NS	NS
Final heart girth (cm)	166.7^{c}	172.7^{a}	170.6^{b}	***	167.8^{b}	172.1^{a}	***	NS
Initial body condition score (1-5)	2.57	2.79	2.73	NS	2.78	2.61	NS	*
Final body condition score (1-5)	4.12^{c}	4.66^{a}	4.61^{b}	*	4.54	4.39	NS	*
Final body weight (kg)	377.1^{c}	412.6^{a}	407.9^{b}	**	387.4^{b}	411.0^{a}	**	NS
Weight gain (kg)	48.26^{c}	83.69^{a}	79.06^{b}	**	58.5^{b}	82^{a}	**	NS
Average daily gain (kg)	0.536^{c}	0.93^{a}	0.88^{b}	**	0.650^{b}	0.913^{a}	**	NS

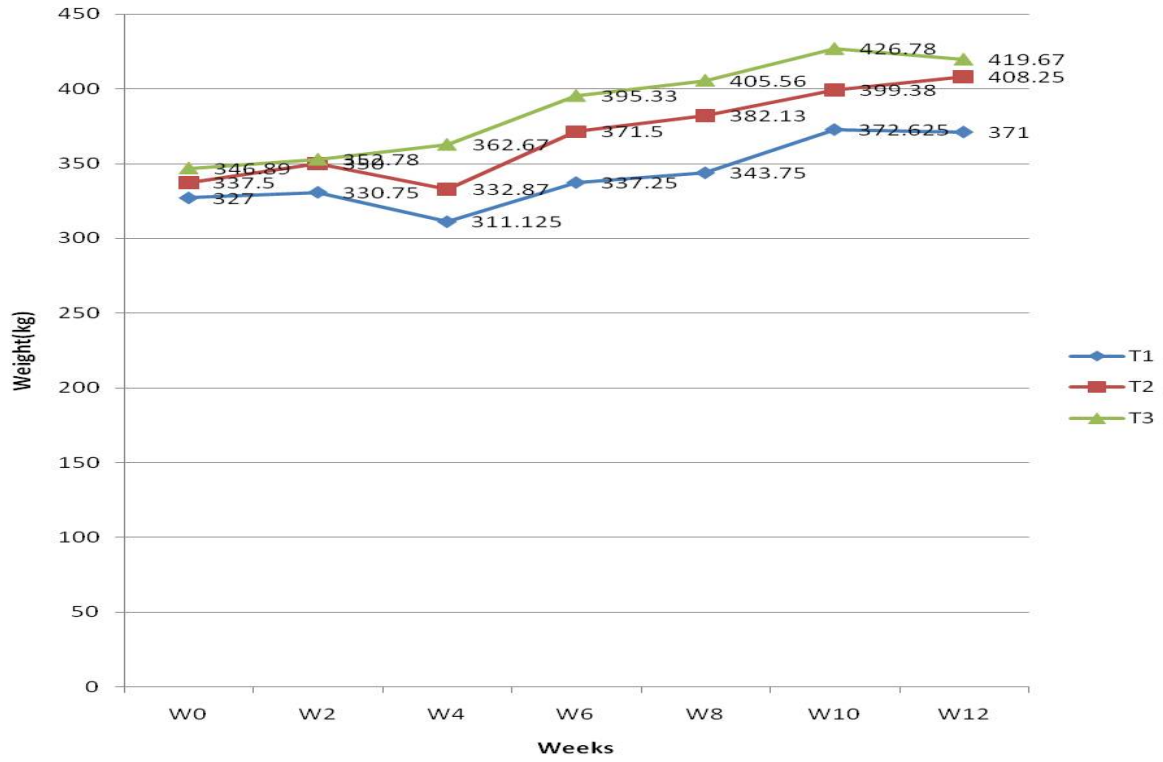
Note: Means followed by different superscript letters within rows are significantly different (P<0.01, P<0, 05); NB: NS=P>0.05; ***=P<0.001; **=P<0.01; *=P<0.05; LS=Level of significance.

Figure1: Fortnight Weight Gain Trend of Fogera and Adet Oxen



experimental animals were not significantly different (P>0.05) consistently between breed, treatment and the interaction between breed and feeding level. This was inconsistent with the results of Nega *et al*. (2002) that showed highly significant effect (P<0.001) between treatments and insignificant between breeds (P>0.05). The feed conversion efficiency of Adet (0.09) and

Figure 2: Weight Gain of Experimental Oxen Allotted to the Different Feeding Levels



Fogera (0.10) old oxen reported in this study is lower than what was reported for Boran (0.14) and Arsi (0.13)

Body Condition, Body Weight and Average Daily Gain

Initial heart girth, final heart girth, initial body condition, final body condition, final body weight, weight gain and average daily gain of the experimental oxen are presented in Table 3. Final body weight and weight gain and average daily gain of experimental animals were highly significant between breeds (P<0.01). The average daily gain reported for fogera old oxen in this study is lower than what was reported for other local breeds, Arsi (697 g) and boran (836 g) fed on different forage legumes and concentrate (1.5 kg noug cake and 1.5 kg maize grain per day)(Nega *et al*., 2002). In contrast, the figure reported for fogera oxen was higher. Final body condition was also significant (P<0.05) between feeding levels. Initial heart girth and initial body condition were not shown significantly different (P>0.05) for both feeding level and breed difference. The interaction between feeding level and treatment was also significant (P<0.05) for initial body and final body condition. In contrast, initial and final body condition, final body weight, weight gain and average daily gain were found to be non significant (P<0.05). Adet HZ 4 kg concentrate supplemented groups had significantly (P<0.01) the highest final weight and weight gain than the other treatment groups.

The trend of weight gain were declining during the period of week 2 to week 4 for both breeds which might be due to the drastic weather change from warm temperature to foggy and humid

Table 4:Partial Budget Analysis of Old Oxen Fattening

Variables	Feeding Level (kg head^{-1} per day)		
	2	4	6
FOGERA OLD OXEN			
Gross return (ETB head^{-1} per 90 days)	3137.5	5125	5860
Variable cost (ETB head^{-1} per 90 days)			
Concentrate cost	327.61	633.75	764.56
Hay	723.93	807.88	658.68
Cost that vary (ETB head^{-1} per 90 days)	1051.54	1441.63	1423.24
Net return(ETB head^{-1} per 90 days)	2085.96	3683.37	4436.76
Marginal rate of return (%)		409.50	632.45
ADET OLD OXEN			
Gross return (ETB head^{-1} per 90 days)	3175	3212.5	2925
Variable cost (ETB head^{-1} per 90 days)			
Concentrate cost	324.79	644.21	898.09
Hay	585.5	464.02	358.21
Cost that vary (ETB head^{-1} per 90 days)	910.29	1108.23	1256.3
Net return (ETB head^{-1} per 90 days)	2264.71	2104.27*	1668.7*
Marginal rate of return (%)		-81.10	-172.25

Figure 3: The Trend of Costs that Vary and Net Return as Level of Supplementation Increases for Adet Oxen

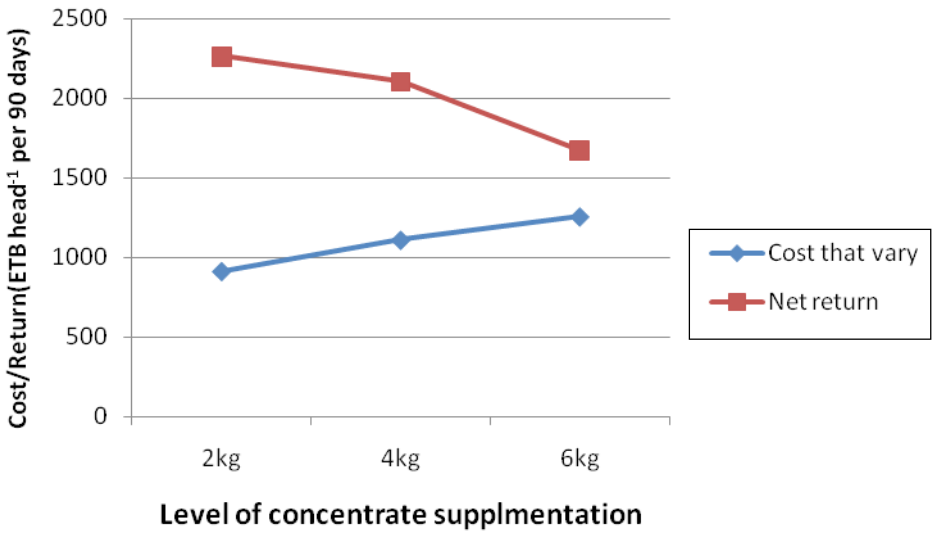


Figure 4: The Trend of Costs That Vary and Net Return as Level of Supplementation Increases for Fogera Oxen

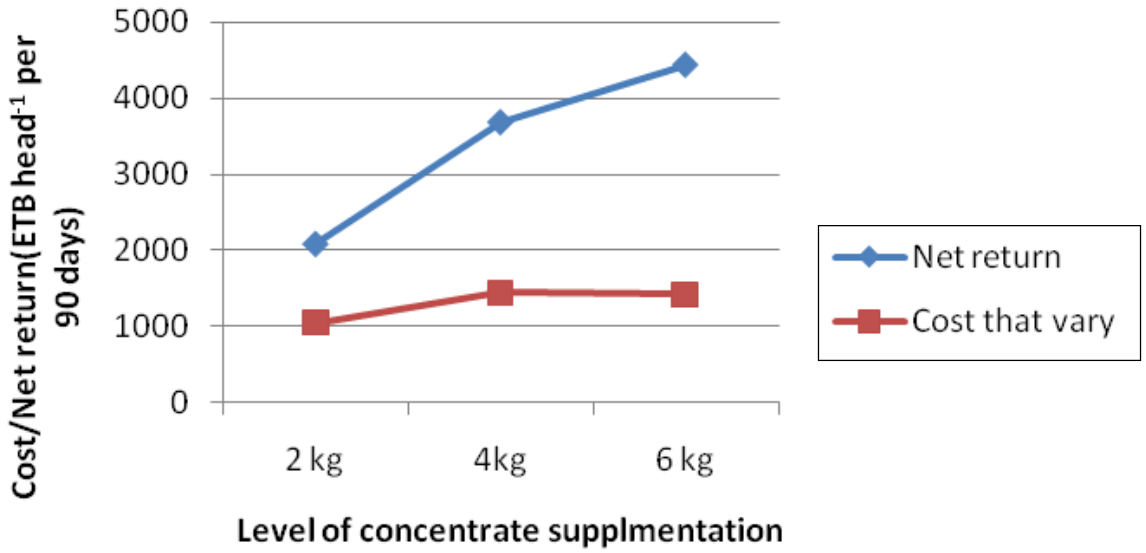


Table 5: Sensitivity Analysis

Parameters	Sensitivity Levels	2kg	4kg	6kg
Selling price		137.5	5125	5860
Variable cost		1051.54	1441.63	1423.24
selling price -	10%	2823.75	4612.5	5717.68
Variable cost+	10%	1156.69	1585.793	1565.56
Net benefit	10%	1667.06	3026.707	4152.11
selling price -	50%	1568.75	2562.5	2930
Variable cost+	50%	2620.29	2162.445	2134.86
Net benefit	50%	-1051.54	400.055	795.14
selling price -	60%	1255	2050	2344
Variable cost+	60%	2103.68	2306.608	2277.184
Net benefit	60%	-848.68	-256.608	66.816
selling price -	65%	1098.125	1793.75	2051
Variable cost+	65%	1735.041	2378.69	2348.346
Net benefit	65%	-636.916	-584.94	-297.346

temperature during the experimental period. From week 4 weight gain shown an increasing trend until week 10 and showed a declining trend thereafter for Fogera cattle. In contrast, Adet oxen had shown, an increasing trend from week 4 (340 kg) to week 10 (366.92 kg). Peak weight gain per day was also recorded during week 10 in both breeds and showed a decreasing weight gain thereafter.

Fortnight weight gain of the experimental oxen within the different feed treatments showed the same pattern of increasing in weight throughout the experimental period. Greater weight gain was recorded for treatment 3 followed by treatment 2 and 1. Peak weight gains were recorded at week 10 for all of the treatment diets. Treatment 1 and 3 showed a declining trend of weight gain in contrast to treatment 2 which showed a slight degree of increasing trend.

Economics of Adet and Fogera Old Oxen Fattening

Economic appraisal of the results was calculated based on partial budget analysis and marginal return analysis (Table 4). A sensitivity analysis was done to show the impact of changes on prices of oxen and feeds used on profitability (Table 5).

Feed cost per unit of weight gain increased linearly with the level supplementation increased for Fogera old oxen (Figure 3). The partial budget analysis shows the highest net benefit obtained from oxen feed 2.00 kg day^{-1} and 6.00 kg day^{-1} for Adet and Fogera old oxen, respectively. Assumptions used in partial budget analysis were 1% weight gain adjustment, ETH 120/100 kg maize price, ETH 265/100 kg noug cake price, ETH 250/100 kg salt price, and 50% minimum acceptable rate of return. The marginal rate of return for fogera oxen fed 4 kg/ day was the highest (511.54%).

The treatment with 4 and 6 kg day^{-1} for Adet old oxen was dominated since the net return from it was lower than that from 2 kg day^{-1} supplement. There is no dominant feeding level for Fogera old oxen. The marginal rate of return analysis for the undominated treatments indicated that the movement from 2 through 6 kg day^{-1} for Fogera old oxen and 2 kg day^{-1} yielded a marginal rate of return higher than the minimum acceptable rate of return.

The net benefit curve (Figure 1) revealed that cost and net benefit of Fogera old oxen increased with increasing the quantity of supplementation. While Adet old oxen, cost increase and net benefit decreased with increased quantity of supplementation. The decrease in net benefit as level of supplementation increases from 2 kg to 6 kg might be due to higher feed cost and less selling price for higher level supplemented groups (4 kg and 6 kg). The rate of marginal return from Fogera old oxen fattening was increased with the increasing rate from 2 to 4 kg day^{-1} and with decreasing rate from 4 to 6 kg day^{-1}. While for Adet old oxen, the marginal rate of return was decreased above 2 and 4 kg day^{-1}.

Sensitivity Analysis

The sensitivity analysis of fattening of Fogera and Adet old oxen has indicated that the feed treatments are economically sound to 50% input price increase and output price decrease for 2 kg concentrate supplementation (Table 5). Similarly, old oxen provided 4 kg and 6 kg were found to be economically sensitive at 60% and 65% input price increase and output price decrease, respectively.

CONCLUSIONS AND RECOMMENDATIONS

From the results it was inferred that Fogera old oxen has higher fattening potential compared to Adet old oxen in terms of weight gain, average daily gain and economics of fattening (gross return, net return and marginal rate of return). Even though, this result indicated that 4 kg concentrate supplemented Adet old oxen had significantly ($P<0.01$) the highest final weight and weight gain than the other treatment groups, it is wise to recommend 2 kg of concentrate in terms of economic feasibility as long as the existing selling practice is based on body condition (subjective). In other words, 4 kg of concentrate would have been recommended had the selling price been based on solely on body weight. Besides, from this study it is also recommended that 5.1 kg of concentrate ration per day should be supplemented for Fogera old oxen in terms of economic feasibility.

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