Journal of Biology, Agriculture and Healthcare
ISSN 2224-3208 (Paper) ISSN 2225-093X (Online)
Vol.8, No.15, 2018

Pre Scaling up of Crop Residue Treatment Technology for Improving Quality and Nutritive Value of Crop Residues for Beef Cattle Fattening in West Arsi and East Showa Zone of Oromia Regional State, Ethiopia

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Abstract
Pre scaling up of crop residue treatment technology for improving quality and nutritive value of crop residues for beef cattle fattening was conducted under market oriented crop-livestock production system of East Shoa and West Arsi zones of Oromia Regional state during the dry season (January to March).The study was undertaken in two kebeles of Adami Tulu Jido kombolcha and one kebele of Arsi Negele district, Anano shisho,Desta Abjeta and Kersa Ilala, respective with the objectives of to convince the merits and increase confidence on the technologies, thereby to facilitate dissemination and adoption of the technology, to collect farmers' opinion on the performance of the technology, to improve farmers' knowledge and skill of application of the improved technology through training and to increase local capacity for future scaling-up or out of the technology. Maize is the major crop residue at Adami Tulu Jido kombolcha whereas, wheat, barely and *teff* straws are the major crop residue used for fattening at Arsi-Negale. The amount of ingredients used were Straw (200kg)Water (200L) Urea (5kg) for single pit (1m*1m*2m) with a capacity of 200kg of urea treated straw. Totally about 5800kg straw was treated by urea in selected kebeles and provided for fattened animals. Biological and economic data were analyzed by using descriptive statistics. Twenty nine oxen were fattened by twenty nine farmers in selected kebeles. The end result of the study revealed that daily weight gain of animal was 0.54 kilograms per day within net return of 1474 Ethiopian Birr per animal in ninety days. Therefore, this technology should be further scaled up by stakeholder body in areas where at molasses and crop residues are available.
Keywords*:* Arsi oxen, crop residue, pre scaling up, stakeholder and urea treated straw

Introduction

Urea-ammonia treatment of straw is a technically effective and feasible on-farm technology to improve the nutritive value of fibrous crop residues. The Mid rift valley area of Ethiopia is characterized by mixed crop-livestock farming systems where the crop and livestock sub-systems complement each other. This area is inhibited by large human and livestock population. The area of land allocated to grazing land is progressively declining through time due to expansion of cultivation. As more and more land is put under crop production, livestock feed becomes scarce and crop residues, particularly cereal straws remain the major feed source for animals particularly during the dry period of the year. The use of crop residue can reach up to 80% during dry seasons of the year (Berhanu *et al*., 2009; Ahmed *et al*., 2010). However, crop residues are known by their high cell wall and low protein, energy and mineral contents (Solomon *et al*., 2008). As a result, their intake is limited and they hardly fulfill even the maintenance requirements of animals for essential nutrients (Zewdie *et al.*, 2011). This suggests the need for exploring alternative supplementation strategies that would help to enhance the quality of these low quality feeds.

Urea straw treatment increase digestibility of organic nutrients, voluntary intake, protein content, productivity of livestock and animal performance, palatability, storage duration, reduce feed wastage and refusal during feeding. Untreated maize husk which is fed as a sole diet contained 5.76% CP, which is less than the marginal CP required for maintenance of the animal, particularly at high temperature and high relative humidity. Urea treated straw has higher quality, in addition it needs low costs (P B O'Donovan *et al.,* 1997*).* Untreated straws has 2-4 % CP and Treated straw has 7-12% CP which is sufficient for maintenance of live weight (Ghadaki *et al*., 1972). Therefore, this study was undertaken to pre scaling up of crop residue treatment technology for improving the nutritive quality of crop residues on farm condition with the objectives; to convince the merits and increase confidence on the technologies, thereby to facilitate dissemination and adoption of the technology, collect feedback/farmers' opinion on the performance of the technology (farmers' feedback assessment) and improve farmers' knowledge and skill of application of the improved technology through training

Material and Methods

Pre scaling up work was conducted under a market oriented crop-livestock production system of East Shoa and West Arsi zones during the dry season (January-March 2017) at two kebeles (Anano Shisho and Desta Abjata from East Shoa and Kersa Ilala from West Arsi zone), Mid rift valley of Ethiopia. Geographically, it extends

from 7°09"N to 8°45'N and38°32'E to 39°17'. The valley has about40-60km width and bound by highland plateaus. The altitude ranges from 500 to 2000msl and has a semi-arid type of climate. Its temperature ranges from 10.8-25^{o}C. The area receives an annual rainfall of about 500-9000mm. Cereals (teff, wheat, barley and maize), pulse (haricot bean) and tuber crops (Irish potato) are grown in this area. More attention is given to the livestock production, especially dairy and beef. As a result the districts were selected with the view that it could represent the beef production system in the Mid Rift Valley of the country. The kebele's within the districts were selected with the help of extension agents, representing the agro-ecology in terms of climate and market oriented crop-livestock production system.

Farmers' selection

Fifty two farmers were purposely selected with the collaboration of Development agent (DAs) based on; Farmers experiences and practiced in cattle fattening activities, having availability of crop residue, water availability around home stead, willingness to prepare pit and willingness to accept and disseminate technology. After farmers selected training was provided on, methods of improving nutritive value of crop residue, usefulness of urea treated straw, method of feeding, precaution taken during feeding and preparation, entire management of fattening program, Size of pit used for treatment (1*1*2m), Ingredients used in treatment, procedure of preparation and finally crop residue treatment was conducted in the study area by the trainees.

Ingredients and materials used

This technology is biologically and economically feasible at farmer condition. Because of all ingredients are locally available at farmers' level. Ingredients used in the study area were water, crop residue (wheat, teff, barley straw and maize Stover) and urea. The amount of ingredients used for prepared silo with dimensions of 2m length, 1m width and 1m height (1m *1m*2m), straw (200kg),water(200L)and urea (5kg). The ratio of water, urea solution to straw was 1:1 (200L of solution for 200kg of straw) P B O'Donovan *et al.,* 1997. Materials used in the study were chopper, weighting balance, pit, polythene plastic sheet (10m), Barrel, Water spray, Sack roller (man power, Shovel, Digging hoe and Indian hoe

Preparation of urea treated straw

The treatment of the straw was done in the ground rectangular silo constructed two pits using pieces of wood, available at the farm on the corner location on their farms. Each pit had dimensions of about 2m * 1m * 1m, with a capacity of 150-200 kg of urea treated straw. The entire wall of the pit was lined with a mixture of soil and dung. A polyethylene plastic sheet lined the floor and side of the pit. In order to prepare 100 liters of solution, 5kg urea was added in to 100 liters of water and stirred very well until the urea dissolves and clumps of urea disappeared from the solution.

The ratio of water urea solution to straw used was 1:1 (200 liters of solution for 200kg of straw). Untreated straw, in batches of ten kgs weighed by using a sack, was spread in the silo over a plastic sheet layer. Ten liter of urea solution was sprinkled uniformly over the straw layers using a sprinkler. The treated straw was mixed by using a fork. Further batches were treated following similar procedures. After treating one layer of straw, it was pressed by trampling (compressed) manually before the next layer was placed on top and finally the stack was covered tightly with a plastic sheet to exclude the entrance of oxygen and prevent ammonia from evaporating for adequate fermentation. The stack was loaded with heavy materials with either stones or wood, according to the available materials. The treated straw was opened after three weeks from one side to take out the straw. The urea treated straw was aerated for a minimum of 12 h prior to feeding to facilitate the escape of free ammonia (Misra *et al.,* 2006). The treatment of the straw and feeding were synchronized in such a way that animals got urea treated straw without any interruption during the entire period of the experiment.

Fig.1. Preparing maize straw

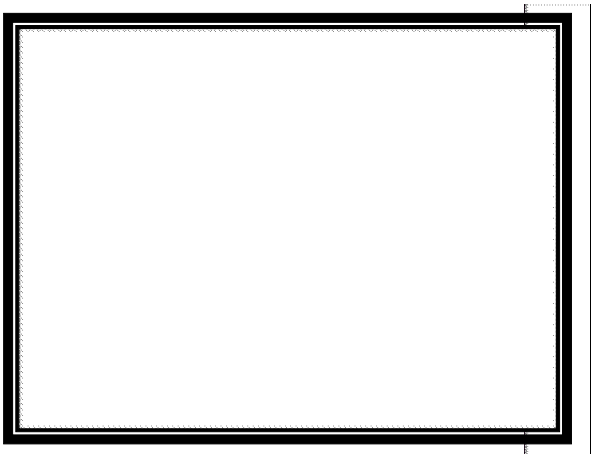


Fig. 2. Preparing water urea solution

Fig.3. Manual pressing of treated straw

Fig. 4. Covering within plastic sheet on the pit

Animal selection and feeding

Animals selection was made from their herds they have, based on body frame of animals by the use of heart girth and age of animals were estimated by their teeth. Before feeding selected animals were dewormed from internal parasite by Albendazole (2500mg), adaption period is needed for animals that have not previously consumed urea-treated low quality roughages. This allows them to become familiar with the feed stuff and, in particular, with the ammonia odor. The level of treated low quality roughage fed can be gradually increased over a period of 1-2 weeks, and provided by mixing with the feed stuff previously being given for selected oxen. Urea treated straw and water provided ad-libtum. Additionally 0.5 kg of concentrate mixture (mixture of noug-cake and wheat bran in 1:1 ratio) was given by mixing with treated straw to selected animals for three months.

Data collected

Initial body weight, finally body weight, initial price, final price, feed cost and opinion of the farmers toward the importance of the technology were collected.

Statistical analysis

Data on initial and final body weight, initial and final price and feed cost were analyzed by using descriptive statistics. Initial body weight and final body weight data were taken by heart girth. Total live weight gain (TLWG) = FWG-IW, DWG= TWG/TFD were FW=Final weight gain of animals IW= Initial weight of animals DWG= Daily weight gain and TFD= total fattening days.

Body weight of animals was estimated from heart girth measurement using the regression equation developed by ILRI as cited by Yoseph (1999).Y= -423.405235+4.833697x (R2 = 0.86; CV= 10%) Where Y= Estimated body weight and x= Heart girth, cm

Result and Discussion

Farmers Training

Training was provided to the farmers on**;** Awareness creation on the importance of urea straw treatment, Selection criteria of animals to be fattened (based on body frame of the animals), Ingredients to be used for preparation, procedures to be followed in preparation, and Precautions to be taken during feeding.

Table: 1 Numbers of farmers trained (involved both Husband and Wife in some households)

Districts	Kebeles	Participants		Total
		Male	Female	
ATJK	Desta Abjeta	15	7	22
	Anano shisho	11	6	17
Arsi Negele	Kersa Ilala	9	4	13
Overall		35	17	52

Farmers participations

After training was provided for farmers in selected kebeles twenty nine farmers were hotly participated in the technology up to the end.

Table 2. Total number of participants in three Kebeles

District	Kebeles	Number of farmers		Number of animals fattened
		Male	Female	
ATJK	Desta Abjeta	8	4	12
	Anano Shisho	7	2	9
Arsi Nagelle	Kersa Ilala	5	3	8
	Overall	20	9	29

Body weight changes

After feeding the urea treated straw and concentrate feed animals were attained 48.5kg of average body weight gain and the average daily body weight gain of the animal was 0.54kg per day which similar to work done by ATARC unpublished report.

Table: 3. Body weight changes

Kebeles	***MIBW/kg***	***MFBW/kg***	***MTWG/kg***	***MDWG/kg***
Desta Abjata	226.42	270.92	44.5	0.49
Anano shisho	221.33	262.33	41	0.46
Kersa Ilala	213.75	273.75	60	0.67
Overall mean	220.5	269	48.5	0.54

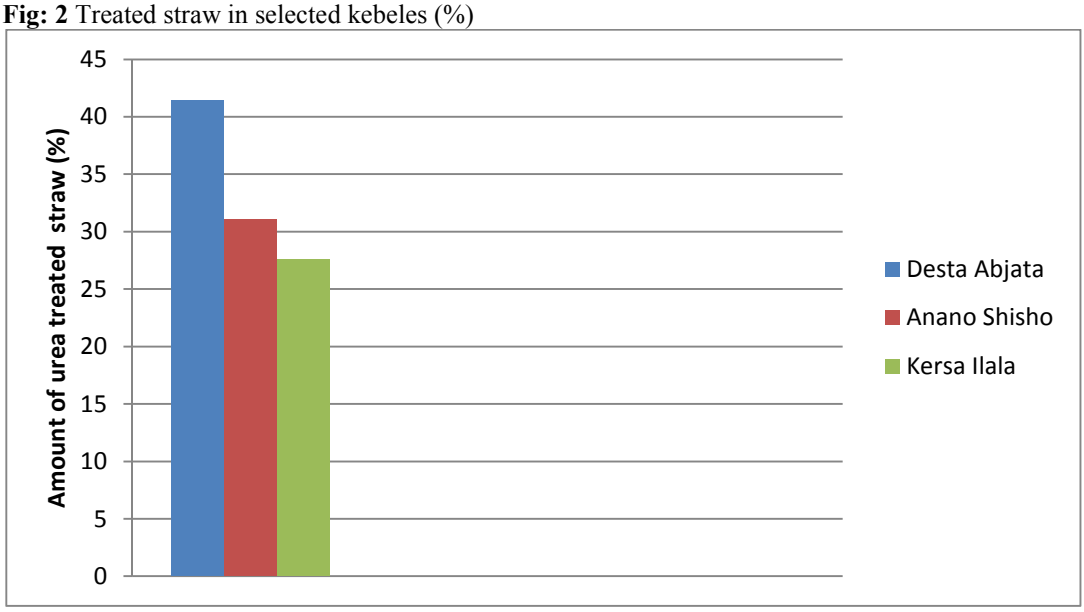
Where MIBW= *mean of initial body wt, MFBW= mean of final body wt, MTWG= Mean of total wt. gain MDWG= mean of daily weight gain*

Fig 1: Body condition of Animals fattened by urea treated straw (left) and urea treated in 21 days (right)

Treating straw

After training was provided for selected farmers, the site was selected in their around home stead for pit (silo) preparation and pit was made by 2m*1m*1m size for each farmers. Totally about 5800kg of straws were treated by urea in selected kebeles.

Fig: 2 Treated straw in selected kebeles (%)



Partial budget analysis

Simple calculation was done to determine gross profit using feed cost and animal purchasing price. Estimation of labor cost has been difficult since farmer using his family as labor and gives little time for feeding, watering and other management. The cost of feed per animal was 341.6 Ethiopian Birr and average price of animal purchased was 3614 Ethiopian Birr. The total cost of production per animal was 3956 Birr. The farmers were sold the fattened animal at local market with gross margin 1474 Ethiopian birr per animal.

Table: 4. Partial budget analyses

Kebeles	Items	Cost
Desta Abjata	Animal purchased price per head	3629.17birr
	Crop residues cost per head	140.00birr
	Concentrate cost per head	201.60birr
	Total cost per head	3970.77birr
	Gross return/revenue per head	5120.83birr
	Gross margin per head	1150.06birr
	Total gross margin (12)	13800.76
Anano Shisho	Animal purchased price per head	3588.89birr
	Crop residues cost per head	140.00birr
	Concentrate cost per head	201.6birr
	Total cost per head	3930.49birr
	Gross return/revenue per head	5380birr
	Gross margin per head	1449.51birr
	Total gross margin (9)	13045.59
Kersa Ilala	Animal purchased price per head	3625birr
	Crop residues cost per head	140birr
	Concentrate cost per head	201.6birr
	Total cost per head	3966.6birr
	Gross return/revenue per head	5787.5birr
	Gross margin per head	1820.9birr
	Total gross margin (8)	14567.2
Overall mean	Animal purchased price per head	3614.35birr
	Crop residues cost per head	140birr
	Concentrate cost per head	201.6birr
	Total cost per head	3955.95birr
	Gross return/revenue per head	5429.44birr
	Gross margin per head	1473.49birr
	Total gross margin (29)	42731.21

Feedback assessment

Almost all the participants reported that, the consumption of treated straw by animals was achieved after a week from when this type of feed has been introduced to the animals. UST increase productivity and body weight gain of fattened animals after adaption period. Participants noticed that the benefits of feeding the intervention diet were not visible immediately. It took 2 to 3 weeks depending upon the adaptation of the new diet by the oxen. This type of technology was accessible to us, because of all used ingredients are available in our farm level. They noticed that animals fed urea-treated low quality roughage requires a lower level of supplemental concentrate feed to achieve a desired level of animal performance as compared with animals fed untreated low quality roughage.

Challenge encountered

Some animals were refused to consume the treated straw for the first time of feeding. This challenge was solved by mixing *atela* and other feeds which were previously fed by animals, for the sake of adaption.

Discussion

Urea straw treatment feeding package technology was conducted in three kebeles; Anano Shishoo, Desta Abjeta and Kersa Ilala to fatten Arsi Oxen. Urea straw treatment was made from locally available materials with cheap price like crop residues (*teff* straw, wheat straw, barley straw and maize stover), water and urea. Fifty two farmers (35 males and 17 females) were skilled on importance of the technology, way of preparation, feeding method, selection criteria of fattened animal, precaution taken during feeding and preparation .Twenty nine farmers were fattened thirty one Arsi oxen by 5800kg of treated straws for ninety days .Fattened animals were conquered 0.54kg mean daily weight gain (Mean of total weight gain 48.5kg) similar with the work conducted on urea straw treatment at Arsi Negele (ATARC unpublished data 2006) and The farmers were got 1474 ETB birr gross margin per head in ninety days of feeding.

Conclusion

UST is an important source of supplementation which made from local available materials. Maize is the major crop residue at Adami Tulu Jido Kombolcha district, whereas, wheat, barley and *teff* straws are the major crop residue used for fattening at Arsi-Negale district**.** The fattened animals were attained 0.54kg daily weight gain within net return of 1474 Ethiopian Birr per animal in ninety days. As this result showed that urea treated straw improve animal performance, improve quality, increase shelf life of treated crop residues and increase animal body weight gain. As the farmers noticed that animals fed urea-treated low quality roughage require lower levels of supplemental concentrate feed to achieve a desired level of animal performance as compared with animals fed untreated low quality roughage.

Recommendations

If UST is properly disseminated and extended in the study area and other districts of the zones, it will play a vital role in improving the livelihood of the farmers. Farmers show an enormous interest to exercise further this cheapest technology. Therefore, livestock development sectors, local farmer groups, young graduates and farmer cooperatives should be further scaled up this improved feeding package.

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