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Research Aplication Summary

Production and potential utilization of crop residues and agro-industrial by-products in ruminant nutrition in Eritrea

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Abstract

Sufficient and quality feed resource has been identified as the main limiting factor to increasing animal flock sizes especially in the tropics where feed quality and quantity fluctuates within and between years. Eritrea is setting up programmes aimed at increasing animal productivity. One of the considerations in this process is the exploitation of crop residues and agro-industrial byproducts as feed. One of the main challenges to this however is that the amount of crop residues and agro-industrial by-products available to the country is not known. This information would enable designing of a proper policy towards utilization of crop residues as animal feed. This study was carried out to establish the production and utilization status of crop residues and agro-industrial by-products in Eritrea. A comprehensive survey utilising various data collection tools was carried out in the five administrative zones of Eritrea. Findings indicated that approximately 1.3 million tonnes of crop residue is produced annually mainly from sorghum, millet, barley, wheat, chick and field peas, vetch and groundnuts. The production and utilisation of these crop residues varied across zones although all farmers indicated that they used their crop residues primarily for animal feeding. Further analysis of data indicated that crop residues accounted for 9.63 to 36.31% of the total annual maintenance feed requirements of the grazing ruminants. The contribution varied according to land size set aside for crop production. The total agro-industrial by-products were estimated at between 19,604-19,788 tonnes and mainly comprised of brans, oilseed cakes and brewers grains. This study is the first one in a series that intends to determine the quantities, chemical and nutritive value of the crop residues and agro-industrial by-products. The implication of the findings is discussed in the manuscript.

Key words: Agro-industrial by-products, crop residues, Eritrea, ruminant production

Résumé

La disponibilité des aliments d'élevage en quantité et qualité a été identifiée comme le principal facteur limitant l'augmentation de la taille des troupeaux d'animaux en particulier dans les tropiques, où la qualité et la quantité des aliments d'élevage fluctuent par année et entre années. L'Érythrée est en train de mettre en place des programmes visant à accroître la productivité des animaux. Une des considérations de ce processus est l'exploitation des résidus de récolte et sous-produits agro-industriels comme aliments du bétail. Cependant, l'un des principaux défis à cela est le manque d'information sur la quantité de résidus de

cultures et des sous-produits agro-industriels disponibles pour le pays. Cette information permettrait la conception d'une politique appropriée en ce qui concerne l'utilisation des résidus de récolte pour l'alimentation animale. Cette étude a été réalisée pour établir le statut de la production et l'utilisation des résidus de cultures et de sous-produits agro-industriels en Erythrée. Une enquête approfondie à l'aide de divers outils de collecte de données a été effectuée dans les cinq zones administratives de l'Érythrée. Les résultats indiquent que près de 1,3 millions de tonnes de résidus de cultures sont produites chaque année, provenant principalement du sorgho, du mil, d'orge, de blé, du pois des champs et du pois chiques, de la vesce et des arachides. La production et l'utilisation de ces résidus de cultures varient à travers les zones bien que tous les agriculteurs ont indiqué qu'ils utilisaient leurs résidus de cultures principalement pour l'alimentation des animaux. Une analyse plus poussée des données a indiqué que les résidus de cultures représentaient 9,63 à 36,31% des besoins annuels totaux d'alimentation d'entretien des ruminants. La contribution varie selon la superficie de terre allouée à la production agricole. La quantité totale estimée de sous-produits agro-industriels était entre 19,604-19,788 tonnes et est principalement composé de sons, tourteaux d'oléagineux et des drêches de brasserie. Cette étude est la première d'une série qui vise à déterminer les quantités, chimique et la valeur nutritive des résidus de culture et sous-produits agro-industriels. L'implication des résultats est discutée dans le document.

Mots clés: Sous-produits agro-industriel, résidus de récolte, Érythrée, production de ruminants

Background

There is potential in use of crop residue and industry by-products in feeding animals (FAO, 2006). This is more apparent in the tropics where there is intense competition for grains between humans and animals. In developing countries, grazed systems depend on natural pastures whose supply throughout the year is not guaranteed. Even in systems where the grazed system is sufficient, quality and quantity varies within and between years (Gicheha *et al.,* 2014). The feed deficiency during the dry periods can be counteracted by using crop residues and/or industrial by-products. For instance, in Eritrea, the bulk of livestock feed comes from grazing on natural pastures and crop residues and agro-industrial by-products (FAO, 2006). However, it is important to establish the amounts of crop residues and by-products available in a given country so as to come up with an efficient utilization programme. Crop residues are the most abundant and wide-spread of the non-conventional feed resources and are the most important feed sources for ruminants (Schiere *et al.,* 2004). This study was carried out to establish the amount of crop residues and industrial by-products available for animal feeding in Eritrea.

Methodology

Data for grains and legumes production in Eritrea for the period of 2007-2015 was obtained from the The State of Eritrea Ministry of Agriculture (MoA, 2015) and used to

estimate their equivalent residue yields using the previously established residue to grain ratios. These ratios have been established as 1.5, 2.0, 3.0 3.7, 4.0 and 5.0 for barley, wheat, maize, teff, pulses and oil crops, and sorghum/millet residues quantities, respectively, (Kossila, 1988). Further, a 92% Dry Matter (DM) content was used in estimating pulse and oil crop residues. A value of 3.0 was used in estimating the volumes of the industrial byproducts(Tesfaye, 1999).

Research application

The production distribution of the cereal and legume residues in different Zones of Eritrea are shown in Figure 1A and B, respectively . The total crop residues for the period totalled to approximately 1,249,241 tonnes with the cereal crop residues accounting for 95.11% of the total residues. Gash Barka zone had the highest cereal crop residue but lagged behind Debub, Maekel and Aseba zones in production of legume residues. Debub had the highest legume residues production and second to Gash Barka in cereal crop residues production. Maekel zone had the lowest quantities of cereal crop residues.

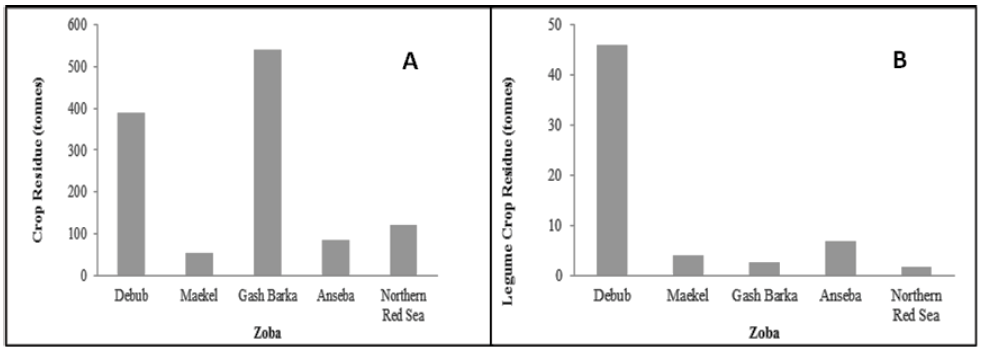

Figure 1: Cereal (A) and legume crop residues produced in different zones in Eritrea

The high quantities of cereal crop residues correspond to the Ministry of Agriculture report that indicated that approximately 91.66% of Eritrea is under cereal crops (MoA, 2015). Different cereal and legume crops produced different amounts of the corresponding residue with sorghum accounting for the biggest bulk of the residues. This is expected as sorghum is the main grain used in making injera (flatbread made from sorghum, teff, millet or wheat) which is an important staple food in Eritrea.

This study further attempted to relate the availability of crop residues and livestock production in different zones in Eritrea. Table 1 shows the herd size in Tropical Livestock Unit (TLU; 1 TLU = 250 kg bovine on maintenance level) and crop residues production in different zones of Eritrea.

Table 1: Herd size (TLU), crop residue production per TLU in the five zones of Eritrea

		Crop Residues Production	
Zones	**Herd Size (TLU)**	**Tonnes/year**	**Tonnes/TLU/yr.**
Debub	820,469	436,068	0.53
Maekel	64,213	58,443	0.91
Gash Barka	1,346,959	541986	0.40
Anseba	374,104	90,334	0.24
Northern Red Sea	499,977	122,410	0.24

Gash Barka which had the highest cereal crop residues production had correspondingly largest livestock number at 1,346,959 head with Debub zone ranking second in terms of livestock numbers. A similar ranking was observed in production of cereal crop residues. This implies that cereal crop residues are utilised more in livestock feeding than the legume crop residues. Maekel which has 58,443 TLU had the highest tonnage per TLU per year at 0.91. This means there is potential underutilisation of the crop residues in this zone and/or there are other factors that affect livestock production more than feed related constraints.

According to Kayouli (1996) the edible proportion of crop residues is about 70%. This implies that if the average annual crop residue production per TLU in Eritrea was converted to daily production, the amount of residue per TLU would be 0.40 kg per day assuming a 91.52% DM content. According to Kearl (1982) this would account for 9.09% of the 4.4 kg maintenance DM required per TLU per day.

Besides the crop residues, this study obtained the quantities of agro-industry by-products with an aim of evaluating their potential use in livestock feed. The main by-products identified to be in quantities that can be utilised in ruminant feeding were the brewers' yeast waste, brans mainly wheat and oil cakes especially sesame cake. The annual brewers' waste production in Eritrea is currently estimated at 3,031.51 tonnes of dry waste and 8,431.45 of wet waste. This is sold to smallholder farmers near the brewery.

The main grains by-products are mostly derived from wheat and these are the bran, middling and shorts all of which can be used in supplementing grazing stock especially during dry periods of the year. The respective annual totals for the three by-products is 8,579.25, 1,190.68 and 4,514.37 tonnes. Wheat bran is sold to small-scale commercial livestock producers, mainly keeping exotic and/or cross dairy breeds, while wheat shorts and middling are mainly used in feeding poultry kept on small-scale commercial farms.

Sesame cake is the only oil seed by-product that can be considered to be in volumes that can be sustainably utilised in supplementing livestock in Eritrea with an annual production capacity of 2,299.50 tonnes. Sesame cake is included in poultry rations as a source of protein.

Conclusion

Findings from this study have shown that there are substantial amounts of cereal and legume crops residues that are being used to supplement grazing livestock in Eritrea. It is notable that the cereal crop residues production corresponds with livestock numbers in different zones implying that the main limiting nutrient is energy and therefore technologies applicable in enhancing energy availability from the residue would be important. Though not reported in this study, the researcher observed that there is little effort applied by the smallholder farmers in improving nutrient availability in the crop residues. Such technologies as use of urea in treating maize straw used in feeding dairy cattle have been shown to be beneficial and have resulted in increased livestock production. There is also need to determine the reasons why Maekel zone which has the highest tonnage per TLU per year lags behind in livestock production. Besides, it is important to evaluate the chemical and nutritive value of the crop residues so as to better advise the farmers on the most appropriate utilisation approaches.

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