Recent Development of Tanzania Feed Industry through Improvement of the Feed Analytical Facility

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Abstract

The quality and supply of conventional feed ingredients in Tanzania is expected to decrease due to climate change's negative effect on crop, livestock and fish yields. In order to maintain a high quality and supply of feed, the feed industry may have to adapt by making frequent modifications to feed formulations and use alternative feed ingredients. This strategy requires the services of a reliable and trustworthy feed analytical facility. In efforts to regulate the feed industry, the government of Tanzania appointed the feed laboratory at Tanzania Veterinary Laboratory Agency to be the Government Analyst for livestock feeds. The capacity of this analytical facility was strengthened with support from the US Grains Council. Currently, the analytical facility has the capacity to do basic nutrient analysis and mineral analysis of feeds; it can also perform the Urease test to determine levels of anti-nutritional factors in Soya. The efficiency of service provision has improved; however, the capacity of the analytical facility needs to be strengthened further because it has no equipment for determining levels of mycotoxin in feeds and has to depend on outsourcing for feed safety analysis. Climate change conditions are expected to increase the incidence of mycotoxin contamination of feeds. Although there has been an increase in demand for the services of the analytical facility, more can be done to increase awareness on available services and the importance of feed analysis to the production of quality feeds.

Keywords: Feed, Analytical facility, Capacity building, Climate change

Introduction

The feed industry in Tanzania plays a significant role in the livestock and fish value chains, with feed taking up to 70 percent of production costs (Makkar, 2019). Under climate change, rainfall has been decreasing and temperature increasing, negatively affecting the feed industry through various constraining factors (Lema and Majule, 2009). Unpredictable rainfall is leading to low crop yields or crop failure and diminishing the supply of feed ingredients. Research suggests that over the next decade, a temperature increase of 4 degrees Celsius and the doubling of CO_2 (350 vs. 650 ppm) will result in yield penalties of 40 to 50 percent in soybean production and 10 to 20 percent decreases in corn and wheat (Roembke, 2018). Invasive weeds grow faster than cereals under climate change, affecting yield and quality (Roembke, 2018). Pest and diseases incidences are increasing due to global warming, contributing to unsustainable crop, livestock and fish production (Lema and Majule, 2009). As staple crops are damaged by insects, it creates the opportunity for more diseases, mycotoxins and additional pest infestations (Ensley, 2013; Lizárraga-Paulín *et al.* 2011; Roembke, 2018). These pose management challenges in the field, in storage and at the feed mill (Lizárraga-Paulín *et al.* 2011). Climate change conditions may also decrease the nutritional value of feed grains by as much as 10 to 20 percent (Roembke, 2018). Climate change-driven supply shortages lead to high feed costs and food insecurity.

To adapt to climate change, farmers have changed their cropping practices and used a combination of strategies such as proper timing of agricultural operations, crop diversification,

use of different crop varieties, changing planting dates, increased use of water and soil conservation techniques and diversifying from farm to non-farm activities (Lema and Majule, 2009). However, it was recommended that such measures need to be strengthened to improve agricultural production (Lema and Majule, 2009). A recent study shows that making changes to livestock feed could reduce the contribution of livestock production to climate change (Food Tank, 2016). A way of sustainably raising livestock is to reduce the use of livestock feed that competes with direct human food crop production. Instead of feeding ruminants crops that can be used for human consumption, the strategy takes advantage of the animal's ability to convert less useful resources into food (Food Tank, 2016). The process of making changes to livestock feed and feed formulation require the services of a reliable and trustworthy feed analytical facility especially when unconventional feed resources are being used. The Tanzanian feed industry can be supported by building capacity of the feed analytical facility. The objectives of this study were to compare the facility's capacity before and after capacity building, to describe support inventories, to identify type of samples received and determine their quantity and distribution.

Materials and Methods

A memorandum of understanding was signed between Tanzania Veterinary Laboratory Agency (TVLA) and US Grains Council (USGC) in June 2014. The USGC donated robust and state-of-the-art equipment for feed analysis to the analytical facility at TVLA. The equipment provides fast, reproducible and cost-effective results with minimal sample preparation and allows for timely return of analytical results for the customer. Technical consultants were hired by USGC to rehabilitate the existing laboratory and to train the laboratory staff on operating the equipment and laboratory management to ensure sustainable analytical services. Training took place at the analytical facility and four feed laboratories in South Africa were visited for training on laboratory management. After training, the technical consultants remained in contact with the laboratory staff for further consultations with support from USGC. The analytical facility was appointed by the Ministry of Livestock and Fisheries to be the Government Analyst for livestock feed in 2015. This was done to implement the Grazing land and Animal Feed Resources Act of 2010 and its regulations of 2012. All feed manufacturers operating in Tanzania are obliged by law to send their feed samples to the Government Analyst for analysis. The aim is to monitor the quality and safety of locally manufactured and imported livestock feeds and feed ingredients for feeding livestock in the country. Data on number of samples received by the analytical facility from January to June 2014 was compared with January to June 2019. Analysis of the data was done using MS Excel to calculate the mean and standard deviations.

Results

Water and electricity systems in the analytical facility were rehabilitated and a water pump and electricity generator was installed. The analytical facility also received the following equipment from USGC (i) A Near Infrared Reflectance Spectrophotometer (ii) An Energy Dispersive X-Ray Fluorescence Spectrometer and (iii) Urease Test Equipment for Soya. Eight laboratory personnel were trained on how to operate the equipment and four laboratory staff received training on laboratory management. The analytical facility now has the capacity to do basic nutrient analysis of feeds and ingredients, mineral analysis of feeds, ingredients and water; it can also determine the level of anti-nutritional factors in Soya. Samples received from customers include feed ingredients like maize, maize bran, sorghum, rice polishings, wheat pollard, sunflower seed cake, cotton seed cake, fish meal, shrimps, blood meal, soya, forages, hay and mineral compounds such as limestone, bone meal, shells, di-calcium phosphate (DCP), mono-calcium phosphate (MCP) and mineral licking blocks. Samples of compounded feed are also received, for example, poultry feed, pig feed, fish feed, ruminant feed, dog food, horse feed and rabbit feed. The number of samples received for analysis increased from an average of 60.3 ± 11.9 per month in 2014 before capacity building to 152.5 ± 29.3 per month in 2019 after

capacity building (Fig. 1). Feed ingredients made up 21.1 percent of the samples received in 2014 while 78.9 percent were compounded feeds (Fig. 2). In 2019, the percentage of feed ingredients received for analysis increased to 34.7 percent with compounded feeds forming 65.3 percent (Fig. 3).

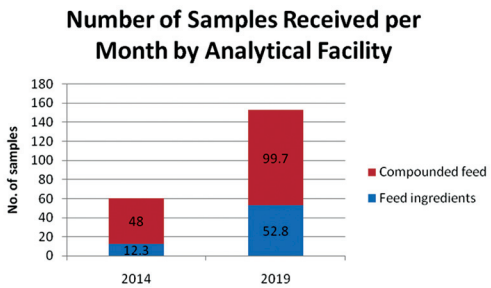

Figure 1: Demand for Analytical Services Before and After Capacity Building

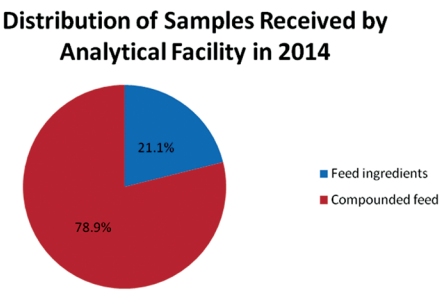

Figure 2: Distribution of Samples Before Capacity Building

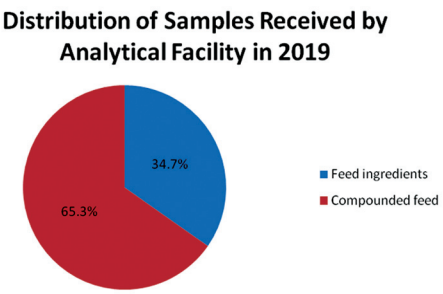

Figure 3: Distribution of Samples After Capacity Building

Discussion

The vision of the analytical facility is to provide reliable feed analytical services to the Tanzanian feed industry. Results show that demand for analytical services has increased suggesting that the supporting role of the analytical facility to the feed industry has been strengthened. The percentage of feed ingredients analyzed has increased suggesting that the feed industry is relying more on actual results of feed analysis for feed formulation than on nutritional information available in the literature. Strengthening of the analytical facility's capacity has led to an increase in efficiency of service provision. This has encouraged demand for analytical services resulting in improvement of the quality of feed manufactured (Doto *et al.* 2018). However, in order for the feed industry to take full advantage of the analytical facility there is a need to promote awareness on the services available and the importance of feed analysis to the production of quality feeds. Results of feed analysis are instrumental in the process of feed formulation. Laboratory analyses of feeds provide the best indication of nutrient availability, allowing feeds to be utilized to their full potential (Omafra, 2019). Reliable nutritional information is important to not only balance rations, but also allows ration balancing programs to determine the most economical ration that will meet the animal's requirements (Omafra, 2019).

Normally feed formulation starts with analysis of the ingredients. This is followed by analysis of the compounded feed, which is done to confirm the accuracy of the feed formulation and to determine if the formulation needs further adjustments. Under climate change, the supply and quality of conventional feed ingredients in Tanzania is expected to decrease, subsequently affecting the supply and quality of feed. In order to adapt to these shortcomings, feed producers may increasingly explore alternative ingredients to offset supply shortages (Roembke, 2018). In these scenarios, feed formulations will require frequent modifications with increased reliance on the services of a trustworthy analytical facility. Good laboratory data can help promote the use of locally available feed resources and create employment, giving a boost to local economies (Makkar, 2019). Good feed analysis also helps researchers develop more cost-effective and sustainable feeding strategies that can then be commercialized or directly used by farmers (Makkar, 2019). At a regional and

international level, the reliable and accurate analysis of feed promotes trade and economic growth, not just involving livestock but also the feed itself (Makkar, 2019). Feed analysis laboratories assist in reducing environmental pollution caused by animal production by more reliably determining the chemical constituents of feed ingredients and ensuring they are not excessive or unnecessary in the diets (Food Tank, 2016; Makkar, 2019).

Extreme weather events and rising temperatures associated with climate change create the perfect conditions for mycotoxin contamination of feed ingredients (Ensley, 2013; Roembke, 2018). Under climate change, there will be increased instances of aflatoxin, which is the most dangerous to humans and animals (Bommakanti and Waliyar, 2013; Lizárraga-Paulín *et al.* 2011; Robens and Richard, 1992). Spoilage and mycotoxigenic molds can also reduce the nutritional value of grain by up to 15 percent (Roembke, 2018). The analytical facility lacks equipment for analyzing feed safety against mycotoxins. Currently the analytical facility depends on outsourcing for feed safety analysis. However, outsourcing is quite expensive; therefore, there is a need to further support the feed industry by equipping the analytical facility so that feed safety analysis can be done in-house and at more affordable rates.

Conclusions

Strengthening the capacity of the analytical facility has led to increased efficiency of service provision and attracted higher demand for analytical services. It is expected that this higher demand will result in the improvement of the quality of feed produced by the feed industry. The more awareness is promoted about the services available at the analytical facility, the higher the demand for its services.

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