



Evaluation of Commercial Animal Feed Quality and Manufacturing Status in Ethiopia

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Abstract

Animal production in Ethiopia is hindered by numerous constraints such as poor nutrition and management amongst others. The supply of processed animal feed stuffs is very limited. This study was undertaken in four regions of the country namely Oromia, Amhara, Tigray, South Nations, Nationalities and Peoples in selected towns and Addis Ababa city administration to assess compound feeds sector and evaluate the quality of compound feeds supplied to farmers in Ethiopia. A total of 34 feed producers were surveyed, to provide an overview of the sector, while chemical analysis was used to assess the quality of 64 compound feeds which are categorized in to three (layer, milking cow, and beef feeds). Qualitative and quantitative survey methodology by using a structured questionnaire vs qualitative data to collect basic information and further details on specific parameters and key informant interview to understand details of particular issues such as key challenges and opportunities are the two techniques used in this study. The feed samples were analyzed for chemical contents (DM, CP, CF, Moisture, Metabolic Energy and Fat) at Animal Products, Veterinary Drug and Feed quality Assessment Center laboratory. The results of the analysis revealed that contents of the various nutritional parameters have variations when compared with the feed standard of Ethiopian Standard Agency, 2019. Compound feed production is dominated by poultry feed products (61%), while 27.2%, 8.4%, 3.2% are dairy, fattening and others respectively. Most of the feed companies operate below their installed capacity. Raw materials are sourced locally, and maize makes up around 39.5% of total tonnage from the companies ingredient. The DM content ranges between 88.28%-91.87%, 89.21%-91.99% and 89.61%-91.31% for lactating dairy cow, beef and layer poultry respectively. The CP content ranges between 10.91%-17.90%, 10.27-16.34% and 11.39-18.57% for layer beef and lactating dairy cow respectively. The metabolic energy value ranged between 1364-2746Kkal/kg, 1092-2890kcal/kg and 1703-2880kcal/kg for layer, beef and lactating dairy cow respectively. Production of Compound animal feed in Ethiopia have many challenges both by internal and external factors of the industry. So to produce quality and safety feed more concern is necessary from government and feed industry owners. The Government should institute sound policies to assure adequate feed supplies and reliable quality of raw materials and finished feeds at prices affordable to livestock and poultry raisers.

Keywords: Compound Feed; Challenges and Opportunity; Feed Quality

Introduction

Ethiopia is a country with largest livestock population in Africa and with a huge livestock genetic diversity. In the second Growth and Transformation Plan (GTP), Ethiopian government has identified livestock sector as a new source of economic growth. The rationale in using livestock sector as a growth driver emanates from the unexploited potential of the sector and a wide range of agro-industries to be created along the path of market led economy and commercialization.

The feed sub-sector is central for all livestock commodities and is a key pillar of livestock growth and transformation from various perspectives. From economic point of view, about 70 percent of the cost of animal production is feed and suggesting economic feasibility of animal agriculture is mainly a function of quantity or quality

of nutrients and the science of feeding. Thus feed is a point of convergence and a critical commodity for which all livestock species compete and it is a major pillar towards ensuring economic, social and environmental goals of livestock production [1].

The supply of processed animal feed stuffs is very limited in Ethiopia. According to the Ethiopian Animal Feed Industry Association, there are a total of 32 privately owned feed processing plants and 28 farmers unions animal feed manufacturers currently operating in the country. Moreover, majority of them are working below their designated owning to several reasons including: low supply of raw materials, lack of commercial orientations by the farmers, poor awareness about processed feeds utilization by livestock producers, lack of tax exemptions and double taxations for individual feed ingredients in the compound feed mixtures [2]. Consequently,

most feed processing plants are primarily producing for their own consumptions with very limited supply to the market. Study by Birhanu., *et al.* [3] indicated that only five manufacturers that are congregated in and around Addis Ababa were producing feed for sale with an average annual feed production of about 8,997 metric tons.

Availability of supplementary feeds (both conventional and non-conventional types) per se is not the only challenge to the development of livestock industry in general and the dairy industry in particular, but also quality of the feeds is equally important. Various research reports have been documented on nutritional profiles of different agro- industrial by-products (AIBPs) and locally available supplementary feed resources in the country [4-9]. However, qualities of these feed resources are highly dynamic and subjected to variations depending on the type of raw material, processing method, season, handling, storage, transportation, and utilization. This necessitates periodical assessment and laboratory analysis to generate up-to-date information on nutritional qualities of the feeds, which in turn helps to sensitize farmers and the concerned institutions in charge of monitoring and regulating qualities of feedstuffs in relation to the standards set for the different groups/species of animals in the country. Therefore this research was conducted with the following objectives.

- To characterize the existing commercial compound feed manufacturing practices and the status of production, distribution and raw material usage;
- To quantitatively evaluate the existing commercial compound feeds quality status in terms of nutrient supply;
- To identify the gap between the existing commercial compound feeds nutrient supply and the Ethiopian Animal feed standards; and
- To identify the challenges/constraints and opportunities of the existing commercial compound feeds manufacturing practices.
- Forward recommendations for future improvement.

Materials and Methods

Study sites

The study was conducted in four regions of the Ethiopia namely Oromia, Amhara, Tigray, South Nations, Nationalities and Peoples Regions in selected towns and Addis Ababa city based on the distribution of commercial animal feed companies in the area. Ethiopia is a very extensive country with diverse people, cultures and agro-ecologies, the sites chosen for the research cannot be considered representative and as such it was misleading and superficial to draw conclusions or make generic assumptions relating to Ethiopia or East Africa. Instead, as explained by Sumberg [10], due to the exploratory nature of the research, the aim was to use these areas to highlight the key issues which could be considered more

generally. Having said this, the cities in which the study was carried out greatly differ in size and geographic location, which offers the opportunity to explore issues relating to scale, raw material availability, markets and prices.

Study design

A cross sectional study was conducted from March to August, 2019 in selected towns of Oromia, Amhara, Tigray and South Nations, Nationalities and Peoples regions, and Addis Ababa City on selected feed manufacturing companies. The selection of the Companies was conducted using purposive sampling technique.

S. No.	Region	Feed Manufacturing Companies		
		Private	Farmers Unions	Total
1	Oromia	8	2	10
2	Amhara	3	7	10
3	Tigray	-	5	5
4	SNNPP	2	6	8
5	Addis Ababa	1	-	1
Total		14	20	34

Table 1: Data collection centers for the study.

Feed producer questionnaire

A semi-structured questionnaire was prepared, pretested and administered. The company owners, managers or representative individuals were included in the questionnaire survey. Field observation was also conducted during the questionnaire administration time to assess the status of the companies. In each of the five study sites, the first questionnaire was arranged, through the data collector, with a respondent which was the profile of the subject required for the study (i.e. animal feed manufacturers). Starting from the first respondent in each location, the subject was asked to provide the name, contact and location of other feed producers. A total of 14 private and 20 farmer Unions animal feed producers were selected for interview using the questionnaire and out of them the representative feed sample was collected from 24 companies. At the time this survey was conducted from the total 34 company covered samples were not taken from the remaining 10 companies which had no feed stock during the survey.

Sample/data collection and sampling

Primary data was collected using pre tested semi-structured questionnaire through interview and discussion with the employs, companies owners or representatives. In addition, secondary information was gathered from literature and other written sources. Physical observation on commercial feed companies was also used as an instrument to collect data during the study. Data on the compound feed manufacturing potential, supply and market demand, marketing, and constraints and opportunities were collected from the commercial feed manufacturers. The compound feeds selected for sampling include three types of compound feed used

in livestock production, the samples were collected directly from the manufacturers. Three types of feed samples (poultry layer 17 samples, milking cow 24 samples and beef 23 samples) were collected from each company and sealed and labelled in a paper bag for chemical analysis.

Chemical analyses of the samples were conducted at Animal Products, Veterinary Drug and Feed Quality Assessment Center Laboratory for different parameter analysis. Nutritional parameters such as DM, CP, CF, Moisture, ME and Fat contents were analyzed.

Methods of chemical analysis

Near infrared Reflectance Spectroscopy (NIRS) is a method that makes use of the near infrared region of the electromagnetic spectrum (from about 850 to 2500 nanometers). It measures light scattered off and through a sample. The amount of radiation reflected from the sample is quantified as the reflectance (R) of the sample (Norris., *et al.* 1976).

The NIRS™ DS2500 uses highly accurate optical NIR technology to give best-in-class performance across the full wavelength range of 850 to 2500 nm. Regardless of whether you are testing moisture, fat and protein or more demanding parameters such as amino acids, ash or fibers, the NIRS DS2500 F delivers precision results in under a minute. The NIRS DS2500 can be pre-calibrated with global data (library) for the most common feed types and ingredients.

NIRS DS2500 is operated by two separate software programs: ISIScan Nova and Mosaic. The ISIScan Nova is the operating software for NIRS DS2500. It contains all necessary functionalities for the normal analysis routines. The Mosaic is used for configuration of the user of ISIScan Nova determining what is available for routine analysis operation.

Analysis Procedure

- Before running the sample the instrument was checked with check sample for verification of the wave length.
- The grinded compound feed was homogenized or mixed well to make sure the sample is representative.
- Appropriate sample cup was selected: Small ring sample cups with a quartz window installed, designed for the analysis of dry, ground products, were employed in conjunction with the Foss NIR spectrometer.
- The sample cup glass was filled with homogenized sample till the bottom of the sample cup is completely covered and that the layer of sample is at least 1 cm thick.
- After placing the filled sample cup in the sample compartment, the lid was closed properly for analysis.

- Then the appropriate Product icon and the product type (compound feed) was selected and Started for analysis.
- Register the sample information on sample registration window including Sample lab ID.
- Finally the result was presented on the screen and printed via report view.

Statistical analysis

The data collected from the study areas was coded and stored in Microsoft Excel of the central 2007 spread sheet and analyzed using simple descriptive statistics such as frequency and percentage.

Result and Discussion

Mapping the value chain

The information gathered during the entirety of this research has been used to map the value chain of the compound feeds sector in Ethiopia, as shown in figure 1. However, it must be noted that this is a simplistic representation which is specific to this study. This will serve as an introduction to several themes which will be discussed in greater detail further on. The flow of processes in the chain are presented horizontally, with the direction of the arrows indicating linkages and functions.

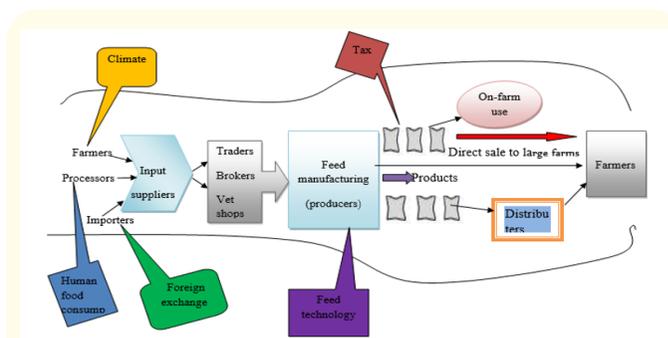


Figure 1: Map of the animal feeds in Ethiopia.

Note: External factors which have impact in the industry are indicated outside of the line.

Figure 1 provides a snapshot of the animal feeds industry in Ethiopia. Most plant and animal based ingredients are sourced in Ethiopia, with the exception of premixes, feed additives and minerals, which are in part imported from other country. Most of the time animal feed manufacturers do not deal directly with farmers. Brokers (locally known as delala) act as middlemen and negotiate transactions between farmers and feed manufacturers. The delala’s are key actors and do not share market information. They form loyal relationships with feed producers. Large companies which process materials for human consumption supply by-products to the animal feed sector. Premixes, additives and minerals are mainly

imported (e.g. Belgium, Netherlands, South Africa). There are very few importers of premixes, feed additives and minerals, who distribute throughout the country. Manufacturers buy these micro-ingredients from veterinary input shops.

Most producers use small, locally produced mixers, with an output of 1 to 1.5 ton/hour. Only five of the larger companies use imported mixers (from Holland, India and China) whilst two companies use pelleters (from China and Holland). Several companies use a least-cost (L-C) computer based programme. Few companies market their product by handing out leaflets and conducting seminars with farmers on appropriate feeding practices.

Once the finished feed is produced, producers tend to integrate forward into the value chain by delivering feed directly to farmers (usually only in quantities >10 bags=500kg). The final product is also distributed to various outlets for sale. Some larger companies operate their own distribution system with appointed agents throughout the country. A number of feed producers also run their own commercial poultry operations, therefore producing feed for on-farm use and for sale. Once the farmer uses the product, they provide feedback to the manufacturers. If they have complaints, they phone the number labeled on the bag. Farmers often complain about poor quality feeds, but feed manufacturers claim that farmers dilute the finished feed with cheap energy sources such as maize bran. For this reason, it is expected from feed manufacturers to provide one-to-one support to farmers, carrying out personal farm visits when necessary and providing knowledge about animal nutrition and management but, this is not conventional in Ethiopia.

Employment

The following section discusses the employment in the compound feeds sector. This only relates to those directly employed by the feed producing companies. The total number of people employed by the 34 feed companies surveyed is 878.

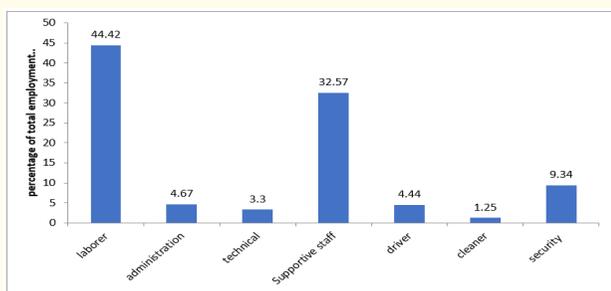


Figure 2: Employment in the compound feed manufacturing sector.

As shown in Figure 2, the dominant form of employment is labour (44.42% of total). Manual labourers are commonly referred to as day labourers, performing duties such as loading and unloading compound feed and raw materials. This unskilled labour explains

why almost half of the total workforce in this study are not qualified. Although this does show that the sector is labour intensive and characterized by a low degree of mechanization, it also highlights the importance of the industry in job creation. Furthermore, these figures refer to those jobs opportunities created directly by the feed manufacturing companies, however the compound feeds sector indirectly creates additional jobs to other actors in the value chain (e.g. suppliers, traders, distributors etc).

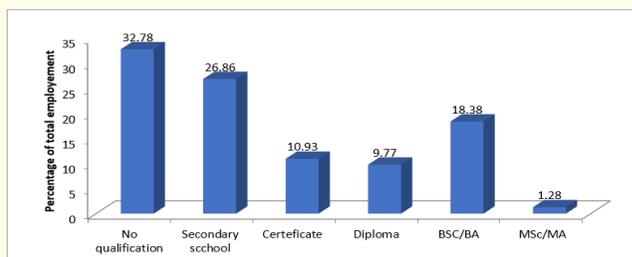


Figure 3: Employees level of qualification in the compound feeds sector.

It is also worth noting that there appears to be a shortage of qualified experts with the sector. This is clear when looking at the level of qualification within the sector. The lack of expertise within the sector was also reported by a few respondents, not in terms of numbers but in terms of availability. According to most of the respondents, there are plenty of highly qualified experts. This idea is similar with our observation and the data analysis result, because most of the feed manufacturing companies have no enough qualified person.

Product distribution

Product distribution (Figure 4) describes how companies get their products to the final consumer. The majority of compound feeds are sold direct to the farmers (consumers) channels (50.12%). Some companies operate their own distribution system while other pass their products through a retailer before being sold to the consumer.

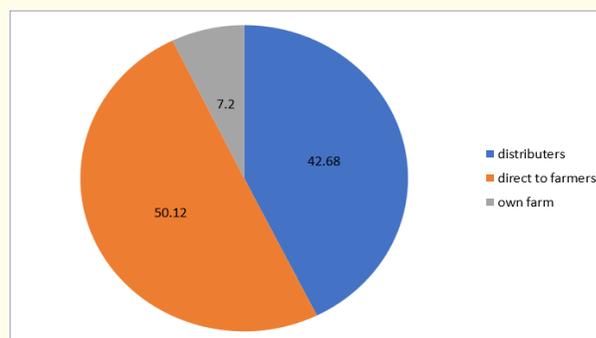


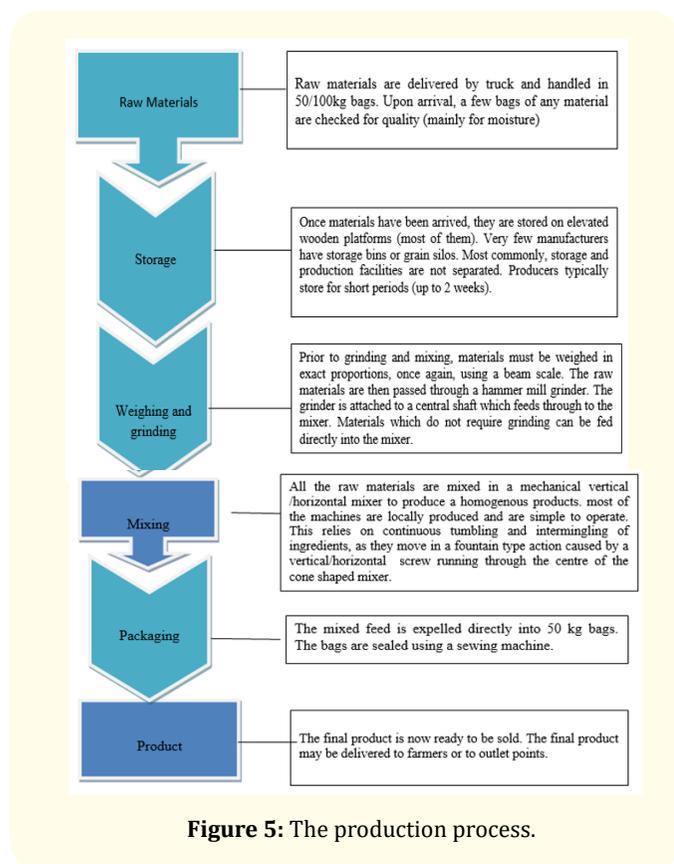
Figure 4: Product distribution.

The fact that several companies are vertically integrating within the value chain by selling directly to farmers may indicate that feed production in Ethiopia is becoming increasingly market-oriented. Strong customer relationships are an important source of market-related knowledge, whilst at the same time producers are more service oriented, offering consultancy to farmers with regards to animal nutrition and husbandry [11], which seems to be an attempt to establish loyal relationships with the client base.

Production

The production process

The representation below highlights the main flows in the production process of animal feeds (Figure 5). However, this schematic depiction is that of a typical animal feed producer. This cannot be generalized to say that all companies follow the same production process. For a few of the producers that were surveyed, it was clear that the production process was more complex and elaborate than what is presented below.



Total production

This study revealed that the 34 manufacturers surveyed produce an average of 345.20 tons/working day (8hrs), and the average production per manufacturer was 10.15 tons/day but this tonnage is not include the unions because all the farmers unions produce less than the above tonnage per day. The reason behind under production of the farmers unions are, market connection, inadequate attention of the unions managers for the feed plant,

low awareness of the farmers to use this feed and other reasons are the bottle neck for this industries. The figures indicate that animal feed production in Ethiopia is relatively low, especially when compared to neighboring Kenya, which is a country of similar history, geography and population yet produced 955,000 tons of animal feed in 2012 [12].

Production capacity

Figure 6 shows the installed and actual production of all the private feed companies surveyed. It was found that on average, feed mills operate at 83.89% of their installed capacity. Some hard-ly working companies operate close to full capacity. The average quantity produced per company is of 2.16tons/hour, but there was a company which produce 12.5 tons/hour. Generally private feed processing companies production is greater than farmers unions.

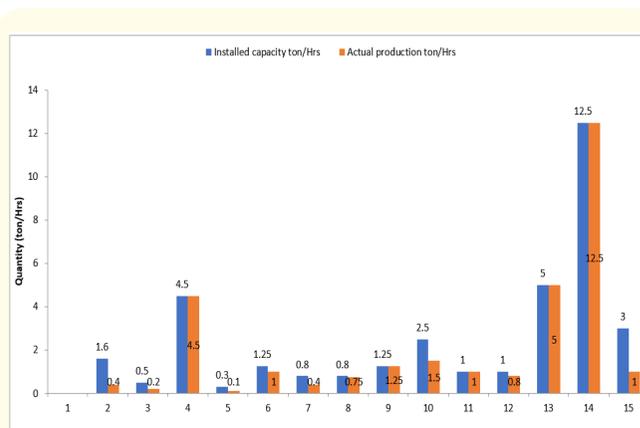


Figure 6: Installed capacity vs actual production of private feed processing plants.

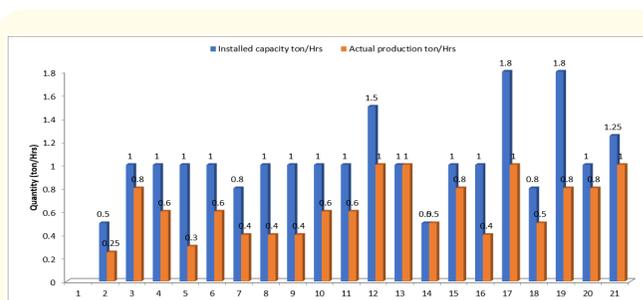
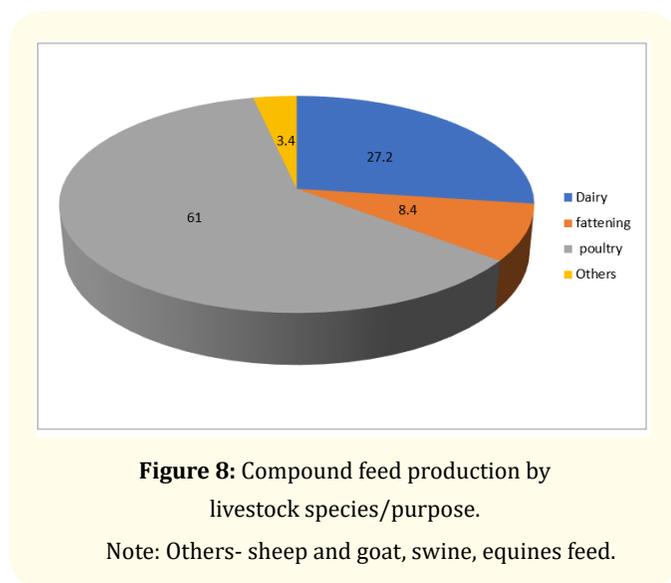


Figure 7: Installed capacity vs actual production of farmers unions feed processing plants.

The results presented in figure 7 highlight a phenomenon which is common in Ethiopia. That is the livestock sub-sectors operate far below full capacity. Most of the farmers union feed producing plants are operating below their potential. Among 20 farmers union only two plants were operating at 100% while the others are operating below 75% of their installed capacity. Similarly, the result reveals that private feed processing plants produce 83.89% of their installed capacity while, farmers union produce 61.81% of their installed capacity.

Production by species

The section below presents the production of compound feeds according to livestock species. It was revealed that the compound feeds sector in Ethiopia is dominated by poultry feed.



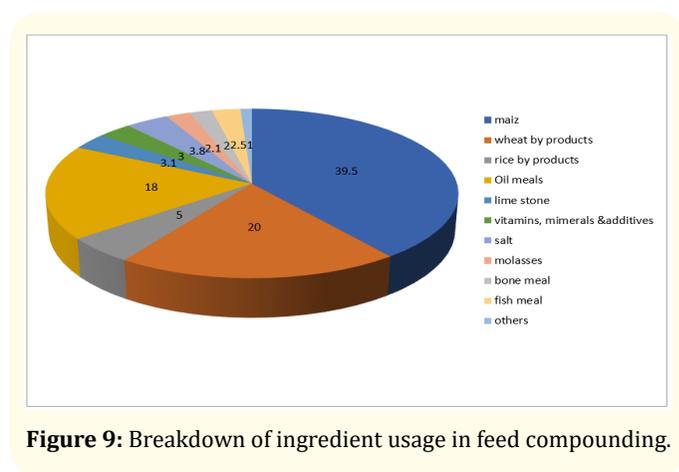
As shown in Figure 8 at the time the survey was conducted combined poultry products, make up 61% of animal feed products, and followed by dairy, beef and other feeds. Once again, these findings are comparable to neighboring Kenya, where poultry feeds roughly 90% of feed mill products [13]. These findings further confirm the trend which characterizes East Africa, as the low usage rates of dairy feed production and utilization technologies in neighboring Kenya, Uganda and Rwanda were of 33%, 4% and 12% respectively [14]. Informal conversations with farmers at a milk collection centre in Ade'a district revealed that farmers do not provide compound feed because of the high cost. The farmers stated they supplement their cattle mainly with maize bran, Wheat bran, nougseed cake and cottonseed cake, whilst the mineral requirements are met through the provision of mineral salt which is not fulfill the requirement of the animal.

Raw material usage in the sector

The following section presents details on raw material usage in compound feed production, and when possible respondents also provided information regarding the source of ingredients used. Respondents were also asked in what quantities they use each ingredient. This was used to show levels of incorporation in compound feeds.

It is by no means a surprise that maize is by far the most used input in the animal feeds sector in Ethiopia. In fact, maize products (maize grain and maize bran), represent 39.5% of all inputs used by feed compounders, which is very similar to the South African and Kenyan feed industry, where maize represented 54% and 50 to 65% of inputs used, respectively [15]. This study shows that

the compound feed industry relies heavily on maize because high amount of processed feed is poultry feed which is formulated with high percentage of maize.



Nutrient category	Major ingredients	Source
Energy	Maize	Traders
	Wheat bran, wheat mid-dling	Agro-industries
	Rice bran	Traders
	Molasses	Sugarcane factory
Protein	(Noug, soyabean, cottonseed, sunflower, peanut, sesame, linseed, etc) cake	Agro-industries
	Fish and blood meal	
Minerals, additives and premixes	Lime stone	Cement factories
	Common Salt	Traders
	Bone meal	Abattoirs
	Liysin, methionine, DCP	Importers

Table 2: Common feed ingredients used in feed processing plant and their sources.

Product standards

Feed analysis

Figure 10 below shows how often feed manufacturers perform proximate analysis of their finished products and raw materials. Fifteen manufacturers never analyse their compound feeds, and it was often stressed that farmer feedback is the most important form of quality control, and 24 manufacturers never analyse raw materials. It is worth noting that all of the companies that never analyse their feeds produce 3 tons/day or less. On the other end of the scale, the two companies that analyse their feeds most frequently (every batch) produce 5-12.5 t/hour. Nonetheless, even several of those who do carry out proximate analysis claimed that farmer feedback is an important part of quality control. Most of the manufacturers those who analysis the feed or feed ingredients are not make the analysis by them self rather they analyse by the support of ACIDI/

VOCA and sometimes by Veterinary Drug and Animal Feed administration and Control Authority (VDAFACA) once or twice a year.

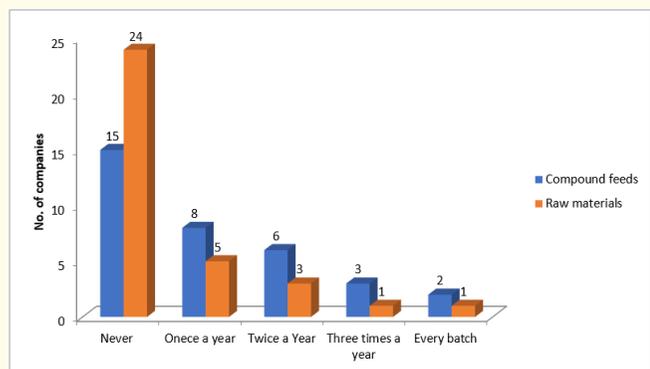


Figure 10: Proximate analysis of compound feed and raw materials.

At the time the survey was conducted most of compound feed processing companies say that feed analytical services are inadequate in Ethiopia because of high cost and access. There are few well-equipped, qualified laboratories. There are only two commercial labs offering feed analysis. Labs in public institutions have limitations in capacity and mode of service delivery that limit their support to the commercial feed sub-sector. In terms of scope, the existing labs are very much limited to conventional analysis and there are no labs which can support analysis of all parameters relevant to feed quality and safety.

Ration formulation

This study showed that from the 34 feed manufacturers interviewed 29 of them use L-C computer programs while, 5 of them are use feed tables. From the 29 manufacturers those use computer programs only 6 of them are formulate by their company staff and the rest 5 are by external advisers while, the 18 surveyed farmers unions are dependent on ACIDI/VOCA. For feed products to be competitively priced and for manufacturers to maximize profit, L-C computer program ration formulation software is very important. Considering the fact that feed ingredient can constitute up to 80% of total costs of the feed manufacturing, it becomes clear that L-C formulation can provide manufacturers with an opportunity to minimize the cost of inputs used, whilst farmers can be guaranteed efficient feed at a minimum diet cost [16].

Price of compound feed

Seasonality, shortage and very high prices of feed ingredients are key challenges for sustainable and affordable delivery of compound feeds. During the last five years, prices of feed ingredients and compound feeds have increased by an average of 52 and 82 percent, respectively leading to low demand of compound feeds. This situation has even led to closing of some commercial farms (dairy and beef), essentially due to low return on the investment

(EAFIA, 2017). During this survey was conducted the price of compound feed was highly increased because of increment of the cost of the ingredient.

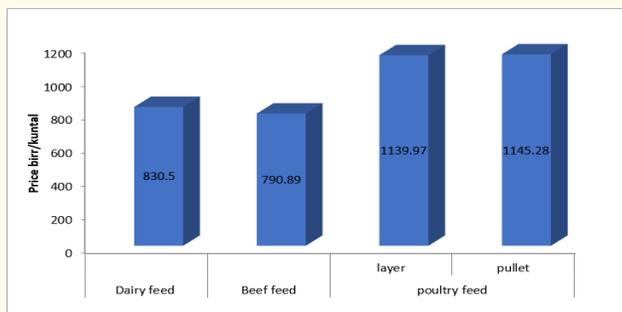


Figure 11: Price of compound feeds.

These findings indicate that despite the lack of statutory control product labeling, and large amount of variability, there appears to be a system of self-regulation within the industry, which may be explained by the competitive nature within the industry, meaning that manufacturers are forced to competitively price their products in order to retain their clientele and in order to explore issues relating to product quality. Although competition was mentioned as a constraint by most of the respondents, farmers may be benefitting from the competitive environment as producers strive to maintain the quality of their products. Because several respondents had mentioned the fact that adulteration of feeds with maize bran, and counterfeit packaging has been a problem in the past.

Feed manufacturers association

A strong presence of the association is essential in protecting the interests of the animal feed industry within the country, and is also responsible in ensuring the quality and safety of compound feeds, which is achieved by setting clear rules and good manufacturing guidelines which ensure self-regulation and improved government regulation throughout the supply chain [15].

The Ethiopian Animal Feed Industry Association (EAFIA) is a membership based association initially established by volunteer feed factory owners/processors, feed input and machinery suppliers, dairy and poultry producers in order to solve their common problems and enhance their benefits and contributions to the feed industry development. EAFIA was legally registered in January 2008 and re-registered in June, 2015 by the Ministry of Industry in accordance with a sectoral association establishment proclamation no 341/2003. EAFIA members included feed processors, feed input suppliers, forage seed producers as well as dairy and poultry producers most of which are from Addis Ababa and Oromiya surrounding Addis Ababa, and very few from regions (Amhara, SNNP and Tigray). Thus, the membership development has to include the newly emerging privates and unions in the regions to establish a strong nationwide association. At the time this survey was con-

ducted out of the 34 surveyed companies 14 of them are not the member of the association.

Furthermore, associations are useful in providing missing or inadequate services, improving bargaining strength with suppliers, and allowing a greater co-ordination of the flow of input supplies [17]. A feed manufacturers association is also required to address the knowledge gaps within the sector, thereby setting the agenda for research and development in order to enhance competitiveness and capacity to innovate, so as to ensure sustainable and resource efficient livestock production systems. Overall, the association has the duty to play a central role in the decision making process within the animal feeds industry [15], acting as a link between all stake-

holders in the sector, both public and private. But, EAFIA is limited in institutional and organizational capacity in terms of manpower, finance and logistics to fully organize and support all the regional feed industry owners. As a young institution, strengthening the organizational capacity of the Ethiopian Animal Feed Industry Association deserves attention to spear head the development of feed industry. EAFIA has been closely working with different government institutions (MoA and LR, MoTI, etc.) and non-government organizations (ACDI/VOCA, LMD, AACC, etc.) In particular with the USAID support of the ACDI/VOCA FEED II Project has accomplished various capacity building and related activities.

Nutrient composition of compound feed samples

Type of feed		Test result (%)						
		N	Fat	Fiber	Moisture	CP	DM	Energy (kcal/kg)
Layer feed	Result	17	4.91	7.34	9.51	14.68	90.45	2451
	Standard		2	9	12	16.5	88	2600
Lactating dairy cow	Result	24	5.69	17.95	9.49	14.16	90.50	1942
	Standard		10	15	11	17	89	2500
Beef	Result	23	5.19	13.69	9.57	13.50	90.43	1931
	Standard		10	11	11	14	89	2650

Table 3: Average nutrient composition of compound feeds.

N: Number of Samples; DM: Dry Matter; CP: Crude Protein.

The above table illustrates that except fat and DM all parameters in layer feeds were recorded below the base mark of the ESA, 2019 standard but fat and DM were recorded above the standard. The lactating feed samples average result shows that, the fiber and DM content is recorded above the standard while, the rest of them were scored below the standard. Similarly, the beef sample analysis result showed that, except fiber and DM all parameters are below the standard.

The above figure show that the fat content of the whole feed analyzed are fully below the standard stipulated by the Ethiopian Standard Agency (ESA), 2019.

Figure 12 reveals that altogether 64 feed samples (17 poultry, 24 dairy and 23 beef) were evaluated for their dry matter content. Dry matter content of 62 feed samples was found above the standard and 2 of them are recorded below the standard. The DM content ranges between 88.28%-91.87%, 89.21%-91.99% and 89.61%-91.31% for lactating dairy cow, beef and layer poultry respectively. The result was not far from the standards sited by Ethiopian Standard Agency, 2019 (89 for dairy and beef and 88 for poultry). In general, dry matter content of different compound feed was observed to be satisfactory.

Crude protein (CP) is the most important quality indicator in animal feeding [18] and therefore merits considerable attention. A total of 64 samples were evaluated for crude protein content in this research. Among them, there were 15 samples in which protein content was recorded less than the standards in their constituent. There were 49 samples with crude protein content above the standard. The layer samples CP content was ranges between 10.91%-

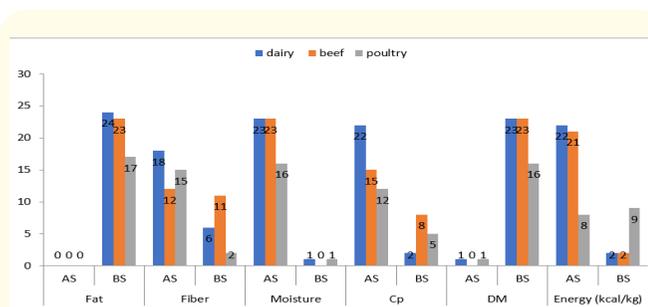


Figure 12: Feed Analysis Result and feed standard comparison.

AS: Above standard; BS: Below standard; CP: Crude protein; DM: Dry matter.

17.90% in which the standard is 17%. Similarly, the CP content of the beef feed is ranges between 10.27-16.34% where the standard is 14%. The CP of lactating dairy cow is ranges between 11.39-18.57% but the standard is 16.5. As a general most of the results in all feed types were much close to the standard.

Crude fiber content of 64 samples were evaluated from the collected samples. Crude fibre content of 45 samples was found to be below the standard. There were 19 samples, which had crude fiber content above the standard sited. The layer feed result was ranged between 1.76-23.51% which is somewhat far from the standard 9%. Similarly, there were beef and lactating dairy cow feed samples in which the crude fiber constituent ranged between 5.63-24.9% and 7.84-23.19% respectively. Because of the fiber is an indigestible part of the feed most of the feed manufacturing was processing less fiber content feed.

Moisture is an important diluents of the nutrients in feedstuffs. It is necessary to know the moisture content of raw materials and compound feeds as a check on their feeding requirements, for use in calculating analytical data on a dry matter basis and also because moisture has an important function in determining the form of the diet. It also has an effect on its stability and its shelf life. Controlling the moisture content of any feed is very important, because of it is the mainly cause for aflatoxin. From the above figure we observe

that the moisture content of all feed types: poultry, beef and dairy was show highly below the standard. From the 64 sample analyzed 62 of the samples from all feed types was below the standard, while only 2 of them are above the standard. The result value ranges between 8.58-12.16%, 8.01-79% and 8.13-11.72 while the standard is 12,11and 11 for layer, beef and lactating cow respectively.

From the 64 samples analysed the DM content of 62 compound feeds were above the standard while, only 2 samples recorded below the standard. But the result recorded is not much far from the standard. As stated by Kaijage, *et al.* [19], this suggests that all feeds analysed are appropriate for use and storage in animal feeds. High DM contents control the growth of mould in feeds, thereby reducing deterioration which is particularly important in tropical countries [19].

From the total of 64 feed samples analysed for metabolizable energy content 52 samples result was recorded below the standard while 12 of them are over the standard. The result value ranged between 1364-2746Kcal/kg, 1092-2890kcal/kg and 1703-2880kcal/kg while the standard is 2500, 2650 and 2600kcal/kg for layer, beef and lactating dairy cow, respectively. The above result shows that a great attention is needed to fulfill the energy requirement of the animal because most of the feed manufacturing industries in Ethiopia are not take into consideration the energy content in the feed they process.

Factors		Milking Dairy cow feed		Beef feed		Layer feed	
		Private	Unions	Private	Unions	Private	Unions
CP (%)	Mean	13.419	14.603	14.039	13.159	15.906	13.819
	SE	.570	.442	.570	.457	.646	.541
DM (%)	Mean	90.269	90.651	90.339	90.488	90.389	90.554
	SE	.264	.205	.264	.212	.300	.0251
ME (Kcal/Kg)	Mean	1792.367	2031.733	1929.144	1932.457	2365.257	2511.800
	SE	128.458	99.503	128.458	102.996	145.658	125.866

Table 4: The nutrient contents of private and farmers unions compound feeds.

The CP content of feeds produced by private feed processing plants was relatively close to the ESA, 2019 when compared with the feeds produced by farmers unions. The reasons for this variation between private and farmers unions was the awareness of the customers unions was less than that of private customers because most of the unions customers are farmers, lees attention of the farmers unions managements for feed processing plant is cause less the shortage of necessary ingredient to produce quality feed. Another reason was most farmers unions are not use appropriate ration formulation software.

The DM content of the feeds from farmers unions and private feed processing companies are statistically the same. The statis-

tical value was ranges between 90.2-90.55. The ME content was show a significant difference on a milking dairy cow and beef feed while, the layer feed was almost the same between the farmers and private feed processing plants.

Constraints/challenges in the feed industry sub-sector

Respondents were asked about the constraints they face in their feed manufacturing business (Figure 13). High price of ingredient was the most frequently mentioned constraint (50%).

The role of the industry should be that of providing high quality livestock feeds which meet the nutrient requirements of livestock in different stages of growth or production, whilst the production

of such feeds remains economical, attainable only through the optimal blending of ingredients. However, as it stands, the feed industry in Ethiopia faces several constraints which ought to be addressed.

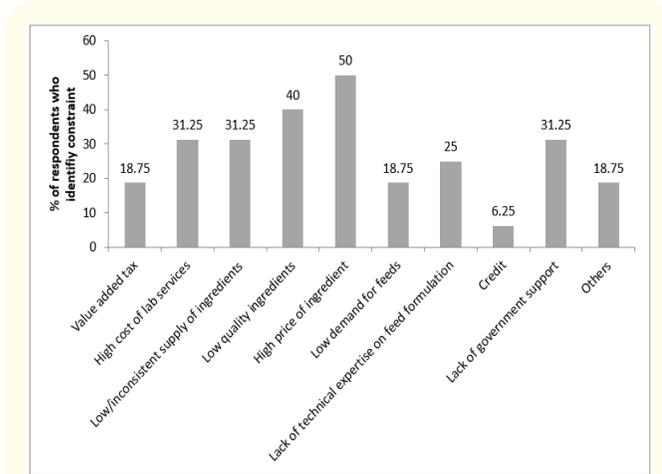


Figure 13: Production constraints identified by respondents

Feed ingredients and compound feeds price

Seasonality, shortage and very high prices of feed ingredients are key challenges for sustainable and affordable delivery of compound feeds. At the time this survey was conducted all feed manufacturing industries are facing the problems in terms of inconsistent supply (31.25%), low quality (40%) and high price of feed ingredient (50%). During the last five years, prices of feed ingredients and compound feeds have increased by an average of 52 and 82 percent, respectively, leading to low demand of compound feeds. This situation has even led to closing of some commercial farms (dairy and beef), essentially due to low return on the investment (EAFIA Feed bulleting no.007/2017). The major components of the animal feed formula (grains, oil meals, milling by-products) are not always available at the right time and at the right place. During this survey was conducted all the feed ingredients price was extremely very high, this sky rocketing prices of ingredients with the consequences of high compound feed price. This high price of compound feed revealed on impacts on commercial farms and the consequently depressed markets and declining trend in consumption pattern of animal products as a result of inflation have contributed to the low production of livestock and animal feeds.

Demand of compound feed

The livestock production of Ethiopia is largely of a subsistent type where compound feed supplementation is extremely low. Compound feed production and intensification of animal agriculture are key processes which ought to go hand-in-hand towards transforming animal agriculture. Although market led economy and commercialization of animal agriculture have opened new avenues to achieve this goal, increase in demand of compound feeds

has not yet reached to the desired level. At the time of this survey most of the feed processing plants were working under capacity. Most farmers are still dependent on pasture, crop residues and raw agro-industrial byproducts. The available demand for compound feeds is dispersed all over the country, relatively the demand is better along the Addis Ababa-Adama corridor, where the feed enterprises and modern livestock farms (Poultry, dairy, and cattle fattening) are found.

Un-fair taxation policy on feed ingredients and compound feeds

Several animal feed companies respondents voiced their concern that VAT exemption on agricultural inputs may be removed. It is therefore likely that those who mentioned high tax as a constraint were referring to the threat of the introduction of VAT in the animal feeds sector. Commercial feed sub-sector and livestock production in general have long been suffering from un-fair taxation. On ruminant feeds, 15 percent value added tax (VAT) is charged on feed ingredients and compound feeds leading to double taxation for feed ingredients and formula/compound feeds. On poultry feeds, since most of the feed supplements especially the premixes are imported from abroad, the government has taken positive measure recently in removing VAT on poultry feed ingredients and formula feeds. Such a policy has led to unaffordable price of feed ingredients and compound feeds and acts as deterrent to use of commercial to intensification of animal agriculture.

Feed quality and safety analytical service

The feed quality is related with fulfilling of the nutritional requirement of the livestock under consideration with minimum possible cost. Therefore, the quality of feed consider the nutrient requirement of the livestock and the nutritive value of feed ingredient available. Most private and farmers' union feed processing plants are currently facing serious challenges in analytical services mainly because of high cost and inadequate service delivery. There are no well equipped and accredited labs to the satisfaction of the commercial feed sector. To date only one commercial lab that undertakes modest number of analysis is available. Laboratories in public institution have limitations in capacity and mode of service delivery to support the commercial feed sector. In terms of scope, the existing labs are very much limited to the conventional analysis and there are no well equipped laboratories to support analyses required for ensuring feed quality and safety.

The low confidence in the nutritional information of feed provided by suppliers' means that buyers (livestock farmers) are not guaranteed high quality feed. In itself, this suggests that the industry is under-developed, which can in part be explained by its infancy. As proposed by Safalaoh and Chapotera [20], the absence of baseline data from which to anchor recommendations or development strategies, makes public and/or private sector interventions

extremely difficult. Although this research was not set out to fill this information gap, it can be regarded as an important starting point in characterizing commercial animal feed production in Ethiopia.

Research and extension support for commercial feed sector

Technical services (research and extension) in promoting the commercial feed sector (use of alternative feeds for compound feeds; use of innovative approaches in import substitution via local production of feed supplements; research, extension and infrastructure development support in feed processing machineries; on-farm testing and promotion of compound feeds, and technical support for feed safety and quality regulation) are very weak or non-existent.

Organizational capacity of Ethiopian animal feed industry association (EAFIA)

EAFIA was established in 2008 by feed factory owners, private dairy farmers and farmers' unions. As a young institution it has not yet reached to the desired level of operation. It is currently facing several challenges, among them technical, financial, and organizational deserve attention. Technically, members of EAFIA have not yet developed the required capacity for internal or self regulation for ensuring the desired quality and safety of their products. In terms of finance, the major source of finance so far has been project based and such a source is not sustainable. From organizational point of view, all feed factory owners are not yet members of EAFIA and a lot more remains to be done to make EAFIA an influential association.

Ration formulation

Lack of experience and facilities such as computer software for best-cost feed formulation for efficient animals production as well as compounding feeds from tables that have limited information or have been produced in other countries are the major problems challenging the Ethiopian feed industry. professional advisory is rarely used by the feed processing owners.

Opportunities for the Ethiopian feed industry

Among the aforementioned challenges the key concern in commercial feed sector is resourcing of the quality ingredients throughout the year at affordable price. For this to happen the following issues deserve special attention.

Feed ingredients (maize and soya bean)

Adequate opportunities currently exist to produce maize and soya bean for feed production in Ethiopia. Last five decades of research and technological advances have led to the availability of varietal choices and production packages. Additionally, huge land is available for commercial production of these commodities. These offer opportunities to enhance their production in Ethiopia.

Feed Supplements or inoculants

Ethiopia is very much dependent on importing feed supplements like premix, minerals and vitamins. Imported products are usually generic and not tailored for local purpose. Additionally, from economic point of view, hard currency is required to procure them from abroad. Therefore, alternatives have to be sought and developed from technical and economic perspectives for sustainable supply. Domestic production of feed supplements is emerging with wider business opportunities as a result of intensification of livestock production. Thus, there are opportunities for foreign direct investment or involvement of local investors in domestic production of feed supplements. The production of effective microbes as feed inoculants is currently a take off point with huge business opportunity in commercial feed sector.

By-products of agro-industry

By-products of sugar industry (molasses, bagasse, sugarcane tops), breweries and food processing industries are not yet effectively utilized for animal feed production. The increasing number of upcoming sugar industry projects, breweries and agro- and food-industries would provide opportunities for improving feed supply through utilization of alternative feeds. Additionally, abattoir by-products such as bone, blood and meat can be converted to animal feed and incorporated into non-ruminant feeds.

Feed processing machineries, equipment and tools

Feed processing machineries, equipment and tools are currently supplied by few companies. Taking into account the need for modernization of the feed industry dictated by commercialization of livestock production, there will be high demand for feed processing machineries. A revolution is needed in this field for making the feed industry vibrant.

Laboratory service delivery in feed quality and safety

Commercial feed sub-sector is currently encountering lack of laboratory service delivery system for feed quality and safety assessment. Labs rendering such services are very limited in number and scope, and mode of service delivery needs to be efficient and reliable. Taking into account the future growth of the feed industry, establishment of laboratory service delivery system by commercial labs is an opportunity for investment.

Enhancing capacity and impact of EAFIA

Quite a range of opportunities exist for improving overall organizational capacity of EAFIA. Financially, securing funds from alternative sources can be designed and implemented. In addition, EAFIA can link with key actors (research, academia, development organizations, international institutions) engaged in feed value chain to improve its efficiency and impact. It may develop a status of non-profit organization so that it can participate in the activities of development and international organizations. EAFIA can also

make the best use of its technical advisory board to develop an action plan for the next 5 to 6 years.

Conclusion and Recommendation

Overall, it seems that there is a concerted effort by producers to provide quality feeds, but it appears that producing a product of consistent quality is not easy to achieve, as the composition of the raw materials is what ultimately determines the quality of the finished feed. The results from the feed analyses showed that despite the fact that the sector is characterized by a high degree of informality, few expertise, the lack of government regulation, and very few laboratories for feed analysis, the compound feeds produced are of satisfactory quality. However, it can also be concluded that there is a large amount of variability in the compound feeds, which means that farmers are still not guaranteed a high quality feed on a frequent basis. This places a greater emphasis on the importance of raw material analyses, both for the producer and at a national level, in order to vast database of the available feed resources. The increased confidence about nutritional quality would allow farmers to use this information in order to develop feeding strategies for improved animal performance and income. However, this could not be successfully achieved without improving knowledge and training on livestock nutrition management.

In the light of the ongoing development of Integrated Agro-industrial Parks, supply of feed ingredients can be enhanced by integrating the feed processing plants to these initiatives. The Integrated Agro-industrial Parks, among various activities, are involved in processing of crops and other agro- and food-products, and they generate a huge volume of by-products for use as feed ingredients for feed processing plants. The integration would be a win-win situation both in terms of creating effective demand and supply towards enhancing the feed value chain, creating jobs and mitigating disposal problems of by-products.

Access to quality feed should be enhanced by providing special support e.g. making available finance, improving overall infrastructure, providing market information to feed micro-businesses (private dealers, marketers and organized youth) at the grass root level. Although animal feed by and large is a private good, extensive technical and policy support such as research, regulatory framework and conducive policy environment are required from the public domain. As a young institution, strengthening the organizational capacity of the Ethiopian Animal Feed Industry Association deserves attention to spear head the development of feed industry.

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