Commercial poultry feed analysis and value chain mapping in northern Ethiopia

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Investment by the private sector in the commercial feed sector shows an improvement; however, the value chain of the poultry feed sector has not yet been mapped. This study was conducted in northern Ethiopia to assess poultry feed sources and feed value chain mapping. A multistage sampling technique and a proportionate sample determination method were used to fix the sample size. Accordingly, 147, 109, and 64 poultry producers were selected from semi-intensive, small-scale, and medium-scale farms. Nine focus group discussions comprising relevant stakeholders were conducted to verify the information gathered from households. The collected data were analysed using chi-square and descriptive statistics. The results revealed that the feeding practices, feed sources, feeding intervals and feed shortage coping mechanisms of the poultry producers were significantly different ($P \leq 0.05$). Commercial feeds were reported as the major feed sources, with a slight use of homemade feeds from locally available grains and non-conventional feed sources. As a food shortage coping mechanism the majority of semi-intensive (n = 83) and small-scale (n = 85) farms, use locally available grain feeds, whereas medium-scale farms use flock size reduction. The price of major feed ingredients and poultry compound feeds substantially increased from 2015/2016 to 2019/2020. The price increase was from 50 - 213% in raw materials, whereas it was from 63 - 84% in different poultry compound feeds. Value chain profiles were drawn, and the relationship among the chain actors was found to be weak and informal. Therefore, training should be given on proper feed formulation, and comprehensive and systematic studies should be conducted using alternative feed ingredients available in various geographic locations.

Keywords: Compound feed, coping mechanism, feeding practice, non-conventional feed, poultry feed price

Poultry meat and eggs are among the animal-source foods most widely eaten at the global level (FAO 2021). In Ethiopia, there is a huge demand for poultry meat and eggs, leading to the emerging establishment and expansion of modern and organised poultry farms in the entire country, particularly in peri-urban and urban areas (FTFE 2022; Sime 2022). These emerging farms have a vital contribution to generating employment, improving family nutrition, and empowering women with economic opportunities (FAO 2019).

The demand for protein foods is progressively growing with the improvements in society income and population growth. In fulfilling the protein requirements of people, sources of poultry products play a significant role. Poultry meat is healthier than other meats because it contains less overall fat and more beneficial monounsaturated fats (Sime 2022). Moreover, poultry production is considered to fulfill the nutritional requirements of the poorest sections of society (Reta 2009). Thus, if food self-sufficiency is to be achieved and to combat malnutrition in developing countries, particularly in Ethiopia, there is a need to give due attention to poultry production (Melkamu 2013). Due to increasing demand for animal products and increasing urbanization, there is a pronounced tendency to shift from poultry for subsistence use to poultry for commercial use.

The transition from no or low-input poultry production to commercial production should be considered as a complete change of production system. However, numerous factors affect chicken production under the commercial production system. Feed, marketing constraints, diseases and bio-security are the most important ones (Matawork 2016). Among the other challenges, feed inadequacy, in terms of both quantity and quality, plays a great role in reducing the production of poultry meat and eggs. The inflation pressure on feed prices

0041–3216/2023/010032–043

presents a serious bottleneck to the poultry production sector (FTFE 2022).

The feed sub-sector is central to all livestock commodities and is a key pillar of poultry growth and transformation from various perspectives. From a production point of view, poultry production is essentially the conversion of feed into poultry products, dictating the level of production and product quality and safety (Seyoum et al. 2018). From an economic point of view, about 70% of the cost of poultry production is feed, which suggests the economic feasibility of poultry production is mainly a function of the quantity or quality of nutrients and the science of feeding. Thus, feed is a point of convergence and a critical commodity for which poultry species compete, and it is a major pillar towards ensuring the economic, social, and environmental goals of poultry production (Makkar 2016).

The establishment of feed processing plants in Ethiopia dates back to the early 1950s, when modern livestock husbandry began, followed by the establishment of feed processing enterprises during the socialist regime. As a follow-up to the new economic policy of 1991, the feed processing enterprises operated by the government were privatised, and a number of feed processing plants of various capacities came into operation. An overall assessment of the Ethiopian feed processing plants was carried out in 2012 by the Ethiopian Animal Feed Industry Association (EAFIA 2012). However, in a market-led economy where production signals are derived from the market, it is rational to expect basic changes and dynamism in overall status.

Currently, the feed processing enterprises in Ethiopia are dominated by private companies and farmers' unions engaged in the production of compound feed, and the majority of them are located in Oromia and Amhara regional states (Seyoum et al. 2018). However, there is an absence of feed processing plants dedicated to the production of commercial feed in the major regional states such as Amhara, Oromia, SNNPR, and Tigray. The private sector's investment in the commercial feed industry has gradually increased over the past few years. However, the value chain of the poultry feed sector has not yet been mapped, and the key players have not been clearly identified and characterised. Therefore, this study assessed the current poultry feed sources, feeding system, the status of the feed sector and feed value chain mapping in northern Ethiopia.

Material and methods

Description of study area

The study was carried out in Tigray, northern Ethiopia. It covered 13 districts; Tahtay-Koraro, Wukro-killite-Awlaelo, Laelay-Machew, Hawzen, Raya-Azebo, Hintalo-Wejerat, Tahtay-Adyabo, Tselemti, Kafta-Humera, Tsegede, Enda-Mekoni, Ofla and Ganta-Afeshum. Tigray is located at the northern limit of the central highlands of Ethiopia. The landform is complex and composed of highlands (with an altitude range of 2300 – 3200 m), lowland plains (with an altitude range of <500 – 1500 m), mountain peaks (as high as 3935 m) and high to moderate relief hills (1600 – 2200 m).

Sampling design

In this research, a multistage sampling technique was employed. First, the study area was classified into three agroecological zones: highland, midland and lowland. Four districts from the highlands, six from the midlands, and three from the lowlands were purposefully selected based on their commercial poultry production practices. In each district, the production practices were stratified into three production systems: medium-scale, small-scale and semi-intensive production systems based on the number of poultry (>500, >200, and 50–200, respectively) kept on the farm (FAO 2019; Wondmeneh et al. 2017). On each of the selected poultry farms, households were

selected randomly. The number of districts in the study area within the agroecological zone, poultry producers per district and producers per farm size were selected using a proportionate sample size method to make sure that sampling sites with large populations had the same probability of getting into the sample as those in smaller sites, and vice versa, as described in Cochran (1963). Accordingly, 147, 109, and 64 poultry producers were selected from semi-intensive, small-scale and medium-scale operations, respectively, making a total of 320 poultry producers used in this study.

Data collection method and tools

Survey

A structured and semi-structured questionnaire was used to generate both qualitative and quantitative data from the poultry producer. The questions were framed in such a way that poultry producers could understand them and respond easily. Secondary data about feed ingredients and compound feed price trending from different sources, published and unpublished, were used for feed ingredient and compound poultry feed prices from 2015 – 2016 to 2019 – 2020.

Focus group discussion

To verify the data obtained through interviews, 13 focus group discussions (one group per study district) were held. The nomination of discussants was made together with the bureau of agriculture staff based on their knowledge of and role in the commercial poultry feed production system. A total of nine participants (five male and four female) from the bureau of agriculture, poultry producers, feed producers, and feed retailers, were invited for a focus group discussion. The date for the discussion was jointly set, and a reminder invitation was sent to them 1 week before the date. Discussions were held in one of the government halls of the towns in each study district. The time taken per discussion was a minimum of 120 and a maximum of 150 minutes. During the focus group, different questions were discussed, such as feed source, feed shortage coping mechanisms, feed price trending and poultry feed value chain functions. Unique observations made were recorded in writing by the researcher during the discussions.

Data management and analysis

Data collected through questionnaires were analysed using chi-square and descriptive statistics in the R programming software package R i386 3.4.2, and the results were presented using tables and graphs. Chi-square was used to analyse the following parameters: feeding practice, sources of feed, feeding interval and feed shortage coping mechanisms. Descriptive statistics were used to examine the trend of feed prices.

Mapping the poultry feed market chain

This was carried out in qualitative and quantitative terms through graphs presenting the key poultry feed market channels, various actors in the chain, their linkages, and all operations of the chain from input supply to compound poultry feed supplementation. It was processed using *Microsoft Office Visio 2007 software.*

Results

Poultry feed sources and feed shortage coping mechanisms

Feeding practices, feed resource utilisation and feed shortage coping mechanisms among poultry producers are presented in Table 1. Feeding practices differed statistically significantly ($P \leq 0.05$) across farm sizes. In middle-scale farms, all respondents (100%) use full commercial feeds in confined housing systems, 76.1% (n = 83) of respondents in small-scale farms use full commercial feeds,

while 23.9% (n = 26) of respondents in the small-scale production system use half commercial feed and half homemade feed supplementation under a confined housing system. On the semi-intensive farms, the highest number of respondents 51.7% (n = 76) use scavenging with homemade feed with 27.9% (n = 41) and 9.5% (n = 14) using half commercial with half homemade feed and full homemade feed resources, respectively.

The feed sources used by poultry producers in the various production systems differ statistically ($P \leq 0.05$). The majority of 86.2% (n = 94) of small-scale producers and all 100% (n = 64) the medium-scale producers acquire their poultry feeds from commercial feed producers, while on the semi-intensive farms, 57.1% (n = 84) obtain their feed resources from purchased grains and nonconventional locally available feeds and 31.3% (n = 46) acquire their feeds from the purchase of grains and commercial compound feed retailers.

The feeding frequency varied statistically ($P \leq 0.05$) within the production systems. In all three systems, around half of the respondents feed their poultry three times a day; 54.4% (n = 80), 51.4% (n = 56), and 50.0% (n = 32) respectively of semi-intensive, small-scale and medium-scale farms feed their poultry three times a day, as they believe this improves productivity. Looking at other feeding frequencies, 40.1% of semi-intensive farmers feed twice; whereas 36.7% of small-scale and 50.0% of medium scale farmers feed at any time.

Table 1: Poultry feeding practice, feed sources and feed shortage coping mechanisms

Variables	Semi-intensive	Small	Medium	Total	Tests	
	N (%)	N (%)	N (%)	N (%)	X^2 value	P value
Feeding practice						
Scavenging with commercial feed supply	8 (6.4)^a	0 (0.0)^b	0 (0.0)^b	45 (14.1)	241.1	0.000
Scavenging with homemade feed supply	76 (51.7)^a	0 (0.0)^b	0 (0.0)^b	39 (12.2)		
Full commercial feed	8 (6.4)^a	83 (76.1)^b	64(100.0)^c	155 (48.4)		
Full homemade feed	14 (9.5)^a	0 (0.0)^b	0 (0.0)^b	14 (4.4)		
Half commercial and half homemade feed	41 (27.9)^a	26 (23.9)^a	0 (0.0)^b	67 (20.9)		
Sources of feed						
Commercial feed producers	8 (5.4)^a	94 (86.2)^b	64(100.0)^c	166 (51.9)	249.3	0.000
On-farm and purchased commercial feeds	9 (6.1)^a	0 (0.0)^b	0 (0.0)^b	9 (2.8)		
Purchase grains and commercial feeds	46 (31.3)^a	15 (13.8)^b	0 (0.0)^c	61 (19.1)		
Purchased grains and nonconventional feeds	84 (57.1)^a	0 (0.0)^b	0 (0.0)^b	67 (26.2)		
Feeding frequency						
Morning 12:00 and afternoon 4:00	59 (40.1)^a	13 (11.9)^b	0 (0.0)^c	72 (22.5)	84.8	0.000
Three times a day	80 (54.4)^a	56 (51.4)^a	32 (50.0)^a	168 (52.5)		
Any time in the day	8 (5.4)^a	40 (36.7)^b	32 (50.0)^b	80 (25)		
Feed shortage coping mechanisms						
Feeding available grains	83 (56.5)^a	85 (78.0)^b	0 (0.0)^c	168 (52.5)	237.4	0.000
Feeding nonconventional feeds	44 (29.9)^a	13 (11.9)^b	0 (0.0)^c	57 (17.8)		
Reduce flock size	20 (13.6)^a	11 (10.1)^a	33 (51.6)^b	64 (20.0)		
Store more feeds	0 (0.0)^a	0 (0.0)^a	31 (48.4)^b	31 (9.7)		

N (%) = number and percentage of respondents; ^{a,b,c} = numbers followed by different superscripts within a row for each feed type are significantly different at $P \leq 0.05$.

The feed shortage coping mechanisms of poultry producers in the study area varied significantly ($P \leq 0.05$) among production systems. The majority of semi-intensive (56.5%; n = 83) and small-scale (78%; n = 85) farms use locally available grain feeds as a coping mechanism during commercial feed supply shortages. Whereas, about 29.9% (n = 44) of semi-intensive farms and 11.9% (n = 13) of small-scale farms used locally available non-conventional feed resources during the period of feed shortage. Meanwhile, about 51.6% (n = 33) and 48.4% (n = 31) of medium-scale farms use the reduction of flock size and storage of excessive feeds as coping mechanisms, respectively.

Poultry feed value chain mapping

The value chain of the poultry feed sector in northern Ethiopia is relatively simple. As shown in Figure 1, it includes four main chain actors, namely: feed input suppliers, who control the supply of imported and locally produced feed raw materials to feed mills; feed producers (those responsible for converting feed raw materials into commercial poultry feeds of mesh and pellets for use by poultry producers), feed marketers and traders (who buy feeds from feed mills and sell them to poultry producers) and poultry producers (who feed their poultry with feeds purchased from feed mills or traders).

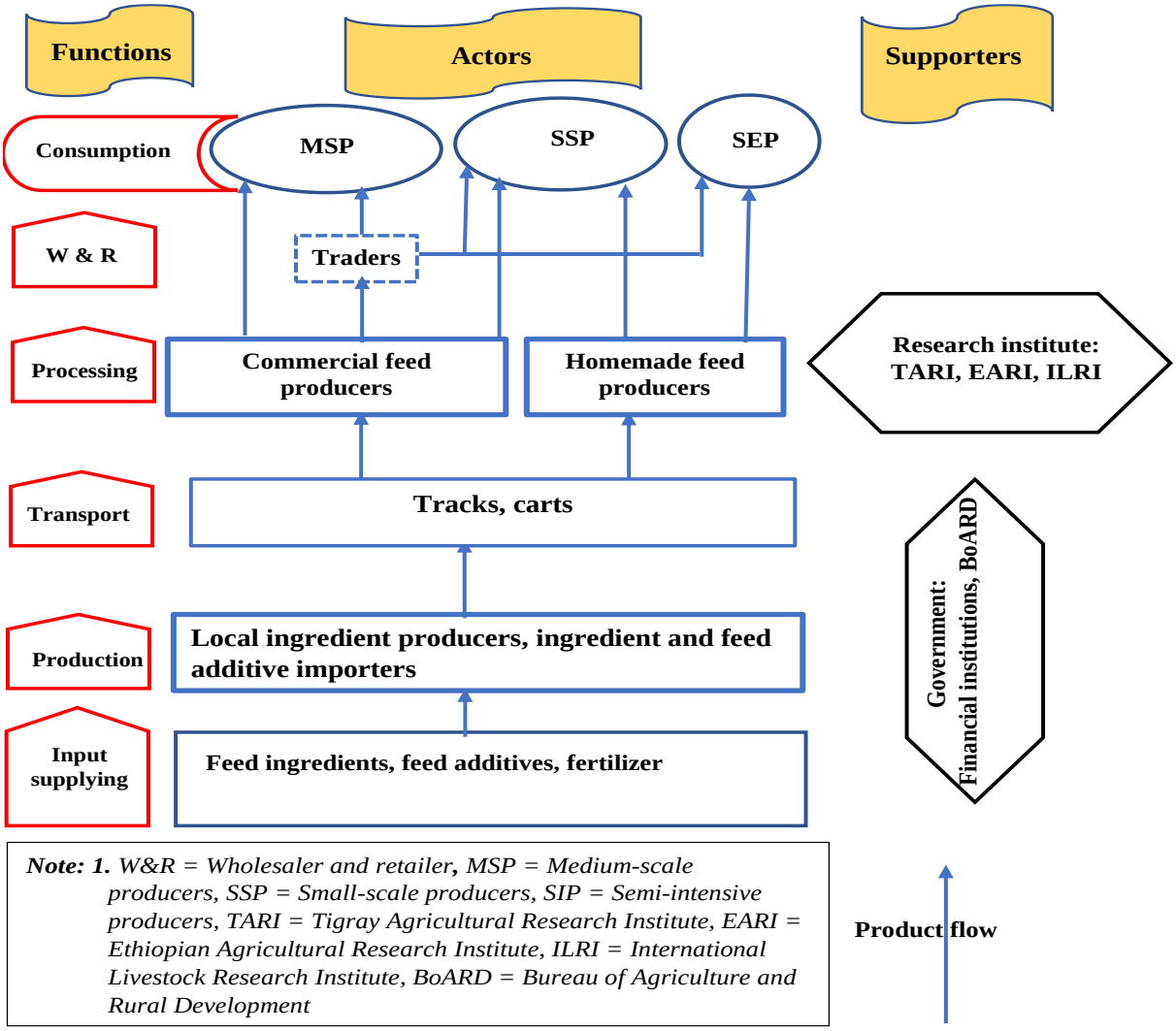
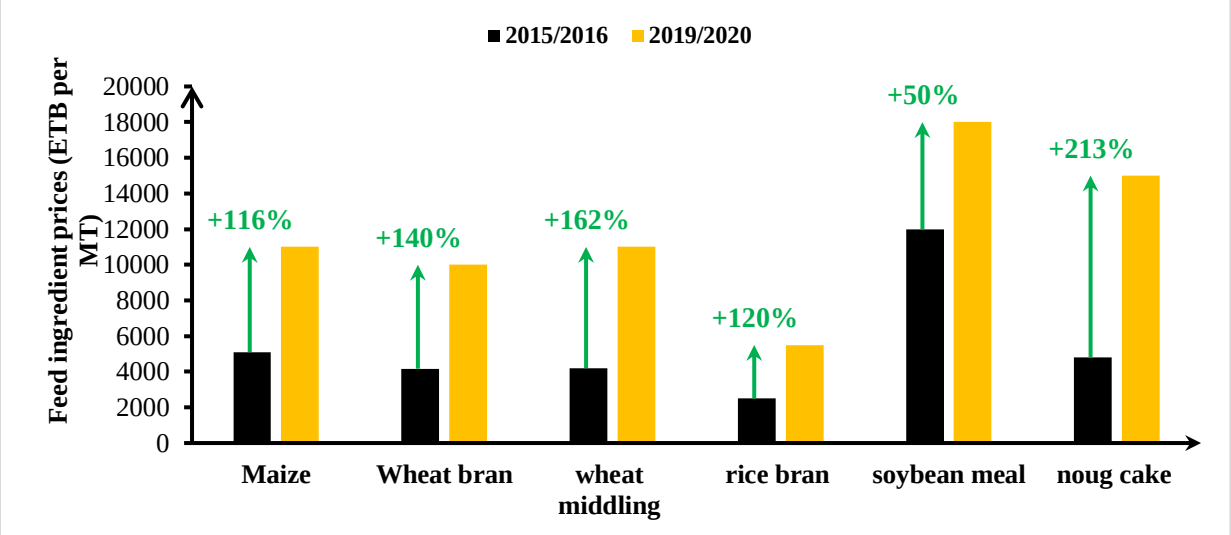


Figure 1: Mapping of value chains for poultry feed in northern Ethiopia

Feed input supply and price trending

The major feed ingredients in the study area for poultry feed production are maize, wheat bran, wheat middling, rice bran, soybean meal and noug cake (Figure 2). The most common protein sources in the study area were soybean meal (20 – 40% of the total) and noug cake (10 – 25% of the total). Other protein sources such as fishmeal, rapeseed cake, sesame cake, meat and bone meal are occasionally included at much lower levels. Major dietary energy sources are generally included at the following levels: maize (10 – 35%), wheat bran (20 – 30%), wheat middling (20 – 30%), and rice bran (10 – 25%). The inclusion levels of these ingredients depend on the protein and energy contents of the feed, the availability of the feed, the prices of the ingredients and feed types, as well as the breed and size of the chicken. Soybean meal and feed additives in the study were sourced from importers and dealers. The price of major feed ingredients used by feed producers in the study area substantially increased from 2015/2016 to 2019/2020 (Figure 2). According to the assessment results, maize, wheat bran, wheat middling, rice bran, soybean meal, and noug cake showed increases of 116%, 140%, 162%, 120%, 50%, and 213% of price changes, respectively.



Note: 1 USD = 29.35 ETB in November 2019

Figure 2: Trends in feed ingredient prices (ETB per MT)

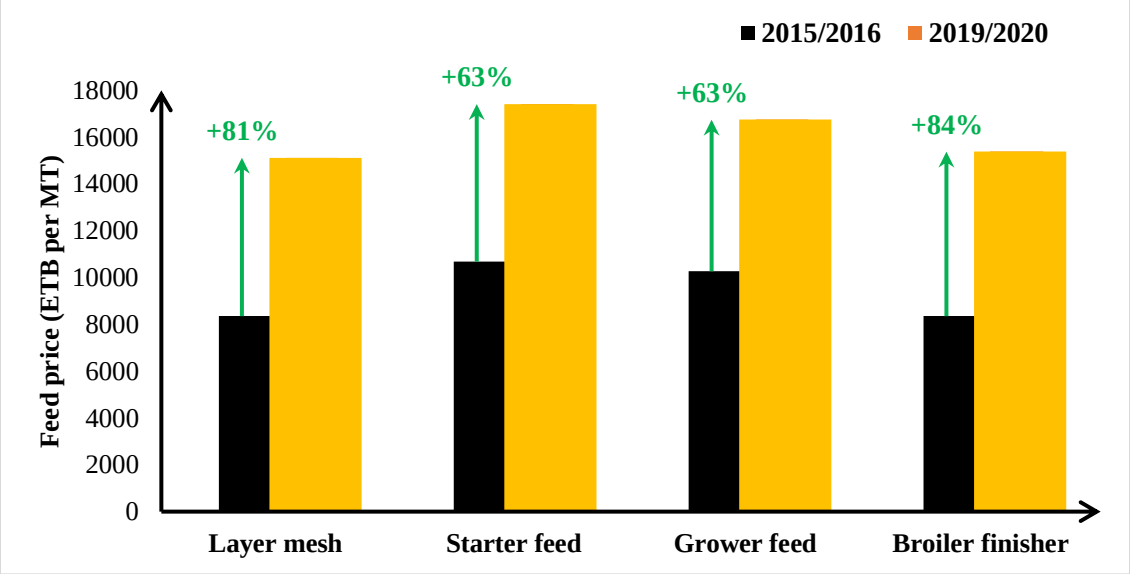
Feed production and price trending

Commercial poultry feeds in northern Ethiopia are produced by the private sector. Based on the current research assessment, there are three licensed industrial feed mills and 10 union feed producers. The unions in the study area were observed to produce mainly dairy feeds. Apart from the unions, the industrial feed producers have about 66,400 t of annual feed production capacity (Table 2). However, it has been identified that a large amount of poultry feed is being transported from the Bisheftu Oromia regional state to northern Ethiopia. Moreover, the three feed producers in the study area, namely Mekelle farms, Meda-Raya and Right Agroindustry, only operate in one shift (8 hours per day). The poultry feed production season lasts for 300 days per year, however the industrial feed producers in the study area are not producing throughout the 300 days or at their capacity due to a lack of raw materials and raw material price inflation. The most common type of feed produced by the feed mills in the study area is layer mesh, followed by starter and grower feeds. The production of broiler feed in the study area is of a lesser quantity in comparison to other poultry feed types.

Table 2: Existing feed mills and annual production potential in tonnes in 2019/2020

Feed mills	Location	Capacity	Production hours/day	Working shifts/day	Actual produced poultry feeds (t/year)
Mekelle Farms	Mekelle	12 t/h	8	1	28,000
Meda-Raya	Raya Azebo	12 t/h	8	1	19,200
Right Agroindustry	Shire	8 t/h	8	1	19,200
Total					**66,400**

The price of commercial poultry feeds over 5 years, from 2015/2016 to 2019/2020, showed a significant price change (Figure 3); in that period the price of commercial poultry feeds for layer mesh, starter feed, grower feed and broiler finisher feed showed increases of 81%, 63%, 63%, and 84%, respectively.



Note: 1 USD = 29.35 ETB in November 2019

Figure 3: Trends in commercial poultry feed prices in Ethiopian birr (ETB per MT)

Feed packaging, transportation and storage

Commercial poultry feed collection and distribution procedures in northern Ethiopia are sourced mainly from Mekelle farms and Meda-Raya feed processors. However, in Shire-Indasslasie, Right Agroindustry Feed Processing also sources commercial poultry feed in the vicinity of the Northwestern Zone of Tigray. Most of the commercial poultry feed producers interviewed in the study area pack the feed in 25 kg polypropylene bags that are closed mechanically with either string or heat sealing. Bagged feeds are generally stored for relatively short periods (a maximum of 1 – 2 weeks) in shaded, well-aerated locations. However, some factories lack appropriate storage facilities for ingredients and finished feeds, and due to the high demands of the feeds, they are directly transported to where they are needed. Most of the time, feed producers use their own vehicles for feed

transportation to medium-scale poultry farms by adding a 1 – 2% margin to the feed price, especially when a large amount is being sold, but small-scale farms, who generally buy small amounts of feed, use rented trucks and the loading of the feed on the trucks is done manually. In addition, carts are a basic transportation system used to transport compound feeds from feed retailers (Figure 1).

Discussion

While commercial feeds are widely used as the main feed resources in all poultry production systems in the study area, scavenging around the household and homemade feed supplementation forms of feeding practices were reported in some of the semi-intensive production systems. Similar reports from different parts of Ethiopia showed that most commercial chicken farms are using commercial feed as a major feed source (Tadesse et al. 2017; Yared et al. 2019; Aderaw et al. 2021). Unlike the cost of commercial feeds, medium-scale and the majority of small-scale poultry producers believe that feeding commercially formulated feeds has a higher productivity effect on chickens, than scavenging or homemade feeds. The current result agrees with Depersio et al. (2015), who reported that it is increasingly important for producers to find a balance between feeding their birds on a least-cost basis and feeding the appropriate amount of nutrients in the diet as the chicken needs them throughout the laying cycle. In line with the current study, Tadesse et al. (2017) reported that commercially formulated feed had a high positive significance on the productivity performance of chickens over homemade feeds.

The majority of small- and medium-scale producers reported their feed sources as commercial poultry feed manufacturers and their agents. This supports by the findings of Aderaw et al. (2021), who reported that the majority of feed sources for commercial layer farms are commercial feed manufacturers. However, the majority of semi-intensive poultry producers and some small-scale farm respondents obtain feed by purchasing locally available grains and nonconventional locally available feeds. Most of these prepare feeds at home using available grains and nonconventional feeds such as abattoir wastes, kitchen wastes, cafeteria wastes and vegetable wastes from the market. However, the quality of this feed is poor due to the lack of knowledge and skills of the producers to prepare feeds. Tadesse et al. (2017) reported that 38.5% of commercial poultry producers used homemade poultry feed, using locally available feed materials, though the quality was poor due to a lack of knowledge on how to prepare feeds.

With regard to feeding intervals, the majority of poultry producers across the different production systems in the study provide feed three times a day. However, about half of the respondents among the medium-scale producers practice feeding their animals anytime during the day. According to different studies in Ethiopia, most intensive poultry producers provide feed three times per day (Getu and Birhan 2014; Tadesse et al. 2017; Yared et al. 2019). According to the group discussion, farmers believed that three feeding intervals improved egg production. This result is in line with the report of Moradi et al. (2013), who reported that the productivity of the chicken could be affected by feeding frequency and indicated that twice and three times a day feeding schedules rather than once a day improved egg production rate. The current finding also agrees with the reports of Tadesse et al. (2017) and Taherkhani et al. (2010), who reported that chickens fed twice a day, produced more eggs when compared with chickens fed once a day.

The price of feed ingredients and poultry compound feed has significantly changed over the last 5 years. As the international market for feed raw materials has risen, and with a falling exchange rate for the Ethiopian birr against major currencies, prices of feed ingredients have increased considerably, which has led to low demand for compound feeds since they are

unaffordable for poultry producers. Seyoum et al. (2018) reported that prices of feed ingredients and compound feeds increased by an average of 52 and 82%, respectively, from 2010/2011 to 2015/2016. In addition, Demissie (2022) and Yosef et al. (2022) reported that the price of feed ingredients has shown continuous increment between the base year 2016/17 and 2020/21 with overall increases of 304, 244, 416, 444, 627, 113 and 211% for wheat bran, wheat middling, noug, groundnut, soya, linseed cake and maize respectively. Similarly, compound feed prices for different poultry categories increased by 86, 80 and 90% for layer, broiler, and chicken, respectively (Demissie 2022; Yosef et al. 2022).

Price inflation of feed ingredients has forced the closure of some commercial farms, primarily due to a low return on investment. Moreover, assessments of imports of supplements or feed additives suggest a total of 677 t of feed supplements were imported by five companies in 2015/16 and made available to users (Seyoum et al. 2018). Among the imported inputs, soybean meal, fishmeal, premixes, minerals and vitamins are critical in supporting the desired level of animal productivity. However, they are currently imported from abroad using hard currency, and their prices are very high (Seyoum et al. 2018; Demissie 2022; Yosef et al. 2022).

In northern Ethiopia, poultry feeds are sourced in two ways: through commercial feed mills and through homemade feeds using different locally available feed grains and non-conventional feed resources. According to a study conducted in three zones of Tigray, 61.5% of intensive chicken farms used commercial feed, while the remaining 38.5% used homemade feed (Tadesse et al. 2017). Whereas medium- and small-scale farms in the study area buy poultry feed from feed millers, the poultry producers on semi-intensive farms purchase processed feeds from retailers in addition to scavenging and homemade feed resources. Kitaw et al. (2012) reported that most of the concentrates sold to small-scale farms by retailers in small shops are purchased from feed processing plants located in and around Addis Ababa. The current study found that the main reason that poultry producers in semi-intensive and small-scale production systems feed homemade and nonconventional feeds to their chickens, is due to limited access to commercially formulated chicken feeds and their cost. In addition, poultry producers from these production systems reported that the feed mixed at home is poor in quality due to a lack of knowledge of how to make the proper feed formulation. In agreement with the current study, Taddese et al. (2017) reported that 54.83% of chicken producers lacked the knowledge to produce proper feed formulations at home. This also concurs with the reports of Nebiyu et al. (2016) in Addis Ababa, who reported that high feed costs were the most noticeable constraint faced by small-scale intensive poultry farms.

Chicken feeds are marketed through different market outlets, which has a significant influence on producers. In the present study, several people had important influences on feed producers (Figure 1). For example, the supply of feed raw materials is controlled by a few importers, and the market is determined by them. Seyoum et al. (2018) reported that five companies contributed to the total of 677 t of feed ingredients imported in 2015 and 2016. The assessment generally indicated that there is no formal and well-organised relationship between input supply and feed producers. If the chain is controlled by a few individuals, this may also have an impact on the local poultry sector. In agreement with the present study, Demissie (2022) reported even though Agro-industrial factories (flour mills, oil mills) are Value Added Tax registered, they sell their products to middlemen and brokers without a receipt. This makes the market engulfed in illegal trade and leads to widespread shortages and inflation. On the other hand, the lack of market linkages and the lack of chain of command have created favorable conditions for brokers and traders. It may also mean that no one in the

value chain is able to add value as the product goes from the chain's origin to the ultimate user. Each participant receives an economic rent in return for bringing this value to the system. In the research area, however, a comparatively better link between feed producers and poultry producers was seen. This may be an effective strategy to increase confidence between feed and poultry producers, lower feed costs, and minimise the number of middlemen.

Conclusion

The majority of semi-intensive and substantial small-scale poultry producers use homemade mixed feeds, using locally available feed resources. However, the quality of feed mixed at home is poor due to a lack of knowledge on proper feed formulation. The prices of feed ingredients and compound feeds have increased in both domestic and, consequently, global markets, and the trend is set to continue. Furthermore, trade is monopolized by a few large importers who control supply and price, and the linkage between input suppliers and feed producers is weak and informally practiced. Therefore, training will be required on sourcing quality materials, nutrition characteristics of locally available feed ingredients, and feed formulation. Furthermore, by moving toward coordinated comprehensive and systematic studies, technical solutions in using alternative feed ingredients available in various geographic locations can help to reduce inflated feed prices. The government should give better incentives to the feed industry and promote the business venture to potential investors.

Acknowledgement

The authors are grateful to all participants in the study who generously gave their time and shared their farm records and relevant data needed to fulfil this study.

Authors' contribution statement

Dawit Mamo: conceptualization; methodology, data curation; formal analysis; investigation; visualisation; writing original draft and editing. Mohammed Beyan: conceptualization; data curation; methodology; project administration; supervision; visualisation and editing. Wondmeneh Esatu: methodology; supervision; validation and editing. Tegene Negesse: conceptualization, methodology, supervision.

Funding

This research was funded by the Ethiopian Ministry of Education and Aksum University (project number Ph.D./025/10) as part academic staff development plan. Any opinions, findings, conclusions or recommendations expressed here are those of the authors alone.

Conflict of interest

The authors have not declared any conflict of interest.

Compliance with ethical standards

The nature of the work does not require approval by a (bio)ethical committee. Informed consent was obtained from the farmers interviewed.

Data availability

The datasets generated during the current study are available from the corresponding author on request (davoma43@gmail.com).

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