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Technical Competence Gaps and Training Priorities among Livestock Feed Processors in Nigeria

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Abstract

This study assessed technical competence gaps and training priorities among livestock feed processors in South-West Nigeria. A cross-sectional survey was conducted among 287 registered feed processors selected through a multistage sampling procedure from Lagos, Ogun and Oyo States. Data collection was done with structured questionnaire which included technical knowledge, skills in feed processing and training required. Technical competence was measured in operational, scientific and analytical areas, and training priorities were identified through the use of Borich Mean Weighted Discrepancy Score (MWDS) and the respondents' stated training needs. The findings show that processors had higher competence in routine processing activities as compared to technically demanding formulation and analytical activities. Training gaps existed in the preparation of feed formulas (MWDS = 3.68), feed analysis (MWDS = 3.48), determination of ingredient inclusion levels (MWDS = 2.42), identification of anti-nutritional factors (MWDS = 2.33) and in the determination of the nutrient composition of feed ingredients (MWDS = 2.10). The two other most common priorities, as expressed training needs, were calculating proximate analysis (mean = 2.48) and basic feed formulation (mean = 2.47). These results show that the lack of competencies does not occur in routine part of producing feed, but in the scientific and analytical part. The study identifies the need for targeted capacity development and competency-based training, with a focus on formulation, feed analysis, and quality management. Development of these skills may enhance feed quality and resilience of livestock feed systems.

Keywords: *Alleviate poverty; Agricultural extension; Capacity-building; Food bank; Training needs; Nigeria*

Introduction

The livestock sector is an important component of Nigeria's agricultural economy and contributes to national gross domestic product (GDP) (National Bureau of Statistics [NBS], 2021). Livestock production is also an important livelihood activity, with livestock farming practiced by a substantial proportion of agricultural households in Nigeria (NBS, 2024). Given the rates of population growth and urbanization, as well as the demand for animal-source foods, livestock productivity is a critical part of Nigeria's strategy to bolster food and nutrition security. Livestock production is not only an input into food production, but it gives work to people and income to households, and backs a wide range of businesses that are upstream and downstream of the livestock industry. There is therefore a potential for enhancing livestock productivity and value-chain efficiency to improve livelihoods and reduce poverty, especially for those households whose livelihood is directly and/or indirectly connected to livestock production. However, the evidence from Nigeria has also highlighted the need for sustainable agricultural practices, efficient use of resources, and better agricultural systems to achieve food security and sustainable development (Kehinde et al., 2024).

The livestock feed industry plays a key middle role in this production system as feed availability, quality, safety and nutritional adequacy impact on animal health, growth, productivity and the profitability of enterprises. Optimal nutritional balanced and economical feeds are, therefore, critical to maintain efficient livestock production. Feed is one of the greatest costs in intensive livestock production and the efficiency with which the ingredients are selected, formulated, processed and used is of particular concern. The feed processing industry can therefore be considered as an important upstream segment in the national food chain as it supports the continuous supply of animal-source foods such as meat, eggs, milk and other animal products to the consumers. Improving the technical efficiency of the feed processor therefore applies to a feed-milling business and to the stability, cost-effectiveness and sustainability of animal-source food supply chains.

The role is growing in significance as feed processors are under increasing pressure to lower production costs as they experience rising ingredient costs, as well as raw materials quality variation and fluctuations in conventional feed supplies. The more effective use of local feed resources, like agricultural by-products and crop residues, is one possible answer. For instance, Shoyombo et al. (2025) reported that agricultural by-products and crop residues can be used as alternative sources for the processing of low-cost nutritious livestock feeds in South-West Nigeria. Similarly, Oluwafemi et al. (2025) reported that sweet potato peel–cassava leaf mixtures could serve as alternative feed sources that can enhance production performance and decrease reliance on feed based on maize. The results of this study highlight the need for having the technical knowledge to identify, process, evaluate and include alternative feed ingredients in livestock ration appropriately.

However, alternative use of feed sources does not guarantee that they will be effectively utilized. Therefore, feed processors should be technically competent to evaluate the specifications of ingredients and decide the proper inclusion level. Additionally, create a balanced diet, control the processing operation, and ensure the quality and safety of feed. The growing importance of processed and fermented agricultural products as feed resources for livestock production has also been recently demonstrated by Animashahun et al. (2025). They highlighted the technical factors that are involved in the processing of these products and their nutritional potential. Therefore, there is a need to enhance human technical capacity in the feed processing sub-sector, so that locally available agricultural resources can be used to produce safe and nutritionally sound livestock feed which are economically viable.

Although feed processing is a strategic activity for the feed industry in Nigeria, it still faces technical and institutional problems in the industry. Feed processors work in a dynamic market where raw material prices fluctuate, the supplies of raw materials are erratic, access to specialized technical information is restricted, and processing technology varies. Practical experience and informal learning may also be significant for small and medium enterprises, and not necessarily systematic technical training. This may result in a mismatch between routine processing skills and the scientific skills needed to formulate feeds accurately, balance feeds, analyze feeds, monitor feed quality, and utilize alternative feed ingredients. If these are not filled, it is possible that the animal's performance and the profitability of the farm may be affected by the ingredient and inclusion selection, nutrient balance, processing, and quality control problems.

In particular, the challenge has to do with sustainable livestock production. Utilization of feed ingredients can decrease wastage, improve feed conversion, decrease production cost and improve the utilization of locally available resources. The findings by Kehinde et al. (2024) revealed the potential for sustainable agriculture practices to shape farmers' resource-use behaviors and production efficiency in Nigeria, highlighting the need for technical and institutional capacity to improve agricultural sustainability. Similarly, Ojo et al. (2025) reported that the role of disseminating agricultural practices can be effectively achieved by the agricultural extension agents as this depends on their attitude, participation and training. This information is useful in designing extension and capacity-

development programs, which need to be technically oriented to deliver the skills needed by commercial feed processors, not just generic advice on agriculture.

Lagos, Ogun and Oyo States are important centers of commercial livestock and feed-processing activities in South-West Nigeria. This is because the poultry, pig and other livestock enterprises are concentrated in these states generating a sustained demand for commercially produced feed. However, various processors who process livestock feed ranges from a low-scale processor to a commercial processor, which could leave variations in technical capacity and training needs. It is important to be aware of these differences, in order to plan capacity building interventions that target the real competency gaps and avoid giving general training.

In Nigeria, while some studies have looked at livestock production constraints, alternative feed resources, agricultural extension and general training, there has been a limited empirical research that explicitly identified the technical skills possessed by livestock processors, and the scientific and analytical skills in which they may have a gap. This is important because a processor may have adequate knowledge in routine feed production areas like ingredient identification, grinding and mixing, but less technical competence in more specialized areas like feed formulation, nutrient analysis, quality assurance or determining the amount of ingredients to use. These specific gaps help to ensure a more solid foundation for the design of competency-based training interventions.

Agricultural extension services, universities, professional associations and private-sector stakeholders are therefore important actors in designing agricultural capacity-development programs aimed at addressing identified competency gaps. The findings of this study suggest that extension efforts can help enhance the resilience of agriculture and food security, provided they are targeted appropriately (Ojo et al., 2025). Any such measures in feed processing should be more than just providing general information, and should include training in feed formulation, feed analysis, ingredient evaluation, quality control and safe feed processing procedures. Developing these capacities can positively impact on feed quality and resource-use efficiency, livestock productivity, the stability of animal source food supplies and indirectly livelihood improvement and poverty alleviation.

In this context, the present study evaluated the Technical knowledge and training needs of Livestock Feed Processor in South-West Nigeria. This study is specifically directed towards identifying areas of competence and areas where there is clearly a need for further capacity development and training, as well as determining priority areas based on the Borich Needs Assessment Model and the expressed training needs by the respondents. The following null hypothesis was also tested: Technical competency of livestock feed processors does not have any significant relationship with their perceived training needs in South-West Nigeria. The evidence produced will be used to inform more focused agricultural extension/competency development work to improve livestock food value chain resilience, livestock productivity and feed quality.

Materials and Methods

Study area

The study was conducted in South-West Nigeria, with Lagos, Ogun and Oyo States purposively selected because of their concentration of commercial livestock production and feed-processing activities. The region supports substantial poultry, pig and other livestock enterprises and consequently has an active market for commercially processed feeds.

Study population and sampling

The study population comprised registered livestock feed processors operating in the selected states. A sampling frame of 381 registered processors was used. The required sample size was determined using Yamane's finite population formula (Yamane, 1967):

$$n = N / [1 + N(e^2)]$$

where:

n = required sample size

N = total population size

e = margin of error

$$n = \frac{381}{1 + 381(0.029)^2} = 288.7 \approx 289$$

A margin of error of 2.9% ($e = 0.029$) was adopted. The formula yielded an approximate sample size of 289 respondents; however, after proportionate allocation and rounding across the selected Local Government Areas, the final sample size was 287 respondents. The sample was proportionally allocated to each selected Local Government Area based on the number of

registered feed processors:

$$n_i = (N_i / N) \times n$$

where:

n_i = sample size for stratum i

N_i = population size of stratum i

N = total population size

n = total sample size

Based on this procedure, 112 respondents were selected from Lagos State, 62 from Ogun State, and 113 from Oyo State as shown in Table 1. This approach ensured that the sample reflected the distribution of registered feed processors across the study area and enhanced the representativeness of the findings. All selected respondents participated in the survey; therefore, no replacement or non-response adjustment was required.

Instrument development and data collection

Data were collected using a structured questionnaire developed from the objectives of the study and relevant literature on feed processing, technical competence and training-needs assessment. The instrument contained sections on respondent and enterprise characteristics, technical knowledge, feed-processing skills and training needs.

Technical knowledge was assessed using 31 feed-processing statements. Responses were scored on a five-point scale, with higher values representing greater competence. The instrument also captured processors' perceived competence in specific feed-processing tasks and their expressed training needs.

Validity and reliability

The questionnaire was subjected to expert review to establish content and face validity. The reliability of the instrument was assessed through a test-retest procedure involving feed processors outside the study area. The resulting reliability coefficient was approximately 0.82, indicating satisfactory stability of the instrument for the study.

Measurement of technical competence

Technical competence was conceptualized as a multidimensional construct comprising operational, scientific and analytical components.

Operational competence refers to competence associated with routine physical feed-processing activities, including ingredient handling, equipment operation, grinding, mixing and related processing practices.

Scientific competence refers to knowledge and understanding of feed ingredients, nutrient composition, nutrient requirements, anti-nutritional factors and principles of feed science.

Analytical competence refers to the ability to apply scientific knowledge to feed formulation, ingredient inclusion, feed analysis and quality-control activities.

For descriptive assessment, individual competence scores were obtained by aggregating responses to the relevant competence indicators. Domain-specific scores were calculated from the corresponding items. This approach avoids treating technical competence as a single undifferentiated construct and permits identification of the particular domain in which deficiencies occur.

Assessment of knowledge gaps

Knowledge items were analyzed using their mean scores and benchmark classifications. Items with lower scores were interpreted as areas of weaker technical knowledge, while items with higher scores represented areas of comparatively stronger knowledge.

The analysis was used to distinguish routine operational knowledge from more specialized scientific and analytical knowledge. Particular attention was given to feed formulation, nutrient balancing, ingredient classification, anti-nutritional factors, feed additives and feed analysis because these activities require integration of practical experience with scientific knowledge.

Borich needs assessment

Training priorities were assessed using the Borich Needs Assessment Model (Borich, 1980). For each feed-processing task, respondents rated the importance of the task and their competence in performing it. The Mean Weighted Discrepancy Score (MWDS) was calculated as:

$$\frac{\sum(D_i \times W_i)}{N}$$

Where:

D_i = discrepancy between the required/desired level and current level for respondent i

W_i = importance/weighted value assigned to the competency

N = number of respondents

Positive MWDS values indicate that perceived importance exceeds perceived competence and therefore represent a training gap. Higher positive MWDS values indicate greater priority for training. Negative values indicate that perceived competence is equal to or greater than perceived importance and therefore do not indicate an immediate competency deficit. The 10 feed-processing tasks assessed using this procedure and their corresponding MWDS values are reported in the Results section.

Expressed training needs

Respondents also indicated whether each identified training area was highly needed, needed or not needed. The responses were scored on a three-point scale: 1 = Not needed, 2 = Needed, and 3 = Highly needed. A mean score of 2.00 or above was interpreted as indicating that the training area was needed. This procedure is consistent with the existing training-needs table, where mean scores ranged from 2.22 to 2.48.

Statistical analysis

Descriptive statistics, including frequencies, percentages, means and standard deviations, were used to summarize respondent characteristics, competence scores and expressed training needs. The Borich Mean Weighted Discrepancy Score was used to rank task-specific training priorities. Inferential analysis was conducted at a 5% significance level. Where respondent-level composite technical-competence and training-needs scores were available, Spearman's rank-order correlation was specified for testing the relationship between the two constructs because the underlying measures were derived from Likert-type responses. Other associations between respondent/enterprise characteristics and training needs were treated as supplementary analyses rather than as additional hypotheses.

Results

Characteristics of respondents and feed-processing enterprises

The respondents represented commercial feed-processing enterprises operating at different production scales. The workforce was predominantly male, while a substantial proportion possessed formal tertiary education. The mean age of processors was approximately 45 years, indicating a relatively mature workforce. The study also showed substantial accumulated processing experience among respondents.

Despite the relatively high level of formal education and practical experience, access to specialized feed-processing training was limited. This distinction is important because general formal education does not necessarily provide the specialized scientific and analytical competencies required for commercial feed formulation and quality control.

Technical competence and knowledge profile

The results in Table 1 indicate that technical competence was uneven across feed-processing activities. Respondents demonstrated comparatively stronger competence in routine operational activities than in scientifically and analytically demanding activities. The strongest reported practical skills included grinding/mixing (mean = 3.52) and ingredient identification/selection (mean = 3.35). In contrast, competence was considerably weaker in packing/storage (mean = 2.33), feed formulation (mean = 1.87), equipment handling (mean = 1.56) and quality control/assurance (mean = 1.31) and packing/storage (mean = 2.33). The pattern indicates that practical familiarity with routine feed-processing operations does not necessarily translate into competence in the scientific and analytical activities required to formulate and verify nutritionally appropriate feeds (NIAS, 2021).

Table 1. Distribution of respondents according to skill level in feed processing tasks

Tasks	Not skilled	Slightly skilled	Moderately skilled	Skilled	Highly skilled	Mean skill Score	Remark
Feed ingredients identification and selection	8 (2.79%)	15 (5.23%)	78 (27.18%)	154 (53.66%)	32 (11.15%)	3.35	High skill
Feed formulation	82 (28.57%)	73 (25.44%)	58 (20.21%)	58 (20.21%)	16 (5.57%)	1.87	Low skill
Grinding, Mixing and processing techniques	8 (2.79%)	15 (5.23%)	56 (19.51%)	150 (52.26)	58 (20.21)	3.52	High skill
Quality control and assurance	250 (87.11)	19 (6.62)	15 (5.23)	10 (3.48)	3 (1.05)	1.31	Low skill
Equipment handling and maintenance	180 (62.72)	52 (18.12)	30 (10.45)	14 (4.88)	11 (3.83)	1.56	Low skill
Packing and storage	121 (42.16)	100 (34.84)	27 (9.41)	17 (5.92)	22 (7.67)	2.33	Low skill

Note: Not skilled (Cannot perform), Slightly skilled (Needs frequent supervision), Moderately skilled (Can perform with some help), Skilled (Can perform without help but cannot train others) and Highly skilled (Can perform without help and can train others)

The results of knowledge assessment in Table 2 similarly revealed an uneven knowledge profile across the 31 technical areas examined. Areas involving routine processing and basic feed-handling principles were comparatively better understood, whereas gaps were more apparent in technically specialized areas such as formulation, nutrient balancing, ingredient classification, anti-nutritional factors and the appropriate application of feed additives. The result indicates adequate knowledge in 19 of the 31 assessed areas but substantial deficiencies in several technically demanding areas.

Table 2: Distribution of respondents according to their knowledge in feed processing, n = 287

S/N	Knowledge Statements	SA (Freq. /%)	A (Freq. /%)	UD (Freq. /%)	D (Freq. /%)	SD (Freq. /%)	Mean	Remark
1	Maize is a primary source of protein in the feed	29 (10.1)	33 (11.5)	5 (1.7)	128 (44.6)	92 (32.1)	2.21	Low
2	Bone meal provides only Calcium in the feed	53 (18.5)	37 (12.9)	3 (1.0)	93 (32.4)	100 (34.8)	3.51	High
3	Soya bean meal do not contain Lysine and Methionine	25 (8.7)	33 (11.5)	7 (2.4)	126 (43.9)	96 (33.4)	3.84	High
4	Groundnut cake is a primary source of vitamins in the feed	43 (15.0)	46 (16.0)	6 (2.1)	89 (31.0)	103 (35.9)	3.49	High
5	The energy value of layers mash is higher than broiler starters' mash	31 (10.8)	41 (14.3)	6 (2.1)	132 (46.0)	77 (26.8)	3.53	High
6	Unfermented cassava is good for feed production	90 (31.4)	54 (18.8)	15 (5.2)	74 (25.8)	54 (18.8)	2.68	Low

7	Cassava does not contain anti-nutritional factor called Cyanide	60 (20.9)	69 (24.0)	6 (2.1)	79 (27.5)	72 (25.1)	2.88	Low
8	A concentrate is feed	195 (67.9)	80 (27.9)	5 (1.7)	6 (2.1)	1 (0.3)	1.39	Low
9	Maize offal has more protein than maize	74 (25.8)	130 (45.3)	9 (3.1)	61 (21.3)	12 (4.2)	3.66	High
10	Oyster shell and Limestone contain both Phosphorus and Calcium	179 (62.4)	79 (27.5)	13 (4.5)	9 (3.1)	7 (2.4)	1.56	Low
11	Layers mash has less Calcium than Broiler finishers' mash	85 (29.6)	100 (34.8)	7 (2.4)	54 (18.8)	41 (14.3)	3.27	High
12	Mixing of feed ingredients in a Mixer reduces the palatability of feed	154 (53.7)	71 (24.7)	11 (3.8)	43 (15.0)	8 (2.8)	1.89	Low
13	Blood meal is a better source of protein than fish meal	63 (22.0)	73 (25.4)	11 (3.8)	96 (33.4)	44 (15.3)	3.01	High
14	In processing feed for animals, you consider the feed ingredients only and not the nutrient compositions of the feed ingredients	66 (23.0)	44 (15.3)	5 (1.7)	79 (27.5)	93 (32.4)	3.45	High
15	Groundnut cake that is rancid is a source of aflatoxin	136 (47.4)	77 (26.8)	8 (2.8)	44 (15.3)	21 (7.3)	3.91	High
16	The work of enzyme in the feed is to slow fibre digestion	47 (16.4)	56 (19.5)	11 (3.8)	100 (34.8)	73 (25.4)	3.17	High

Note: True Statements: Strongly Agree = 5, Agree = 4, Undecided = 3, Disagree = 2, Strongly Disagree = 1, and False Statements: Strongly Agree = 1, Agree = 2, Undecided = 3, Disagree = 4, Strongly Disagree = 5. Benchmark mean scores ≥ 3.00

Table 2 (continued): Distribution of respondents according to their knowledge in feed processing, n = 287

S/N	Knowledge Statements	SA	A	UD	D	SD	Mean	Remark
17	The heat generated through grinding and pelleting cannot affect the nutrients present in the feed ingredient	57 (19.9)	63 (22.0)	14 (4.9)	68 (23.7)	85 (29.6)	3.21	High
18	Broiler starters' mash contains more energy than Broiler finishers' mash	158 (55.1)	90 (31.4)	10 (3.5)	21 (7.3)	8 (2.8)	1.39	Low
19	Broiler finishers' mash has less Calcium and Phosphorus than Broiler starters' mash	120 (41.8)	109 (38.0)	7 (2.4)	35 (12.2)	16 (5.6)	3.91	High
20	The required crude protein of layers mash ranges from 20 to 24.	30 (10.5)	31 (10.8)	7 (2.4)	140 (48.8)	79 (27.5)	3.72	High
21	In processing chicks feed, the use of less than 4mm sieve is appropriate	191 (66.6)	76 (26.5)	7 (2.4)	6 (2.1)	7 (2.4)	4.53	High
22	Addition of 2 to 5kg of toxin binder per ton of feed is appropriate	138 (48.1)	108 (37.6)	11 (3.8)	20 (7.0)	9 (3.1)	1.78	Low
23	Grinding Groundnut cake and Bone meal together does not reduce dust	89 (31)	87 (30.3)	10 (3.5)	86 (30.0)	15 (5.2)	2.41	Low
24	By biting and chewing the feed ingredients, the moisture content cannot be determined	148 (51.6)	80 (27.9)	6 (2.1)	42 (14.6)	11 (3.8)	2.01	Low

25	Excessive high energy in the feed cannot cause prolapse	104 (36.2)	75 (26.1)	7 (2.4)	63 (22.0)	38 (13.2)	2.43	Low
26	Pearson square involves the use of more than two feed ingredients at a time	48 (16.7)	39 (13.6)	11 (3.8)	124 (43.2)	64 (22.3)	3.46	High
27	Pearson square is used to satisfy both crude protein and energy level in feed	175 (61.0)	93 (32.4)	10 (3.5)	4 (1.4)	4 (1.4)	1.15	Low
28	The use of Trial and Error does not take a lot of time to provide the best results	62 (21.6)	56 (19.5)	10 (3.5)	115 (40.1)	43 (15.0)	3.22	High
29	The fixing of Iron guard to the Mixer-Bucket prevents accidents	174 (60.6)	82 (28.6)	12 (4.2)	15 (5.2)	4 (1.4)	4.42	High
30	Cotton seed meal is used to replace Groundnut cake at the same ratio.	61 (21.3)	72 (25.1)	11 (3.8)	100 (34.8)	43 (15.0)	3.13	High
31	Premixing the micro feed ingredients before pouring into the mixer will not guarantee a uniform mixing with other macro feed ingredients	62 (21.6)	59 (20.6)	15 (5.2)	86 (30.0)	65 (22.6)	3.22	High

Note: True Statements: Strongly Agree = 5, Agree = 4, Undecided = 3, Disagree = 2, Strongly Disagree = 1, and False Statements: Strongly Agree = 1, Agree = 2, Undecided = 3, Disagree = 4, Strongly Disagree = 5. Benchmark mean scores ≥ 3.00

Borich training priorities

The results of Borich analysis in Table 3 revealed a clear difference between the perceived importance of specific feed-processing tasks and respondents' perceived competence in performing them.

Table 3. Borich needs assessment of feed-processing tasks (n = 287)

Feed-processing task	Mean importance	Mean competence	MWDS	Priority	Rank
Preparing a feed formula	2.65	1.26	3.68	High	1
Analyzing the feed	2.58	1.23	3.48	High	2
Determining ingredient inclusion level	2.22	1.13	2.42	Moderate	3
Ascertaining anti-nutritional factors	2.20	1.14	2.33	Moderate	4
Determining nutrient composition	2.47	1.62	2.10	Moderate	5
Standardization of feed	1.87	1.21	1.23	Low	6
Determining nutritional requirements of animals	1.90	1.26	1.22	Low	7
Sourcing alternative feed ingredients	2.00	2.06	-0.12	No current gap	8
Ensuring adherence to safety	1.01	1.25	-0.24	No current gap	9
Determining animal type, age and purpose	1.88	2.31	-0.81	No current gap	10

Note: Importance and competence were measured on five-point scales.

The largest competency discrepancies occurred in preparing feed formulas (MWDS = 3.68) and analyzing feeds (MWDS = 3.48). These tasks combined relatively high perceived importance with low perceived competence. Ingredient inclusion (MWDS = 2.42), identification of anti-nutritional factors (MWDS = 2.33) and determination of nutrient composition (MWDS = 2.10) constituted the next major areas of training priority. These values correspond to the existing Borich analysis.

Negative MWDS values were observed for sourcing alternative ingredients (-0.12), adherence to safety (-0.24) and determining the type, age and purpose of feeding (-0.81), indicating comparatively smaller immediate discrepancies in these areas.

Expressed training needs

Respondents' expressed training needs broadly reinforced the Borich results. The results in Table 4 revealed that calculating proximate analysis ranked first among expressed training needs (mean = 2.48), followed by basic feed formulation (mean = 2.47). These findings provide independent support for the Borich analysis, which similarly identified feed formulation and feed analysis as the largest competency gaps.

Table 4. Expressed training needs of livestock feed processors (n = 287)

Training area	Highly needed n (%)	Needed n (%)	Not needed n (%)	Mean	SD	Rank
Calculating proximate analysis	144 (50.17)	137 (47.74)	6 (2.09)	2.48	0.57	1
Formulating feed using basic methods	155 (54.01)	111 (38.68)	21 (7.32)	2.47	0.59	2
Accessing loans and credits	125 (43.55)	134 (46.69)	28 (9.76)	2.34	0.65	3
Processing techniques/use of feed mill machines	112 (39.02)	154 (53.66)	21 (7.32)	2.32	0.63	4
Producing feeds according to animal type, age and purpose	105 (36.59)	164 (57.14)	18 (6.27)	2.30	0.60	5
Storage, safety and feed hygiene	102 (35.50)	159 (55.40)	26 (9.10)	2.26	0.63	6
Ingredient inclusion levels	103 (35.90)	154 (53.70)	30 (10.50)	2.25	0.61	7
Nutritional requirements of animals	94 (32.75)	171 (59.58)	22 (7.67)	2.25	0.58	8
Nutritional composition of feed raw materials	90 (31.36)	177 (61.67)	20 (6.97)	2.24	0.54	9
Reducing workplace hazards	94 (32.80)	167 (58.20)	26 (9.10)	2.24	0.60	10
Maintaining production records	92 (32.06)	165 (57.49)	30 (10.45)	2.22	0.62	11

Note: 1 = Not needed, 2 = Needed, 3 = Highly needed.

Training needs and production scale

Results in Table 5 revealed that weekly production volume was positively and significantly associated with training needs ($r = 0.245$, $p < 0.001$), while mill production capacity also showed a positive and significant association with training needs ($r = 0.211$, $p < 0.001$). These findings indicate that processors operating at higher production volumes and those with greater mill capacities tended to report higher training needs. Although the correlations were relatively weak, their statistical significance suggests that production scale is an important consideration in understanding variation in training requirements among feed processors (FAO and IFIF 2010).

Table 5: Inferential analysis of socioeconomic characteristics and training needs

Socioeconomic Variable	Measurement Scale	Statistical Test Used	Value	p-value	Statistical Decision / Interpretation
Age (years)	Continuous	Pearson r	-0.114	0.054	Non-Significant ($p > 0.05$); Weak negative trend

Years of Experience	Continuous	Pearson <i>r</i>	-0.187	0.001	Significant ($p < 0.01$): Negative relationship
Weekly Production (tons)	Continuous	Pearson <i>r</i>	0.245	<0.001	Highly Significant ($p < 0.01$); Positive relationship
Mill Production Capacity	Continuous	Pearson <i>r</i>	0.211	<0.001	Highly Significant ($p < 0.01$); Positive relationship
Household Size	Continuous	Pearson <i>r</i>	0.032	0.589	Non-Significant ($p > 0.05$)
Sex (Male vs. Female)	Categorical	Independent <i>t</i> -test	2.141	0.033	Significant ($p < 0.05$); Variation based on gender
Marital Status	Categorical	Chi-Square (χ^2)	4.210	0.239	Non-Significant ($p > 0.05$)
Contact with Extension	Categorical	Independent <i>t</i> -test	-3.854	<0.001	Highly significant ($p < 0.01$)

Relationship between technical competence and training needs

Table 6 results of Spearman's rho correlation coefficient between technical competence of feed processors and their perceived training needs was 0.687, with a p-value of 0.001 and 287 respondents. This indicates a strong, positive, and statistically significant relationship between the two variables. In practical terms, feed processors with higher levels of measured technical competence also tended to report higher levels of training needs, while those with lower competence tended to report lower perceived training needs.\

The positive direction of the relationship is important. It does not mean that higher competence causes greater training needs. Rather, it suggests that respondents with higher levels of technical competence were also more likely to recognize and report areas where additional specialized training was required. This may reflect greater awareness of the complexity of feed processing and the technical demands associated with advanced tasks such as feed formulation, feed analysis, nutrient balancing, and quality assurance (FAO and IFIF 2020).

The coefficient of 0.687 represents a strong positive association, indicating that technical competence and perceived training needs are strongly associated in this population. The significance value of $p = 0.001$ is below the 0.05 significance level. Therefore, the null hypothesis stating that there is no significant relationship between technical competence and perceived training needs of livestock feed processors in South-West Nigeria is rejected.

Table 6. Relationship between technical competence and perceived training needs

Variable	Technical competence	Training needs
Technical competence	1.000	0.687*
Training needs	0.687*	1.000
Sig. (2-tailed)	—	0.001
N	287	287

Note: Significant at 0.01 level (2-tailed)

Discussion

Technical competence and training needs as a continuum of capacity development

The positive association between technical competence and perceived training needs suggests that training needs may not simply reflect a deficit in technical ability. Rather, as technical competence increases, processors may also become more aware of the specialized knowledge and skills required for more complex feed-processing tasks. Thus, training needs may represent different stages of technical development, ranging from foundational skills among less competent processors to more specialized training in formulation, feed analysis, nutrient balancing and quality assurance among more technically competent processors. This interpretation does not imply causation; instead, it suggests that competency development and training needs may operate as a progressive capacity-development continuum.

Taken together with the other findings, this relationship suggests that training needs are shaped not only by competence deficits but also by the technical demands associated with enterprise activities and progressive specialization. Thus, technical competence may be viewed as part of a broader capacity-development process in which differences in experience, production scale, training exposure and access to technical information may likely influence the ability of processors to recognize and address increasingly specialized competency requirements.

Uneven technical competence across feed-processing functions

The results indicate that technical skills of feed processors are not homogeneous. There was a relative competency in the routine operational activities like identification of ingredients and grinding/mixing while the competency was weak in formulation and other analytical activities like quality assurance. The pattern indicates that practice gained through repeated production operations might be adequate for routine operations but may not be suitable for more advanced feed-processing decisions that involve scientific knowledge. The production of commercial feeds involves determining nutrient requirements, ingredient characteristics, analytical quality control of the ingredients and the formulation principles. Therefore, competence in these attributes does not necessarily stem from experience alone.

This finding underlines the need to keep in mind the difference between operational competence and scientific/analytical competence in the evaluation of feed-processing capacity. The idea of considering feed processors as one group of technologists may even mask the exact training gaps where skills need to be developed (FAO and IFIF 2020).

This distinction is also consistent with the knowledge-gap pattern observed in the study, where routine processing knowledge was relatively stronger while more specialized scientific and analytical areas required greater improvement. The results therefore suggest that recognition of training needs is closely tied to the level and type of competence required for different feed-processing functions.

Feed formulation represents the major competency bottleneck

Preparing a feed formula produced the highest MWDS (3.68) followed closely by feed analysis (3.48). The high discrepancies were because of the perceived importance of these tasks and respondents' low level of competence.

Feed formulation is a main technical task since it deals with the selection of the ingredients that are to be used in an economically desirable way to meet the nutritional requirements for a target animal. Feed quality can be affected and production costs raised by errors in the inclusion of ingredients and balancing the nutrients. The significant role of formulation in the Borich analysis and in respondents' stated training needs thus give converging evidence that formulation is a significant technical constraint.

This outcome is significant since calculating proximate analysis (mean = 2.48) and basic feed formulation (mean = 2.47) were the top two training needs expressed. When objective discrepancy assessment is combined with the self-report of preferences, this provides further support for the conclusion that identified gaps are not merely a product of a single method for measuring them. These converging results show how the broader competence–training relationship translates into specific capacity-development priorities, particularly where scientific knowledge must be applied to formulation and feed-quality decisions.

Feed analysis and quality assurance require greater attention

Feed analysis was the second highest MWDS (3.48). Analytical competence is also relevant because the processors must also be able to assess and confirm the nutritional properties of feed grains and finished products. If there is a lack of analytical skill on the part of the processor, he may assume ingredients are of good quality or he may use a generalized approach to formulation. This concern is also reinforced by relatively low competence of quality assurance. Any feed processing system must be technically capable of taking a step beyond the simple mixing of ingredients, and test the finished feed to confirm that it meets the required nutritional and quality objectives.

It is further evidence that the need for proximate analysis was expressed. Almost all respondents considered the proximate analysis as needed or highly needed, of which 50.17% considered as highly needed. The alignment of the perceived need and competency discrepancy indicates a need to integrate analytical training into future capacity building programs.

Intermediate gaps in ingredient science

The moderate MWDS values for inclusion (2.42), anti-nutritional factors (2.33) and nutrient composition (2.10) indicate other areas of scientific knowledge that need improvement for making appropriate formulation decisions. These skills are closely related to the field of feed formulation. Even when basic formulation procedures are known, a processor may have difficulty determining the appropriate inclusion levels of feed ingredients without adequate information on their nutrient composition and anti-nutritional factors.

The results thus indicate that training should not just be limited to mechanical formulation procedures. It should also reinforce the fundamental scientific underpinning knowledge basis for making formulation decisions, as appropriate (FAO and IFIF 2010).

Experience does not eliminate the need for technical upgrading

The accumulated experience is significantly negatively associated to training needs ($r = -0.187$, $p = 0.001$), which indicates that years of experience could work to lessen the need for some training. But the fact that there are still significant training priorities for an experienced processor, suggests that experience does not replace continued technical development.

Technology in feed processing, quality standards, and ingredient markets and nutrition knowledge change over time. A professional processor may thus have a considerable amount of tacit knowledge, but still need formal updating in scientific and analytical fields.

Training needs and enterprise complexity

Training needs ($r = 0.245$, $p < 0.001$) and mill production capacity ($r = 0.211$, $p < 0.001$) had a positive relationship with weekly production volume. This could be attributed to the fact that as the number of production volumes increased, the number of technical and managerial issues experienced by processors would increase, such as formulation of feeds, ingredients management, quality control, equipment operation, production monitoring, and recording. As the analysis was correlational and cross-sectional, however, these relationships should be viewed as indication of association rather than causation of higher production capacity leading to higher training needs. Instead, the results indicate that when assessing and prioritizing training needs, enterprise production size needs to be considered for capacity-building interventions.

Contribution to knowledge

This study contributes to the literature on livestock feed-processing capacity development in three ways. First, it provides empirical evidence that technical competence is positively associated with perceived training needs, challenging the assumption that training demand is necessarily greatest among processors with the lowest competence. Second, the findings suggest that training needs may represent a continuum of progressive technical development, in which increasing competence is accompanied by greater recognition of more specialized knowledge and skill requirements. Third, by examining the enterprise and institutional factors associated with training needs, the study moves beyond descriptive identification of training gaps toward a more targeted understanding of capacity-development requirements. Although the empirical evidence is drawn from feed processors in South-West Nigeria, the underlying implication is relevant to livestock feed-processing systems in other developing economies where enterprises are transitioning toward greater technical specialization, quality assurance and commercial production.

Implications for sustainable feed systems

This study has implications that go beyond the individual feed processing business. Correct formulation and feed analysis can aid in the efficient use of the feed ingredients, minimize nutrient losses, and ensure uniformity in feed quality. These outcomes are important for sustainable livestock production because feed efficiency is related to resource-use efficiency and production costs. This evidence points to a greater move towards competency-based feed-system development from generic training programs. Training should be focused on functions where there are the greatest gaps, not be spread out equally across all aspects of feed processing.

Technical education in formulation, feed analysis, ingredient science and quality management could be continually delivered to processors through a coordinated and comprehensive approach that includes agricultural extension services, universities, professional associations and private feed-sector actors. This co-operation would also be valuable to ensure that training material is relevant to the latest technical requirements and commercial considerations.

Conclusion

Technical competence deficit and training needs of livestock feed processors in South-West Nigeria were evaluated. The results show that there is a lack of uniformity in the feed-processing system with respect to competence. Processors exhibited relatively high competence in the routine operational tasks, but significantly lower competence in technically demanding scientific and analytical tasks. The most important competency gaps were found in preparing feed formulas and analyzing feeds, followed by determining ingredient inclusion levels, identifying anti-nutritional factors and determining nutrient composition. The training needs expressed by the respondents also confirmed these findings, with the most important training needs being proximate analysis and basic feed formulation respectively.

The findings show that general formal education and practical experience are not always sufficient to develop the required specialized skills for producing commercial feeds in the modern era. Capacity development should not, therefore, be aimed at generic feed-processing training, but should be aimed at providing specific training in formulation, feed analysis, nutrient assessment and nutrient quality control. Improving these capabilities could help

improve the quality of feed, their use and feed resource utilization, and enhance resilience in livestock value chains. The results offer insights for the development of competency-based interventions that can be implemented by feed processors in Nigeria and possibly other developing livestock economies.

Practical implications

The positive association between technical competence and perceived training needs has an important implication for capacity development in livestock feed-processing systems. Training needs should not necessarily be interpreted as evidence of inadequate competence alone. Rather, as technical competence increases, processors may become more likely capable of identifying increasingly specialized areas in which further knowledge and skills are required. This suggests a developmental model of training in which capacity building progresses from foundational competencies to intermediate and advanced technical competencies. Such an approach may be particularly relevant to feed-processing systems undergoing technological and commercial upgrading, where continuing professional development is required to address increasingly complex demands related to formulation accuracy, ingredient evaluation, feed analysis, quality assurance, feed safety and regulatory compliance.

The findings on information access and extension contact further indicate that competency development is embedded within an information environment rather than occurring through formal training alone. The range of information sources used by processors, together with the significant association between extension contact and training needs, suggests that capacity-development interventions should combine structured technical training with sustained access to credible technical information and advisory support.

Competency-based training should be given attention to the agricultural extension organizations, universities, feed-processing associations and stakeholders in the private sector on feed formulation and feed analysis. The training modules should cover practical formulation exercises, nutrient balancing, ingredient inclusion, proximate analysis, interpretation of feed quality results and quality control procedures.

Training should also be differentiated based on enterprise complexity and the enterprise's competence and not be given as a one-size-fits-all product. This would enable processors with better routine operational skills to move forward in developing scientific and analytical skills needed for better and efficient production of feed.

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Data Availability

The datasets generated and/or analysed during the current study are available from the corresponding author on reasonable request.

Ethics Approval

Ethics approval: This study was approved by the Institutional Ethics Committee of Landmark University, approval number LMUIREC/HS/061/2025.

Ethical accordance: The study was conducted in accordance with the ethical principles of the Belmont Report and the relevant ethical requirements of Landmark University.

Consent to Participate

Informed consent was obtained from all participants involved in the study.

Consent to Publish

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