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Feeding Practices and Use of Lysine and Methionine in Pigrationing on Intensified Pig Breeding in the West Center and Hauts Bassins Regions of Burkina Faso

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Abstract

The aim of the study was to assess feeding practices and the use of lysine and methionine in pig rationing on intensified and semi-intensive pig breeding in the Koudougou and Bobo-Dioulasso areas. To this end, a cross-sectional survey was carried out on 87 breeding in these towns. A Discriminant Factorial Analysis (DFA) confirming a k-means classification of the data collected was used to retain 71 breeding divided into three breeding classes: Class A (32.4% of breeding), Class B (14.08%) and Class C (53.52%). The results show that the majority of pig breeders were men between the ages of 36 and 59. Average herd sizes were 35 ± 28; 79 ± 42 and 89 ± 21 pigs for Classes A, B and C respectively. The main breeds of pig found on the breeding were crossbred, Large white, local, Landrace and Duroc. Class A (26.1%), B (30%) and C (15.8%) breeders were familiar with both lysine and methionine. Class A breeders distributed feed staggered (65.2%) and in rations (34.8%). Lysine (13%) and methionine (8.7%) were purchased at 5250 FCFA/kg. Those in class B distributed feed staggered (50%) and in the form of rations (50%), in which they incorporated lysine (30%) and methionine (30%) purchased at a cost of 2500 FCFA/kg and 3000 FCFA/kg respectively. Rationing and staggered feeding were practiced by 23.7% and 76.3% of Class C breeders respectively. Only lysine purchased at 3400 FCFA/kg was incorporated into rations by 10.5% of breeders. The high cost of lysine and methionine was incriminated by Class A (100%), B (33.3%) and C (50%) breeders. In conclusion, intensive pig breeding, the practice of rationing and the incorporation of the amino acids lysine and methionine are of ascending importance from classes C, A to B. The high cost of feedstuffs, particularly lysine and methionine, compromises their use in rations, which could have a negative impact on expected breeding performance. The screening and use of feeds rich in and/or enriched with these amino acids, through the development or adaptation of technologies, could improve the efficiency of rations and the productivity of intensive pig breeding in Burkina Faso.

Keywords

Feeding Practices, Lysine, Methionine, Intensive Pig Breeding, Burkina Faso

1. Introduction

The agricultural sector accounts for a significant share of the Gross Domestic Product (GDP) in most African countries [1] [2], with a contribution of 37% to 82% of agricultural GDP [3]. A significant proportion of the populations of West Africa depend directly or indirectly on livestock value chains for food, economy, field work, ritual and social purposes, or as insurance against impending crises [3]. In some Sahelian countries, such as Burkina Faso, Mali and Niger, around 60% of the population is involved in livestock production [4]. Animal species of economic importance in West Africa mainly include ruminants (cattle, goats, sheep and camels) and monogastrics (pigs and poultry) [3]. Production of short-cycle species such as pigs can contribute to improving real per capita income in sub-Saharan Africa [5]. Pig breeding is a profitable enterprise and an important livelihood in many parts of Africa, particularly in rural communities [6] [7]. It is increasingly seen as a source of income generation and poverty alleviation [2] [4] [8] [9] [10]. In Burkina Faso, pigs are raised in rural, urban and peri-urban areas [2] [11]. The development of pig production in urban areas depends on several factors, among which breed and feed are decisive [12] [13] [14]. In urban and peri-urban areas, pig breeding tend to adopt intensive and semi-intensive production systems [2] [15] [16]. In these systems, pigs are kept permanently in pens, where feed, water and care are provided on a daily basis. Feeding is more or less controlled on these breeding, with the distribution of complete feeds and the use of agricultural by-products [17]. The introduction of new exotic pig breeds with higher feed requirements is conditional on strict compliance with feeding regulations, if good pig breeding productivity is to be achieved. The aim of the study was to diagnose feeding practices and take stock of lysine and methionine utilization on intensified pig breeding in the Bobo-Dioulasso and Koudougou areas of Burkina Faso.

2. Materials and Methods

2.1. Study Area

The study was carried out in Burkina Faso in the urban and peri-urban areas of Bobo-Dioulasso and Koudougou.

Bobo Dioulasso is the capital of the Houet province and the Hauts Bassins region. The area is located at 11˚10' north latitude and 4˚16' west longitude.

Bobo Dioulasso covers an area of 1805 km^2. The city of Bobo-Dioulasso had a population of 860,426 in 2019, made up mainly of Dioulas, Mossi and Bobos [18] [19]. The climate is South Sudanese, with a long dry season (October to April) and a 5-month rainy season (May to September). Often described as an agricultural city, it is home to a wide range of urban breeding activities (livestock and market gardening), regional markets for agricultural products and agro-industries that supply by-products useful for animal feeding, particularly for urban livestock. The proximity of food resources (industrial and traditional beer draff, corn bran, meal leftovers) provided by the urban environment has encouraged the development of pig breeding in confinement, which is the second most widespread urban agricultural activity for generating income after market gardening. The Hauts Bassins region ranks fourth in terms of pig numbers, with 286,393 head of pigs, or 11.27% of the national pig herd [18]. Many pig breeding are located either within the built-up urban area, or on the urban fringe of the city of Bobo-Dioulasso [2] [14].

The town of Koudougou is the urban commune of the Boulkiemdé province and capital of the Centre Ouest region. The town is located at 12˚15' north latitude and 2˚22' west longitude. Koudougou is the country's third-largest city, after Ouagadougou and Bobo-Dioulasso. Covering an area of 272 km^2, it had a population of 193,409 in 2019, mainly Gourounsi and Mossi [18]. The climate is Sudano-Sahelian. The town of Koudougou is 93 km from Ouagadougou and 240 km from Bobo-Dioulasso. Agriculture is practiced by 88.1% of the population. Livestock farming in the Centre-Ouest region is characterized by the predominance of two systems: an extensive system based on the movement of herds in search of pasture, and a semi-intensive system characterized by livestock farming in association with agriculture or agro-pastoralism, with most livestock made up of cattle, small ruminants, asses, pigs, horses and poultry. Pig breeding is particularly common in the Centre-Ouest region. This region has the highest pig population in the country, with 494,735 pigs, representing 19.5% of the country's pig herd [18].

2.2. Data Collection Methodology

In order to gain a better understanding of feeding practices in general, and the use of lysine and methionine in pig rationing in particular, a cross-sectional, prospective, single-pass survey was carried out in the two localities in the study area. To select the breeding to be surveyed, preliminary interviews were held with the heads of the Regional and Provincial Directorates of Animal Resources and the pig breeders' cooperatives, enabling us to identify the contacts of pig breeders. Intensification criteria such as permanent confinement of pigs, more or less rational feeding methods and their willingness to answer questions on the survey form were defined. The surveys covered urban and peri-urban breeding, as well as those in villages surrounding towns.

Information collected during data collection included:

- the socio-economic characteristics of the breeders (sex, age, level of education, number of family members, type of labor employed, main activity and motivation);
- the structure of the herd (numbers and categories of pigs) and the breeds of pigs raised;
- the method of feeding and the food ingredients used;
- the use or not of lysine and methionine in the formulation of pig feed;
- and the constraints related to pig breeding.

2.3. Data Analysis

The data collected were recorded in a database designed using Excel spreadsheets. XLSTAT software Version 2016.02.2845 was used for statistical analysis. In order to obtain homogeneous groupings of the pig breeding surveyed for the purposes of characterizing feeding practices and lysine and methionine utilization, dynamic K-means cluster analysis confirmed by discriminant factorial analysis was carried out. This approach has been used by several authors, notably [20] and [21] for poultry typologies in Senegal and pig typologies in Burkina Faso. In this method, it is accepted that a cumulative variance of 75% achieved taking into account the factorial axes retained is sufficient to validate the selection of variables for classification analysis. Correlation analysis was then carried out for the selection of classification variables. Frequency calculations and analyses of variance using the Fisher model (LSD) with a threshold of 5% were then used for the various characterizations. Frequency calculations and analyses of variance using Fisher's model (LSD) at the 5% threshold were used for the different characterizations.

3. Results

3.1. Survey Sample

In total, out of 106 pig breeding visited, 80 breeders could be surveyed, representing a completion rate of 75.47%. Of the 26 breeding that could not be surveyed, 16 (15.09%) were closed and 10 (9.43%) refused to be surveyed. Data processing enabled us to retain 71/80 surveyed pig breeding (88.75% of them) for analysis.

3.2. Descriptive Statistics for Variables Used to Validate Pig Breeding Classification

Table 1 presents the descriptive statistics of 16 classification variables. The results

Table 1. Descriptive statistics for classification variables.

Variables	N	Min	Max	Average	Ecart-type
Age	71	22	70	44.77	11.54
HF_N	71	2	36	8.35	6.28
MO_N	71	0	18	1.62	2.73
INST	71	0	4	2.17	1.17
EFFECTIF	71	4	1025	70.42	134.8
SOURC_lysM	71	1	6	1.35	0.93
ALIM_RAT	71	0	3	0.52	0.86
GAM_INGRE	71	1	11	5.34	1.86
VENTE_AN	71	1	500	61.3	92.17
RV_PORC_AN	71	30,000	50,000,000	4,669,519	8,446,435
ELEV_RAIS	71	2	4	2.24	0.52
SOW_N	71	0	500	14.28	58.98
VERRAT_N	71	0	9	2.07	2.09
CROISS_N	71	0	400	26.1	57.28
PIGLET_N	71	0	250	28.17	41.41
RACE_N	71	1	5	1.23	0.61

HF_N: number of family members; MO_N: number of workers; INST: level of education; SOURC_lysM: source of supply of lysine and methionine; ALIM_RAT: rationed feed; GAM_INGRE: range of ingredients used; VENTE_AN: number of pigs sold per year; RV_PORC_AN: annual income from pig sales; ELEV_RAIS: reason for rearing the pig; TRUIE_N: number of sows; VERRAT_N: number of boars; CROISS_N: number of growing pigs; PORCELET_N: number of piglets; RACE_N: number of breeds reared.

show that the deviations were strictly greater than the mean for 8 variables (50% of variables), greater than or equal to 50% of the mean for 5 variables (31.25% of variables) and strictly less than 50% of the mean for 3 variables (18.75% of variables).

3.3. Classification of Pig Breeding

Correlation analysis enabled us to retain 3 variables as k-means classification variables for pig breeding. These variables are age, number of family members (HB-N) and number of workers (MO_N). The k-means analysis resulted in the selection of 03 breeding classes, A, B and C, which were then confirmed at 100% for each class by Discriminant Factorial Analysis (DFA). The frequency of breeding was 23/71 (32.40%), 10/71 (14.08%) and 38/71 (53.52%) for breeding classes A, B and C respectively. The one-way test for equality of class means (Table 2) shows that the means of the breeding classes were not significantly different for 9/16 of the variables, significantly different for 5/16 and highly significantly different for the variables Age and average number of family members (HF_N ($p < 0.0001$)).

Table 2. Univariate test for equality of breeding class means.

Variable	Lambda	F	DDL1	DDL2	p-value
Age	0.447	42.082	2	68	<0.0001
HF_N	0.325	70.743	2	68	<0.0001
MO_N			2	68	
INST			2	68	
EFFECTIF	0.967	1.165	2	68	0.318
SOURC_lysM	0.888	4.27	2	68	0.018
ALIM_RAT	0.96	1.41	2	68	0.251
GAM_INGRE	0.948	1.872	2	68	0.162
VENTE_AN	0.892	4.107	2	68	0.021
RV_PORC_AN			2	68	
ELEV_RAIS			2	68	
SOW_N			2	68	
VERRAT_N			2	68	
CROISS_N			2	68	
PIGLET_N			2	68	
RACE_N			2	68	

HF_N: number of family members; MO_N: number of workers; INST: level of education; SOURC_lysM: source of supply of lysine and methionine; ALIM_RAT: rationed feed; GAM_INGRE: range of ingredients used; VENTE_AN: number of pigs sold per year; RV_PORC_AN: annual income from pig sales; ELEV_RAIS: reason for rearing the pig; TRUIE_N: number of sows; VERRAT_N: number of boars; CROISS_N: number of growing pigs; PORCELET_N: number of piglets; RACE_N: number of breeds reared.

3.4. Main Class Characteristics

Two factorial axes with a cumulative variance of 100% were validated. The contribution per axis was 88.35% and 11.65% for axes F1 and F2 respectively:

- The F1 factorial axis was determined by the main variable Age of breeders, whose correlation index was 0.491 (Table 3, Figure 1). This axis was weakly and positively correlated with the variable reason why the promoter raises pigs (ELEV_RAIS) (0.259) and negatively correlated with all other variables;
- The F2 factorial axis was determined by the main variables Age (0.770) and number of family inhabitants HF_N (0.494). The axis is equally positively and negatively correlated with 7 variables (Table 3).

The projection of pig breeding classes in factorial space is shown in Figure 2. The coordinates of the barycenters of the breeding classes along the abscissa (F1) and ordinate (F2) were (3.556; 0.958), (−6.037; 1.661) and (−0.565 and −1.017) for breeding classes A, B and C respectively. Figure 2 shows the projection of breeding and breeding classes in factorial space.

Table 3. Correlations between factorial axes and indices of discrimination functions along factorial axes.

Variables	Correlation index between variables and factor axes		Function Index Canonical discrimination	
	F1	F2	F1	F2
Age	0.491	0.77	−1.203	0.854
HF_N	−0.77	0.494	1.797	0.3
MO_N	−0.25	0.098	0	0
INST	−0.115	−0.286	0	0
EFFECTIF	−0.136	−0.17	0	0
SOURC_lysM	−0.238	0.327	0.414	0.711
ALIM_RAT	−0.016	0.265	−0.982	0.134
GAM_INGRE	−0.232	0.077	0.706	−0.27
VENTE_AN	−0.324	0.148	0	0
RV_PORC_AN	−0.322	0.103	1.133	−0.227
ELEV_RAIS	0.259	0.153	0	0
SOW_N	−0.065	−0.166	0	0
VERRAT_N	−0.076	−0.188	0	0
CROISS_N	−0.135	−0.105	0	0
PIGLET_N	−0.156	−0.159	0	0
RACE_N	−0.018	−0.052	0	0

HF_N: number of family members; MO_N: number of workers; INST: level of education; SOURC_lysM: source of supply of lysine and methionine; ALIM_RAT: rationed feed; GAM_INGRE: range of ingredients used; VENTE_AN: number of pigs sold per year; RV_PORC_AN: annual income from pig sales; ELEV_RAIS: reason for rearing the pig; TRUIE_N: number of sows; VERRAT_N: number of boars; CROISS_N: number of growing pigs; PORCELET_N: number of piglets; RACE_N: number of breeds reared.

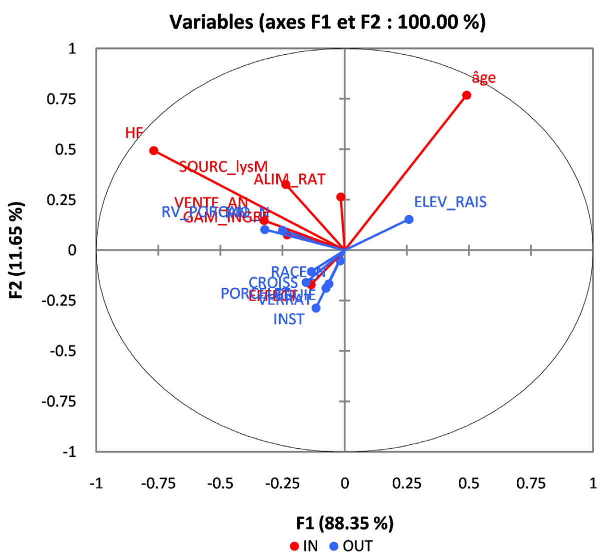

Figure 1. Correlations between variables and factorial axes.

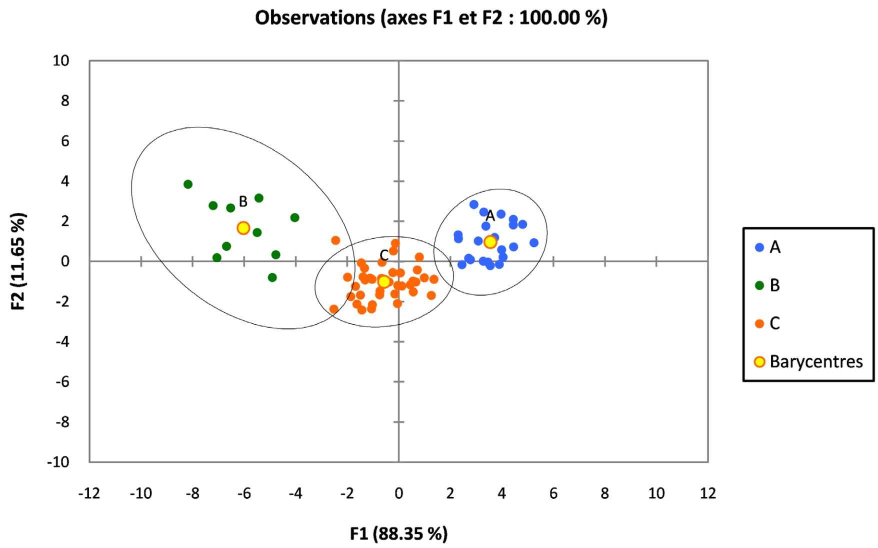

Figure 2. Projection of breeding and breeding classes in factorial space.

3.5. Socio-Demographic Characterization of Pig Breeding Classes

Table 4 presents the results of the socio-demographic characterization of the breeding classes. The results show that men were more represented than women in all classes. The proportion of women was higher and decreasing from class A, B to C. In all breeding classes, the 36 - 59 age range was the most represented. Only Class A recorded breeders over 60. Family dwellers were at least 2 times more numerous in Class B than in the others. Only Class C employed salaried labor. The majority of breeders were educated in all classes, with more breeders of secondary and higher education in Class C. Farming and breeding were the activities practiced by more breeders (+70%) in all classes. Economic motivation was the reason why more breeders in all classes practiced pig breeding.

3.6. Hog Herd Structure by Breeding Class

Table 5 shows the number of herds and pigs reared by class. Herd, sow and piglet numbers were higher and decreasing from class C and B to class A. Growing pigs were almost 2 times more numerous in classes B and C than in class A. Figure 3 shows that mixed-breed pigs were higher in all classes, but much higher in class C (73.6%). Local breeds were higher in class A (30.4%). Large White pigs were high in class B (40%) and low in classes A and C.

3.7. Feeding Method and Ingredients Used by Breeding Class

The results in Table 6 show the proportions of breeders in the different classes feeding an ingredient to their pigs. The results show that staggered feeding was predominantly practiced in classes A (65.2%) and C (76.3%), and moderately so in class B (50%). Several ranges of ingredients were used by breeders to feed their pigs. Corn bran and industrial spent grain were used by more than half the breeders in all classes. Fresh mangoes were used in all breeding classes, with over

Table 4. Socio-demographic characteristics of different breeding classes.

Parameters	Variables	Breeding classes		
		A	B	C
Sex (%)	Men	65	70	79
	Female	35	30	21
Age (years)	≤35	0	20	34.2
	36 - 59	69.6	80	65.8
	≥60	30.4	0	0
Demographics	HF_N	5 ± 1	21 ± 1	7 ± 1
	MO (n)	1 ± 1	3 ± 1	1 ± 0
	MOF (n)	1 ± 1	3 ± 1	1 ± 0
	MOS (n)	0	0	1 ± 0
Education level (%)	Uneducated	17.4	10	15.8
	Literate	26.1	30	15.8
	Primary	30.4	30	10.5
	Secondary	26.1	30	39.5
	Higher	0	0	18.4
Main activity (%)	Farmers	44	50	45
	Breeders	31	30	39
	Employees	13	10	0
	Retired	4	0	3
	Students	0	0	5
	Shopkeepers	4	10	8
	Other Functions	4	0	0
Motivations (%)	Economical	78.3	80	81.6
	Passion	21.7	20	18.4

HF_N: Number of Family members, MO: Labor force; MOF: Family labor force; MOS: Salaried labor force.

Table 5. Average herd size and pig categories by breeding class.

Parameters	Variables	Breeding classes		
		A	B	C
Workforce **(nb)**	Average headcount	35 ± 28	79 ± 42	89 ± 21
	Sows	5 ± 12	10 ± 18	21 ± 10
	Boars	2 ± 0.4	2 ± 0.6	3 ± 0.3
	Growing pigs	16 ± 12	39 ± 19	30 ± 10
	Piglets	15 ± 9	29 ± 13	36 ± 7

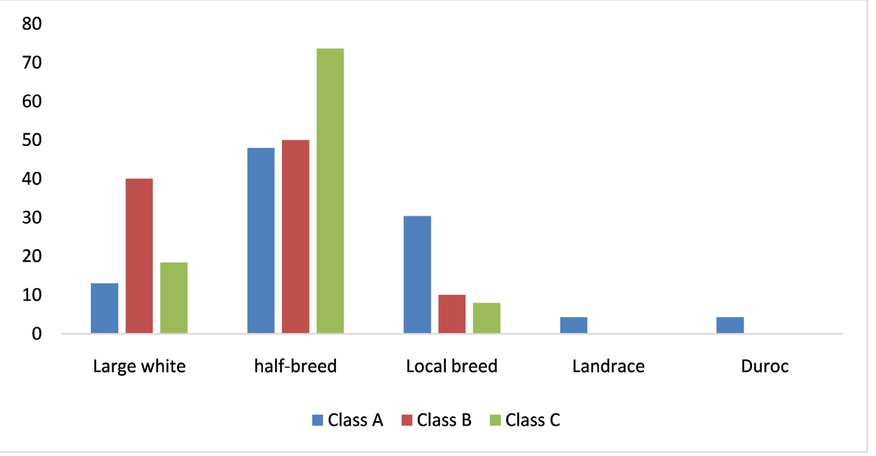

Figure 3. Proportion (%) of pig breeds by breeding class.

Table 6. Proportion (%) of breeders feeding an ingredient to pigs, by breeding class.

Ingredients	Breeding class		
	A	B	C
Corn bran	65.2	70	86.8
Brewery by-products	60.9	60	81.6
Fresh mango	39.1	30	52.6
Dolo by-products	39.1	40	26.3
Various bran	30.4	20	7.9
Fish meal	26.1	60	31.6
Salt	21.7	30	15.8
Nere powder	17.4	20	18.4
Herbs	13	10	5.3
Rice bran	8.7	10	39.5
Soybeans (seed and meal)	8.7	20	13.2
Corn	8.7	10	2.6
Piliostigma	8.7	0	0
Vitamin	8.7	20	7.9
Concentrates	8.7	0	2.6
Cottonseed cake	4.3	20	10.5
Oyster shells	4.3	10	7.9
Kitchen scraps	4.3	20	2.6
Wheat bran	4.3	10	2.6
Various oilcakes	4.3	0	2.6
Baobab leaves	4.3	0	0
Bone meal	4.3	0	0
Poultry food	0	0	2.6
Blood meal	0	0	2.6
Premix	0	10	2.6
Iron	0	10	2.6
Phosphates	0	10	0

50% of breeders in class C. Fishmeal was used more by class B breeders (60%). The number of soybean and cottonseed meal users was highest in class B. Premix, iron and phosphorus were only used by class B breeders.

3.8. Knowledge and Use of Lysine and Methionine in Pig Feed by Class

The results show that the majority of breeders in ascending order in classes B, A and C were not aware of lysine and methionine (Table 7). Lysine was used by 13%, 30% and 10.5% of breeders in classes A, B and C respectively. Methionine was used by 8.7%, 30% and 0% of breeders in classes A, B and C respectively. Users incorporated lysine and methionine at the same rate in class B, 01 times more methionine than lysine in class A and no methionine in class C. Class C breeders paid more for lysine. Breeders who included lysine and methionine in their feed all rated these amino acids positively, moderately and above average, in classes B, C and A respectively.

Table 7. Proportion (%) of breeders with knowledge of lysine and methionine, incorporation rate and cost per kg of lysine and methionine by breeding class.

Parameters	Breeding class		
	A	B	C
Breeders familiar with lysine and methionine (%)	26.1	30	15.8
Breeders using lysine (%)	13	30	10.5
Breeders using methionine (%)	8.7	30	0
Lysine incorporation rate (%)	0.3	1.7	0.4
Methionine incorporation rate (%)	0.6	1.7	0
Cost of 01 kg lysine (FCFA)	-	2500	3400
Cost of 01 kg methionine (FCFA)	5250	-	-
High cost of lysine and methionine	100	33.3	50
Good appreciation of lysine and methionine	80	50	100

3.9. Constraints on Pig Breeding

The results show that farmers encountered production constraints to varying degrees according to farm class. These were 1) food constraints in classes A (41.4%), B (57.1%) and C (48.7%); 2) sanitary constraints (unavailability of products and diseases) in classes A (15. 5%), B (4.8%) and C (15%); 3) housing problems for pigs in classes A (12.1%), B (14.3%) and C (3.1%); 4) lack of financial means in classes A (8.10.4%), B (14.3%) and C (3. 8%); 5) insufficient material resources in classes A (6.9%), B (4.8%) and C (10%); 6) insufficient technical skills of breeders in classes A (5.2%), B (4.8%) and C (8.7%); 7) low availability of labor in classes A (6.9%), B (0%) and C (5%); and finally 8) unprofitable selling prices for pigs in classes A (1.7%), B (0%) and C (1.2%).

4. Discussion

4.1. Data Collected, Analyzed and Need for Classification of Surveyed Breeding

The descriptive statistics of the data collected from the pig breeding showed that there was a wide dispersion among the breeders surveyed. Of the 16 data variables considered, only 3 had standard deviations strictly below their means. The standard deviations of the other 13 variables exceeded more than half their averages. This justifies the need to classify pig breeding in order to group the breeders by class according to the variables, so as to gain a better understanding of the characteristics and practices of each class of breeding.

4.2. Socio-Demographic Characterization of Surveyed Breeding

Our results show that pig breeding is a predominantly male activity. This trend is in line with the results obtained by [2] [22] [23] [24] [25] in West and Central Africa. These results confirm the assertion that men are responsible for livestock management in African societies, with women having very few property rights over animals [26]. Our survey focused on intensified breeding systems, where it is recognized that men are the main pig breeders. In fact, more or less intensive or semi-intensive pig breeding are owned by men, whereas women predominate in the extensive pig breeding system known as "traditional", which is more common in rural areas [27] [28]. Furthermore, women's difficult access to land, both in town and country, further reduces their presence in this area of activity. The high number of breeders aged between 36 and 59 can be explained by the fact that young people are not interested in pig breeding because of prejudices due to a negative perception of the pig and the marginalization of pig breeders in our societies. Our results show that it is mainly economic motivations that lead to the practice of pig breeding. The economic motivation of pig breeding shows that this seen as an economical and profitable activity.

4.3. Main Characteristics of Breeding Classes and Production

Class B and C breedings averaged over 50 head. According to [29], classes B and C fall into the category of large breeding. In fact, the Second National Survey of Livestock Numbers (ENEC II) classified pig breeding with over 50 head in the category of large breeding. According to the same source, class A breeding with an average headcount of less than 50 are classified as traditional breeding. Breeding classes B and C had similar numbers to those obtained by [25] for Bobo-Dioulasso pig breeding. This similarity is justified by the sampling method used in [25], which involved only 10 breeding surveyed, and one of whose criteria was based on breeding size. The practice of rationing pigs was most common on class B breeding, and least common on other classes. The practice of rationing and the high number of users of lysine, methionine and protein-rich ingredients (fishmeal, soya, cotton seed cake), vitamins, premixes, iron and phosphate in Class B breeding can be explained by the fact that Large white pig breeds are more highly bred in this class than in the other two classes A and C.

Breeding Large Whites in class B is explained by their good reproductive and growth performance, coupled with their resistance to high temperatures and disease. These same criteria are the driving force behind breed selection by breeders. This explains the breeding of mixed-breed pigs, which combine good reproductive and growth performance with resistance to disease. The Large white pig is very demanding in terms of nutrients, especially essential amino acids such as lysine and methionine. This exotic breed is very demanding in terms of nutrients, especially essential amino acids such as lysine and methionine. The low rate of lysine and methionine use in classes A and C can be explained by the widespread practice of staggered feed distribution, breeders' unfamiliarity with these ingredients and their high cost, which were cited as constraints by breeders. Other authors [21] [25] had found that Larges White and crossbreeds were higher on large breeding in the peri-urban areas of Bobo-Dioulasso. The same trend was observed in Benin by [30] who reported that breeding of the local breed had fallen by 35.5% in 21 years, to the benefit of crossbreds and exotic breeds. The same source asserted that this practice exposes the local pig to risks of genetic erosion, hence the importance of measures to preserve these indigenous genetic resources. The practice of staggered feeding could be explained on the one hand by the high cost of complete feeds, which call on various feed ingredients that are sometimes unavailable and whose acquisition costs exceed the purchasing power of breeders, and on the other hand by the lack of technical expertise in feed formulation. These constraints mean that breeders feed their pigs whatever they can get their hands on. The high use of corn bran and industrial spent grain is explained by the availability and low cost of these products. Corn bran and industrial spent grain are available, and acquisition costs are relatively lower. The use of fresh mango for pig feed is justified by the fact that this fruit is widely produced, marketed and processed in the Bobo-Dioulasso area. This practice is periodic and coincides with the mango season (March to August). The high use of fresh mango for pig feed in all breeding classes is justified by its free availability and easy access. In fact, fresh mango is obtained free of charge from mango traders and processors, who find it difficult to dispose of downgraded mangoes and/or processing by-products at processing and marketing sites. In general, fresh mango contains a lot of water (80%) [31] [32], whereas rationing calculations in animal feed are based on the dry matter content of ingredients. This avoids variability in the water content of ingredients, which leads to variability in energy and nutrient content. The use of fresh ingredients such as mango in pig feed does not result in stable feed formulas. Good rationing and/or formulation practices should avoid the use of fresh mango. This practice is due to pig farmers' poor knowledge of good feeding practices [21].

5. Conclusions

The classification carried out in this study has enabled us to identify 3 classes of pig breeding, which differ in terms of average number of pigs, breeds bred and feeding practices. There are, however, similarities between the classes of breeding in terms of certain ingredients that are used extensively and constraints linked to pig breeding. Constraints linked to the lack and high cost of feed were mainly mentioned by breeders. The breeders who raised the Larges whites the most were those who practiced rationing and used lysine and methionine and other protein-rich ingredients in feed preparation. Breeders lack of knowledge of lysine and methionine, and their high cost, limit their use in pig rationing.

The development of technologies to improve the nutritional values of local ingredients potentially rich in lysine and methionine can help reduce lysine and methionine deficiencies in rations and pig feed costs. For more productive pig breeding, feeding must be rationed with feeds that cover the pigs' nutritional requirements.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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