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Characterization of cattle feeding systems in the Gbêkê and Bélier regions (Central Côte d'Ivoire)

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ABSTRACT: This study characterizes cattle feeding systems in the Gbêkê and Bélier regions of central Côte d'Ivoire. A questionnaire survey was conducted from September 2019 to January 2020 among 87 cattle keepers in the departments of Bouaké, Brobo, Toumodi, Tiébissou and Djékanou. Feeding practices were described, compared between seasons with McNemar tests, and typed by multiple correspondence analysis (MCA) followed by hierarchical cluster analysis (HCA). All respondents were men; most were older than 30 years (89.66%) and of non-Ivorian origin (64.37%). Natural pasture was used by every keeper in both the dry and the rainy season, whereas only 2.33% also used sown pasture. Supplementation with crop residues and agro-industrial by-products (AIBP) increased significantly in the dry season ($P < 0.05$). Forty-nine percent of keepers provided no supplement. Cassava peels were the resource used most often (48%), followed by cottonseed cake. Four feeding groups were identified: (i) combined use of natural pasture, sown pasture and conserved forage; (ii) almost exclusive reliance on natural pasture (the majority group); (iii) year-round supplementation with both crop residues and AIBP; and (iv) use of a single crop residue throughout the year. The results highlight a persistent dependence on natural rangelands despite their growing scarcity, and they justify targeted support for cultivated forage and the reasoned use of locally available residues.

KEYWORDS: Cattle, feeding systems, natural pasture, crop residues, Côte d'Ivoire.

1 INTRODUCTION

Feed is a decisive component of livestock systems. It accounts for more than 70% of production costs and determines whether farmed species can express their production potential [1], [2]. In ruminants, and particularly in cattle kept in West African pastoral and agropastoral systems, the basal diet is pasture. Depending on what the holding can supply, this basal diet is supplemented with crop residues and agro-industrial by-products (AIBP). AIBP generally have a higher nutritive value than crop residues, but they are more expensive to obtain [3].

In Côte d'Ivoire, cattle feeding relies mainly on natural pasture [4]. The availability of these resources shapes both feeding practices and farm management [5], [6]. As early as the 1980s, Cesar [7] considered that the country still had sufficient forage resources at the national scale, while already noting that herds kept near large cities struggled to access rangelands because of the irregular expansion of cropping onto pastoral land.

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Urbanization, the expansion of cropped land and illegal gold mining have since further reduced natural rangelands, while the national herd has grown. Feeding has therefore become a major constraint on cattle production. Kouamé et al. [8] report that pasture degradation and the establishment of crop farms next to rangelands restrict access to forage and, in some localities, fuel farmer–herder conflict. Central Côte d'Ivoire—the Gbêkê and Bélier regions—is not spared this socio-demographic pressure. Kouadja et al. [9] showed that the quantity and quality of natural forage produced in this area no longer meet animal requirements.

Given this constraint, the question is which feeding strategies cattle keepers in central Côte d'Ivoire use to meet the needs of their herds.

The objective of this study was to characterize the cattle feeding systems adopted in this area and to identify the factors associated with these choices.

2 MATERIALS AND METHODS

2.1 STUDY AREA

The Gbêkê and Bélier regions occupy central Côte d'Ivoire. They lie at approximately 7°41′ N, 5°01′ W (Gbêkê) and 6°55′12″ N, 5°03′00″ W (Bélier). The climate is a transitional equatorial type, with two rainy seasons and two dry seasons, including a harmattan period. Annual rainfall ranges from 1,000 to 1,500 mm. Mean temperature lies between 25 and 30 °C [10], [11]. The vegetation is a transitional savanna, mainly herbaceous and dominated by *Imperata cylindrica* [12].

2.2 SURVEY INSTRUMENT

The survey instrument was a structured questionnaire in three parts: herd characteristics, feed resources used, and the way animals were fed.

2.3 SAMPLING

Respondents were cattle keepers from various localities in the Gbêkê and Bélier regions. They were selected on the recommendation of professional organizations and of the cattle-extension services operating in these regions.

2.4 FIELD SURVEY

Data were collected through interviews with keepers or their herdsmen, using closed and semi-open questions. Each respondent was interviewed once between September 2019 and January 2020 in the departments of Bouaké, Toumodi, Brobo, Tiébissou and Djékanou. Answers were entered on a tablet using the KoboToolbox application.

2.5 IDENTIFICATION OF FEEDING SYSTEMS

Feeding systems were identified by multiple correspondence analysis (MCA) followed by hierarchical cluster analysis (HCA). The variables retained were the use of natural pasture, the use of sown pasture, the use of crop residues and agro-industrial by-products, the practice of transhumance and cattle fattening, and the supply of mineral salts. Each practice was recorded by season (dry or rainy) in order to test whether the same resources were used in the same way in both seasons.

2.6 STATISTICAL ANALYSIS

Data were prepared in Excel and analysed in R. Descriptive statistics first summarized trends and distributions. MCA followed by HCA was then used to identify homogeneous groups of practices. McNemar tests compared the practices of the same keeper between seasons.

3 RESULTS

3.1 SOCIO-DEMOGRAPHIC CHARACTERISTICS

Table 1 presents the socio-demographic characteristics of the respondents. All were men, aged 23 to 79 years. More than 89% were older than 30 years. Most (64.37%) originated from the West African sub-region, compared with 35.63% Ivorian nationals. Quranic schooling was the dominant educational background (45.98%), ahead of respondents with no formal literacy (24.14%). Keepers with

tertiary education accounted for only 4.60% of the sample. Professional experience was recent or intermediate: 47.13% of respondents had 1–10 years of experience and 45.98% had 11–20 years.

Table 1. Socio-demographic characteristics of respondents

Variables	Categories	Number	Frequency (%)
Sex	Male	87	100
	Female	0	0
Age (years)	18–30	9	10.34
	31–50	41	47.13
	> 50	37	42.53
Origin	Ivorian nationals	31	35.63
	Non-nationals	56	64.37
Education	No formal literacy	21	24.14
	Primary school	13	14.94
	Secondary school	9	10.34
	Tertiary	4	4.60
	Quranic school	40	45.98
Years of experience	1–10	41	47.13
	11–20	40	45.98
	> 20	6	6.90

3.2 Use Of Feed Resources

Table 2 reports the frequency of use of feed resources. All keepers (100%) used natural pasture in both the dry and the rainy season. Only 2.33% (two keepers) also used sown pasture. Supplements were used more often in the dry season: 50% of keepers then used crop residues and 24.42% used AIBP, compared with 37.21% and 8.14%, respectively, in the rainy season. Transhumance and fattening each concerned fewer than 4% of respondents.

Table 2. Frequency of use of feed resources (%)

Resources	Category	Dry season (%)	Rainy season (%)
Natural pasture	Yes	100	100
	No	0	0
Sown pasture	Yes	2.33	2.33
	No	97.67	97.67
Crop residues	Yes	50	37.21
	No	50	62.79
AIBP	Yes	24.42	8.14
	No	75.58	91.86
Mineral salts	Yes	98.84	97.67
	No	1.16	2.33
Transhumance	Yes	3.49	3.49
	No	96.51	96.51
Fattening	Yes	3.49	3.49
	No	96.51	96.51

3.3 Feeding Practices By Season

Comparison of practices between seasons (Table 3) shows that the use of natural and sown pasture, and mineral-salt supplementation, did not change from one season to the other ($P = 1$). In contrast, supplementation with crop residues and AIBP differed significantly between seasons ($P < 0.05$): use of these resources increased in the dry season relative to the rainy season.

Table 3. Between-season feeding practices

Resources	Seasons	DS_No	DS_Yes	Test	P-value
Crop residues	RS_No	41	10	McNemar	0.0044
	RS_Yes	0	31		
AIBP	RS_No	62	13	McNemar	0.0009
	RS_Yes	0	7		
Forage	RS_No	78	1	McNemar	1
	RS_Yes	1	2		
Mineral salts	RS_No	1	1	McNemar	1
	RS_Yes	0	80		

Legend: AIBP, agro-industrial by-products; DS, dry season; RS, rainy season.

3.4 Use Of Feed Supplements

Supplementation data show that 49% of respondents provided no supplement and relied on natural pasture alone. Cassava peel was the supplement used most widely in the area (48%), ahead of cottonseed cake. Cereal bran was used by 5–10% of keepers. Only 1% used hay (Figure 1). Among keepers who did supplement, 49% used a single feed, 42% used two feeds, and fewer than 10% combined more than two (Figure 2).

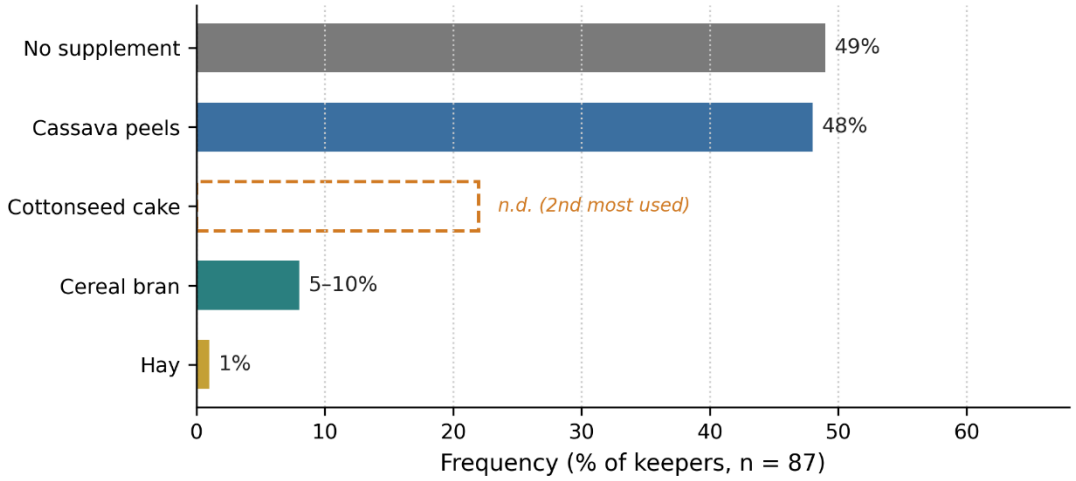


Fig. 1. Frequency of use of feed supplements

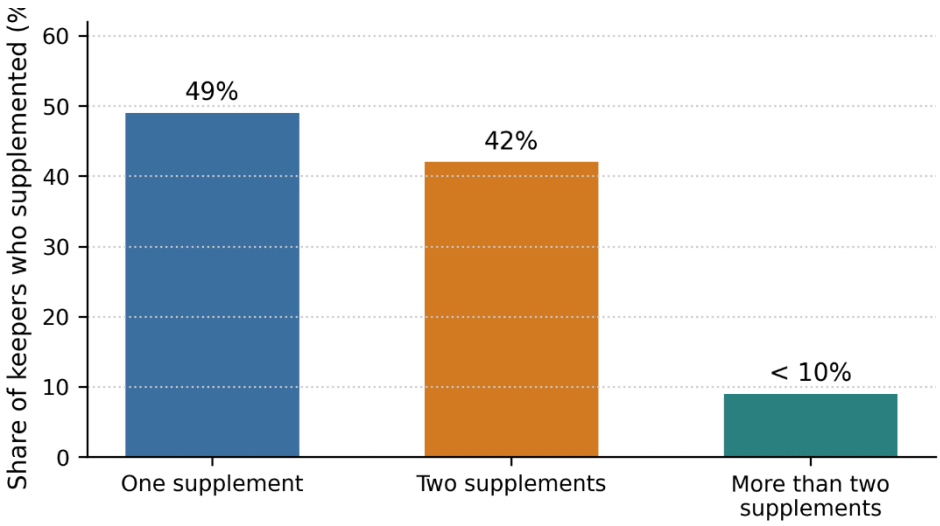


Fig. 2. Combinations of feed supplements

3.5 CONTRIBUTION OF THE MCA DIMENSIONS

The MCA retained two dimensions that together explained 71.25% of the variability. All retained variables contributed to a similar extent (about 7%) to the first dimension, which captured 56% of the variance. The second dimension (15.25%) was driven mainly by the use of sown pasture in the dry and rainy seasons (contribution of about 20%) and by the use of forage in both seasons (about 17%) (Figure 3).

Table 4. Contribution of dimensions in the MCA

Dimensions	Eigenvalue	Contribution (%)	Cumulative contribution (%)
Dimension 1	1.00	56.00	56.00
Dimension 2	0.27	15.25	71.25
Dimension 3	0.16	9.22	80.48
Dimension 4	0.12	6.62	87.10
Dimension 5	0.08	4.58	91.68

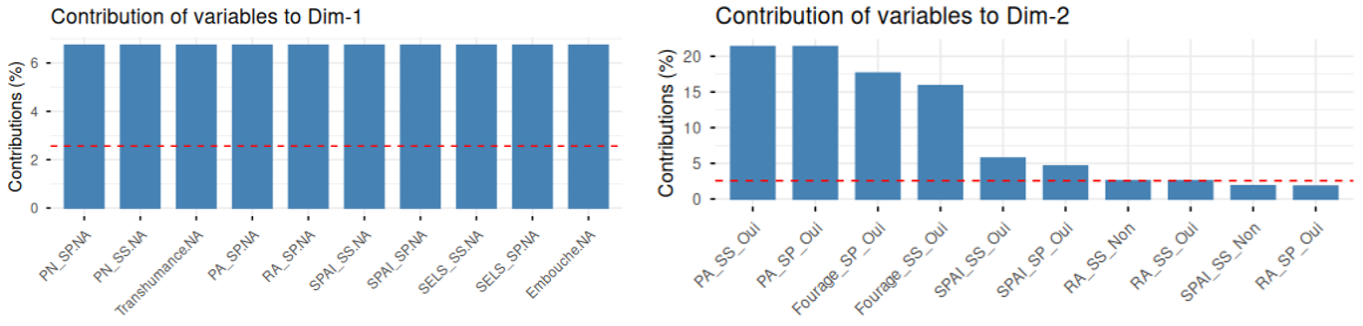


Fig. 3. Variable contributions to the multiple correspondence analysis

3.6 TYPOLOGY OF FEEDING SYSTEMS

MCA followed by HCA distinguished four groups of feeding practices (Figure 4).

Group 1 comprised two keepers. They combined natural pasture, sown pasture and forage in both seasons. Crop residues and AIBP were reserved for the dry season. Expenditure on supplements remained below XOF 500,000 and was directed mainly towards cassava peels and cereal bran.

Group 2 comprised 47 keepers. Its main feature was the absence of supplementation for most members; 16 keepers in this group did, however, provide a supplement and spent less than XOF 250,000 on it. Mean herd size was 155 head, with a wide range (minimum 3; maximum 2,006).

Group 3 comprised 33 keepers. In addition to natural pasture, they used crop residues in both seasons and often combined residues with AIBP. They used at least two supplements; expenditure varied with herd size.

Group 4 comprised four keepers who supplemented natural pasture with a single type of crop residue used throughout the year.

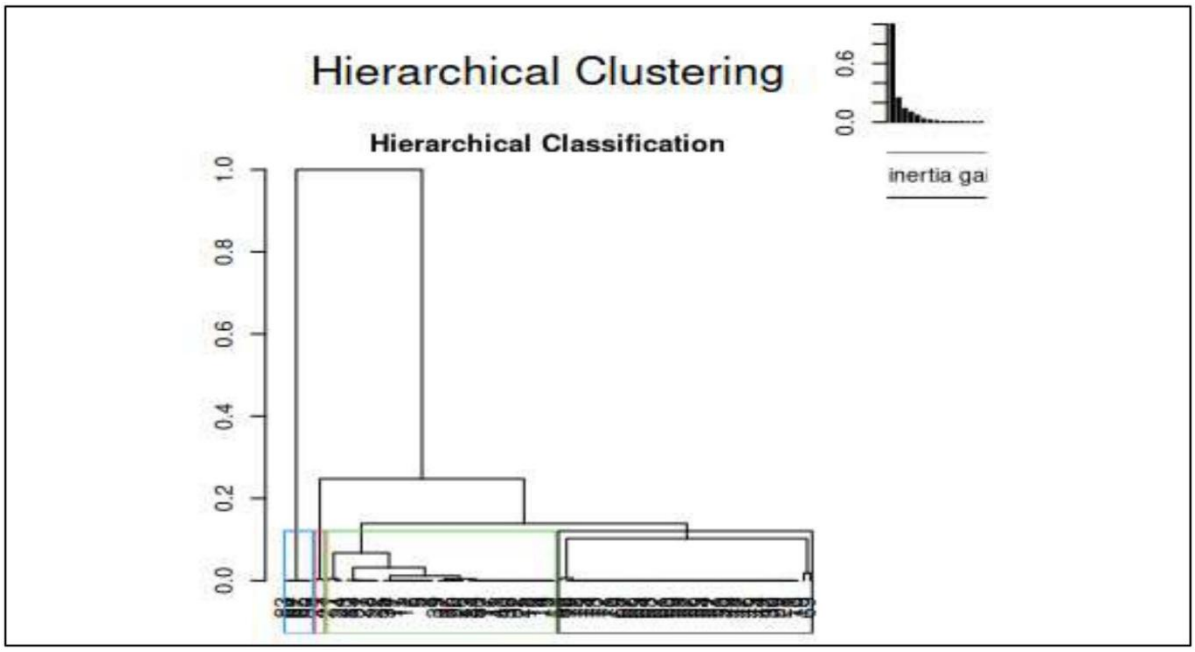


Fig. 4. Homogeneous groups of feeding practices

4 DISCUSSION

The socio-demographic profile shows that cattle keeping in central Côte d'Ivoire is practised exclusively by men, mainly adults (more than 89% were older than 30 years) and of non-Ivorian origin (64.37%). This pattern matches observations from other regions of the country [8], [13], [14]. The predominance of adult men is consistent with the physical and financial demands of managing a cattle herd [13]. The over-representation of keepers of foreign origin reflects a limited Ivorian pastoral tradition: earlier local practices were often restricted to a few animals kept for festive use. The share of nationals (35.63%) nevertheless points to growing Ivorian interest in the activity, favoured by cultural mixing and by the economic outlets of cattle production.

Feeding practices confirm that natural pasture remains the universal resource (100% of respondents), in line with Konaté [15]: in the rainy season the range can be sufficient; in the dry season it is reduced to standing straw and no longer meets requirements. Supplementation then rests on crop residues and, less often, on AIBP. Residues are used more than AIBP because they are more available and cheaper, even though AIBP are more nutritious [16], [17]. Cassava peels predominate (48% of keepers). This predominance is explained by the local importance of processing cassava into attiéké, which makes these co-products available year-round, unlike cereal bran, which is seasonal [18].

MCA, run on transhumance, fattening, the seasonal use of natural and sown pasture, forage, crop residues, AIBP and mineral salts, isolated four homogeneous groups of practices.

Group 1 is distinguished by the use of sown pasture. Where natural rangelands are scarce and overused, access to a cultivated forage resource is an asset: it reduces dependence on common rangelands and limits spending on supplements during the lean period.

Group 2, the largest numerically, invests little in feeding. Exclusive use of natural pasture reduces cash outlay but shifts the cost onto labour: animals must be walked farther to find feed, and exposure to the dry season is greater.

Groups 3 and 4 supplement natural pasture with crop residues and, in Group 3, with AIBP. Aware that the quantity and quality of rangelands are no longer adequate, these keepers provide a supplement, sometimes year-round. Group 3 combines at least two

products; Group 4 uses only one. This supplementation eases the seasonal deficit but remains constrained by the cost of AIBP and by the irregular supply of some residues.

5 CONCLUSION

This study shows that cattle keeping in central Côte d'Ivoire is practised by men, mainly older than 30 years (89%) and of non-Ivorian origin (64.37%). Natural pasture is used by all keepers; only 2.33% also use sown pasture. Supplementation relies mainly on crop residues, especially cassava peels (48%), and intensifies in the dry season. MCA followed by HCA distinguished four groups: combined natural pasture, sown pasture and forage (Group 1); almost exclusive use of natural pasture (Group 2, the majority); combined supplementation with residues and AIBP in both seasons (Group 3); and a single crop residue used year-round (Group 4). These findings call for support for cultivated forage production and for the use of local co-products, in order to reduce pressure on increasingly constrained rangelands.

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