

Structural and Functional Factors of Cattle Breeding Dual Purpose of Molinopampa, Amazonas

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Abstract

Livestock in Latin America, Peru provides work for many families and the dual purpose is a traditional system that has organizational structures associated with biodiversity; dynamic, sustainable and competitive, driven by farmers dedicated to increasing their profits. The present investigation aimed to determine the fundamental factors of the structural and functional characteristics of the cattle farms of dual purpose in the district Molinopampa, 38 farms were surveyed, on structural and functional variables, analyzed with factorial technique of multiple correspondences and ascending hierarchical classification. It was found that the farms, according to the structural characteristics, are predominantly extensive with slight mineral supplementation in the feeding and daily manual milking, they keep production records eventually and have inadequate use of their infrastructure; according to the functional characteristics, they have a production from 0.5 to 2,265 lt / ha, sanitary control from intermediate to good, deficient milking management, intermediate administrative management, reproductive management from 16 to 50% of cows in production. Three factors were determined: Pasture management and animal health; productive technology; production of meat and milk; with 3 kinds of livestock: Intermediate management in animal health, management and production; quality of milk; and pasture management and milk production.

Keywords: Production Systems, Livestock Management, Dual Purpose Cattle, Multivariate Analysis, Rural Development

Introduction

Livestock farming (Ríos, Espinosa & Hassan, 2015) is an economic activity that provides work for many peasant families in Peru and the world. The national cattle ranch, however, has low productivity, accompanied by reduced profitability. The analysis of the productive chain indicates that the causes are: the seasonality of production, the low quantity and quality of pastures and forages, the scarce

development of conservation techniques, the underutilization of fodder and crop residues, the low quality of the cattle (90% are criollo and crossed), low reproductive rates, high mortality rates in replanting replacements, high production costs of intensive herds, scarcity and high price of bellies, low milk quality and of the meat and the technological delay (Gutiérrez, Trujillo & Martínez, 2010).

The dual-purpose livestock is the traditional system in Latin America, since it allows the production of meat and milk (Cortés, Cotes & Cotes, 2011) in tropical environments (Mendieta, 2010).

This system has very diverse organizational structures associated with environmental and functional diversity that make up a complex, dynamic, sustainable (Rangel-Quintos, et al., 2016) and competitive phenomenon, and in comparison with specialized systems; currently livestock producers must move from simple farmers to efficient entrepreneurs, oriented to obtain one or more products that increase their profits (Romero, 2014)

The cattle ranch of double purpose cattle in Mexico is a traditional system that contributes to the market 25% of the milk; and the production of meat is based on the sale of the calf at weaning. Due to the adaptability, in the tropical regions, it is notorious its resistance to diseases, in the production of milk and meat; due to these circumstances, we have worked with new types of cattle that report better development rates in the offspring, better productive, reproductive efficiency and rusticity. In Chiapas, cattle ranching is the base of the primary sector very important in the economy of the state. It concentrates 90% of the total value of livestock production, where the double purpose system is the most representative, occupying 2.9 million hectares equivalent to 33% of the state territory. (Orantes-Zebadua, et al 2014), (Alvarado, 2002).

In Venezuela, dual purpose livestock is a productive activity of significant importance, with substantial contributions to the economic development of Páez of the Apure State. A rapid diagnosis in 29 farms in relation to the structural

aspects and the establishment of a functional typology, with the factorial method by multiple correspondences, reported that the most important variables are associated with the aspects of the management or technical organization of the farms, followed by physical productivity measured in terms of milk per hectare, and health management. The analysis of hierarchical ascending classification reported a typology composed of three categories of farms: 1.- Traditional dual purpose cattle raising, with low levels of intensification and little technical organization; 2.- Intermediate dual-purpose cattle raising, with low to intermediate levels of production and low productivity and little technical management; and 3.- Dual-purpose cattle raising with the best productive performance, better organization and a clear definition towards the intensification of the milk-meat system (Paez, *et.al.* 2003)

Another diagnosis applied the methodology of technical, structural, functional diagnoses and continuous improvement of milk and meat production systems with cattle in the Urdaneta municipality of Lara State, Venezuela, evaluated: size of the farm, milk income, females in the flock, working capital, forage cover, length of stay of the producer on the farm and percentage of females with a medium degree of European heritage. The data analysis generated two modalities of groups of double purpose milk-meat farms; nine with greater tendency to produce milk and fifteen with less tendency to produce milk (Alvarado, 2002).

In the municipality Alberto Arvelo Torrealba, Barinas state, Venezuela; in 30 double-purpose farms, evaluated: income for milk, length of stay of the producer on the farm, females in the herd, cows with a medium degree of European heritage, calves with more than 1/2 European heritage, size of the farm, working capital and the quality of milk (acidity); and the factorial analysis of multiple correspondences and hierarchical ascending classification, generated three modalities with different intensities of milk production: 1.- Eight farms with directionality towards the production of meat, defined as dual purpose meat-milk, 2.- Eight farms with directionality for the production of milk classified as double purpose milk-meat and 3) four farms tending to seek a balance in the production of milk and meat located as an undefined dual purpose. (Paredes, *et.al.* 2003).

Multivariate analysis techniques such as multi-component factor analysis and hierarchical classification analysis; used in the different analyzes of the double purpose herds, they were used to analyze the fundamental factors of the structural and functional characteristics of the cattle farms of dual purpose cattle in Molinopampa district (Murcia, & Martínez, 2013), (Valdovinos, Espinoza, & Vélez, 2015), (Cuevas, *et al.* (2013).

In the vast majority of countries, regions and localities of South America, the need to design diagnostic strategies on the degree of differentiation present in the agricultural sector, for the correct formulation of differentiated work policies; in this sense, the purpose of this work was to analyze the dual purpose livestock system and know its structural and functional aspects, know the characteristics of the components, key processes, strengths and technological weaknesses that allow designing appropriate and adapted intervention strategies to the social, cultural and economic conditions of the ranchers to improve the

productive performance of the livestock properties dedicated to the exploitation of the dual purpose cattle (Vargas, *et al.*, 2014) and answer What are the fundamental factors of the structural characteristics and of the double purpose cattle farms in the district of Molinopampa ?, in addition: Determine the profile of livestock properties dedicated to the exploitation of dual purpose cattle, based on their structural and functional characteristics; summarize the set of structural and functional characteristics of the dual purpose livestock properties, for a small number of variables; make a typology of these livestock properties dedicated to the exploitation of dual purpose cattle from their structural and functional characteristics.

Material and Methods

The population was constituted by the cattle properties of cattle of double intention in the district of Molinopampa, located to 2407 msnm of altitude, latitude 06 ° 12'32 "and 77 ° 40'09" of length, has 333,86 km², Time : 18 ° C, SE wind at 11 km / h, humidity of 57% (INEI, 2007) province of Chachapoyas, Amazonas region. Research of a descriptive and applied type with a single-box design, correlational (Hernández, *et.al.* 2006) and (Tresierra, 2000), and the hypothetical scientific deductive method was used throughout the research process, a random sample was selected stratified of size n = 38 of 93 livestock properties (Santos, *et.al.* 2004) with proportional allocation by annexes of the district: Huasacazala 12, Izcuchaca 6, Ocol 7, San José 10 and Tingo 2. The proportion P = 0 was assumed, 5 of dual purpose cattle graziers, with a maximum estimation error of 10% and 90% confidence.

The data, in addition to the review of specialized bibliography, were recorded in a field notebook and a carefully prepared survey questionnaire Paez, *et.al.* 2003), (Ureña *et al.*, 1997).

The structural analysis that was carried out through the generation of descriptive indicators of the various aspects or variables that are related to the following components of the production system: a. The producer and its characteristics, b. Dimension of the company, c. Equipment, d. Facilities and infrastructure for production, e. Working capital, f. Organizational aspects, g. Indebtedness (Ureña *et al.*, 1997). The functional analysis was selected the following key aspects that relate to the technological processes that identify the functionality of a production system with dual-purpose cattle: a. Quality of the herd, b. Management of animal health, c. Milking management, d. Management, e. Management of cows in production and dry, f. The food system for production, g. Management of cows in production (Ureña *et al.*, 1997).

The data was entered and processed in SPSS for Windows v.15 and SPADN v.3.25. Factorial analysis of multiple correspondences and classification analysis (Crivisqui & Villamonte, 1994), allowed reaching the objectives and solving the research problem.

Results

The structural indicators (tables 1 and 2) describe the predominant features of production, of the cattle properties of dual-purpose cattle in the district of Molinopampa,

Chachapoyas, Amazonas, Peru; systems with productive orientation of traditional grazing, with little diversification of crops in fodder production, low use of improved technology, as well as high variability in the composition by breed of herds. The average values of area and size of the herd (total and production cows), determine a conglomerate of units of low to medium productive intensity (30.08 ha and 23 cows), where the useful area dedicated to livestock activity is high (25.55 ha), representing a high proportion in relation to the total (85%).

We evaluated 38 livestock properties and 8 functional variables (table 3) to observe the distribution of observations within the modalities. The multiple correspondence analysis reported 24 modalities, and a first general overview of the grouping, which indicated that: The daily production of milk per cow in 32% of the farms is distributed between 3 to 5 liters; the production per hectare of milk in 71% of the farms was between 0.5 and 2.625 liters; the ratio of milking cows to total cows, in 76% of farms was less than or equal to 50%; the density (cows / ha), in 80% of the farms was between 0.13 to 0.49; the organization and management of milking, in 74% of the cases it was considered deficient, and only 26% carried out some actions of hygiene and product handling, such as filtering, proper washing of buckets and utensils, washing the udder and cleaning of the milking staff with minimum hygiene conditions.

In the administrative organization of the cattle properties, it is highlighted that the majority (68%) has a production record, they observe an adequate division of the herd, either in terms of management groups by age and nutritional requirements. 94.7% of the cases are milked once a day and 58% of the livestock properties. The feeding system is geared towards grazing; for the production they turned out to be basically grazing with mineral supplementation. In animal health management of the livestock herd (prevention) it is highlighted that 53% of farms are regular or intermediate inclined for good (47%). 100% of these farms apply the vaccine according to the established program of adequate and systematic sanitary control. The parasitic prevention (100%) is regular.

The global inertia of the matrix of the active variables is 2,000 decomposed along 16 main directions of elongation of point clouds-modalities and individuals (table 4); the first 6 eigenvalues are higher than the average value (0.125) but only the first 3 eigenvalues are sufficiently important, after the transformation proposed by Benzecri (Torres, 2010), they bring together around 80.31% of the inertia, starting from 4th own value, the decrease of them is perfectly regular; consequently, it is possible that the first 3 factorial axes provide interesting information depending on the objective of this analysis.

Table 5 shows the variables with the greatest power of explanation and their individual contribution in each factor. The first factor was defined mainly by the variables livestock herd quality (lt / cow / d), animal health management and food inputs with a respective contribution 20,20; 17.89 and 17.83%; while the second one was associated to the flock quality variables (lt / cow / d), technical and administrative management, food supplies 25,44; 21.19 and 13.92% and the third factor with hectare production (lt / ha),% cows in

production, density cows (cows / ha) 31.00; 16.20 and 30.68%.

Table 6 shows the aid indexes for the interpretation of the first factorial axes, the contributions to inertia along the first axis of the set of modalities points, we see that the degree of generality of the first axis is sufficiently broad; 9 modalities of the 24 active modalities that represent 37.5% of the total, present a good contribution to inertia (higher than the average contribution of $(1/24) 100\% = 4.17\%$). Along the second axis, the degree of generality of the first axis is sufficiently broad; 7 modalities of the 24 active modalities that represent 29.17% of the total, present a good contribution to inertia. Along the third axis, the degree of generality is sufficiently broad; 5 modalities of the 24 active modalities that represent 20.83% of the total, present a good contribution to inertia.

The classification analysis of the livestock properties reported their grouping into typologies with the complementary help of crossed tables of the variables and the modalities and allowed associating each group or the class of the modality that defines it with greater weight and its predominant features or characteristics. (table 6). Class 1 (57.9% of the farms) was defined as double-purpose intermediate livestock properties, with milk production per animal (1.5 to 5), intermediate animal health management, feeding based on the extensive system with mineral supplements, management of the cow in production (0.13 to 0.49), deficient milking management and intermediate administrative technical management. Class 2 (2.6%) was related to livestock properties, with a milk production per animal of 5 to 6.1 lt / cow / d. Finally, Class 3 (39.5%) was made up of these properties with a traditional level of technical management, with milk production per animal of 6.1 or more lt / cow / d, food resources clearly grazing, management of good animal health and intermediate milking management.

Discussion

The milk production per physical unit is variable and low (2.46 kg / ha) and the density of cows per physical unit was also very low (0.38 cows / ha). The animal yield was 2.42 lt / cow / day, characteristic of cattle herds made up of cows that are milked once a day and that suckle their young. Reproductive efficiency, considering the percentage of milking cows, showed a low behavior (42.67%), with little variation (47.85%), which could be related to poor management of aspects that influence reproduction, such as food, health management. In reference to the farmer, the 57.89% resulted from an age between 29 - 52.5 years, the rest (42.11%) with ages greater than 52.5 years. It is worth highlighting the participation and permanence of the children in the conduction of the cattle properties, as well as the one of the woman, devoting this almost in general form to the domestic tasks.

Regarding the level of education, 52.6% have basic or primary education. These aspects can be highlighted as qualities or strengths to be properly exploited, through a training program and contribute to the process of collective improvement in the administrative technical management of these properties. In the use of labor, it was found that in a large part of the livestock properties family personnel

predominates in 52.6%. The basic infrastructure of production turned out to be composed of corrals and facilities in 52.6% of the cases cataloged as insufficient in quality and quantity, and the related equipment, such as agricultural machinery and accessories for the tillage and maintenance of paddocks showed to be deficient in 86.8% of these properties.

In the genetic component of the herd, the predominant characteristic was the use of breeders with a predominance of Brown Swiss genes (73.7%), under the natural mating system (60.5%). However, there are other properties where the program of artificial insemination (26.3%) has been introduced with good results, related to the intentionality is to produce calves with favorable characteristics for the market of milk and meat, to obtain greater economic benefits. This productive scheme is an adaptation of the farmer to the instability of the market in relation to the prices of milk and meat.

The milking management was basically manual (97.4%), with support of the calf once a day in 94.7% of the cases. It was observed in the property, which responded to a particular condition by its proximity to the collection centers with mechanized milking.

In most cases, the existence of poor hygienic handling of milking was observed (73.7%), both in the personnel that dedicates to the milking and to the handling of the animals, being this a dominant characteristic for these dedicated properties to this farm with traditional (28.9%) and intermediate (68.4%) characteristics, which significantly influences the quality of the product. Calf rearing methods were characterized by the use of suckling for the support and allocation of 1 or more quarters of the udder, according to age and size of the calf. However, various modalities of milk allocation to the calf were observed, ranging from restricted breastfeeding.

This situation has been reported in other areas of the country and obeys criteria of economic rationality of the farmer, who seeks more milk production for sale and less for the calf all these results to those reported in other locations in Latin America, such as Páez, et al. (2003), Ureña et al. (1997), Alvarado (2002), Paredes, et al. (2003), Murcia, & Martínez, G. (2013), Valdovinos, Espinoza, & Vélez (2015), Cuevas et al. (2013), and Vargas, et al. (2014).

Conclusions

The fundamental factors that synthesize the structural and functional characteristics of these livestock properties dedicated to the exploitation of dual purpose cattle in the Molinopampa district are: Factor I. Pasture management and animal health. Factor II. Technology and livestock management. Factor III. Milk and meat production.

The profile of the cattle properties with dual-purpose cattle in the District of Molinopampa, according to the structural characteristics, are predominantly grazing, with mineral supplementation, with daily manual milking and poor management, records are kept periodically, have an infrastructure insufficient and their level of equipment is poor. According to the functional characteristics, they have a production of <0.5 to 2,265] lt / ha, a management in

animal health from intermediate to good, but a poor milking management, with intermediate administrative technical management, with reproductive management that goes from 16 50% of cows in production, their food resources are pastoral with mineral supplementation, with management of the cow in production or division of the ha of herd, 13 to 0.49 The typology of double-purpose livestock properties in the district of Molinopampa, based on its structural and functional characteristics, is grouped into 3 classes or clusters: Class 1. Integrated by livestock properties dedicated to intermediate management in animal health, management and production of cattle herd. Class 2. Integrated by livestock properties dedicated only the quality of the milk (lt / cow / d). Class 3. Integrated by livestock properties dedicated to the management of pastures and milk (lt / cow / d).

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TABLES

Table 1. Structural and productive indicators of farms with dual purpose cattle

Variable	Minimum	Maximum	Media	Desv. típ.	CV%
Surface (ha)	5	70	30,08	17,848	59,34
Cattle area (ha)	5	60	25,55	15,993	62,59
Milk productivity (L / ha)	0,50	9	2,46	1,968	80,0
Animal performance (L / cow / day)	1	4	2,42	1,222	50,48
Total number of cows	5	50	23,00	12,992	56,23
Number of milking cows	3	15	8,00	3,204	38,65
Density cows - Cows / ha	0,13	1,20	0,38	0,28	73,91
% of cows in production	16	100	42,67	20,417	47,85
Production of the farm (L / day)	8	101	55,99	26,927	48,10

Table 2. Predominant aspects in farms with dual purpose cattle

Variable	Description	Frequency (%)
System orientation	Pastoral and mineral supplementation	92,1
Farmer's age	29.0 - 52.5 years	57,9
Degree of instruction	Primary	52,6
Experience	> 20years	34,2
Workforce	Relatives	52,6
Infrastructure for production	Insufficient	52,6
Equipment level	Deficient	86,8
Use of supplementation	Energy-protein supplementation	7,9
Health management	Intermediate	52,6
Milking per day	1	94,7
Records	If they carry	86,8
Division of the herd	4 or more	57,9
Breed of the bull	Brown Swiss	73,7
Milking management	Deficient	73,7
Milking type	Manual	97,4
Type of reproduction	Natural	60,5

Table 3. Discriminant functional variables and their technological modalities

Variable	Modality	Livestock property	%	Definition
Hectare production (L / ha)	PH2	6	16	<2,625 - 4,750]
	PH3	2	5	<4,750 - 6,875]
	PH4	3	8	<6.875 - 9,000]
Herd quality (L / cow / d)	PV1	11	29	[1,5 - 3,0>
	PV2	12	32	[3,0 - 5,0>
	PV3	3	8	[5,0 - 6,1>
	PV4	12	32	[6,1 or more>
Health management	SA1	0	0	Deficient
	SA2	20	53	Intermediate
	SA3	18	47	Good
Milking management	MO1	28	74	Deficient
	MO2	10	26	Intermediate
Technical and administrative management	GE1	11	29	Traditional
	GE2	26	68	Intermediate
	GE3	1	3	Improved
Reproductive management (% cows in production)	PP1	29	76	<16 - 50]
	PP2	6	16	<50 - 75]
	PP3	3	8	<75 or more
Food resources	AL1	13	34	Pastoral
	AL2	0	0	Mineral supplementation
	AL3	0	58	Supplementation energy-protein
	AL4	22	8	Pastoral and Supplementation mineral
	AL5	3	8	Pastoral, Supplementation, energy-protein
Management of the cow in production (Cows / Ha)	AL6	0	0	Pastoral, Supplementation energy- protein-mineral
	DV1	30	80	<0,13- 0,49]
	DV2	4	10	<0,49- 0,84]
	DV3	4	10	<0,84- 1,20]

Table 4. Variance explained by the main factors

Factor	Own value	Inertia (%)	% accumulated	Adjusted inertia	Adjusted inertia (%)	% accumulated
F1	0,495	24,763	24,763	0,179	57,933	57,933
F2	0,309	15,426	40,189	0,044	14,233	72,166
F3	0,264	13,193	53,382	0,025	8,148	80,314
F4	0,188	9,417	62,799	0,005	1,695	82,010
F5	0,169	8,477	71,246	0,003	0,816	82,826
F6	0,125	6,237	77,483			
F7	0,108	5,407	82,890			
F8	0,083	4,159	87,049			
F9	0,067	3,361	90,411			
F10	0,061	3,036	93,446			
F11	0,041	2,047	95,493			
F12	0,036	1,795	97,288			
F13	0,025	1,253	98,542			
F14	0,017	0,863	99,405			
F15	0,007	0,341	99,746			
F16	0,005	0,254	100,000			

Table 5. Contribution of the selected variables to the definition of the main factors

Variable	Factor 1 (%)	Factor 2 (%)	Factor 3 (%)
Hectare production (L / Ha)	10,57	11,77	31,00
Herd quality (L / cow / d)	20,20	25,44	12,41
Health management	17,89	2,65	0,18
Milking management	8,67	12,13	1,39
Technical and administrative management	10,11	21,19	3,77
% cows in production	1,10	2,33	16,20
Food resources	17,83	13,92	4,37
Cow density (Cows / Ha)	13,62	10,56	30,68

Table 6. Contributions of the modalities to the factorial axes

Variables	Peso	Peso %	F1	F2	F3
Production hectare (L / ha) <2,625 - 4,750]	6	0,020	0,006	0,043	0,009
Production hectare (L / ha) <0,500 - 2,625]	27	0,089	0,009	0,023	0,010
Production hectare (L / ha) <4,750 - 6,875]	2	0,007	0,029	0,052	0,106
Production hectare (L / ha) <6,875 - 9,000]	3	0,010	0,062	0,001	0,185
Herd quality (L / cow / d) [1,5 - 3,0>	11	0,036	0,043	0,018	0,083
Herd quality (L / cow / d) [3,0 - 5,0>	12	0,039	0,033	0,006	0,015
Herd quality (L / cow / d) [5,0 - 6,1>	3	0,010	0,003	0,202	0,020
Herd quality (L / cow / d) [6,1 or more>	12	0,039	0,124	0,029	0,007
Health Management-Good	18	0,059	0,094	0,014	0,001
Health Management-Intermediate	20	0,066	0,085	0,013	0,001
Milking management-Deficient	28	0,092	0,023	0,032	0,004
Milking-Intermediate handling	10	0,033	0,064	0,089	0,010
Technical and administrative management-Intermediate	26	0,086	0,031	0,000	0,008
Technical and administrative management-Improved	1	0,003	0,001	0,091	0,021
Technical and administrative management-Traditional	11	0,036	0,069	0,021	0,009
Reproductive management (% cows in production) <16 - 50]	29	0,095	0,002	0,001	0,037
Reproductive management (% cows in production) <50 - 75]	6	0,020	0,000	0,000	0,106
Reproductive management (% cows in production) <75 or more]	3	0,010	0,009	0,021	0,019
Food resources-Pastoril	13	0,043	0,117	0,003	0,002
Food Resources-Pastoril and Mineral Supplementation	22	0,072	0,058	0,008	0,002
Food resources-Pastoril, Supplementation, energy-protein	3	0,010	0,003	0,128	0,040
Management of the cow in production (Cows / ha) <0.13 - 0.49]	30	0,099	0,028	0,009	0,001
Management of the cow in production (Cows / ha) <0.49 - 0.84]	4	0,013	0,036	0,094	0,116
Management of the cow in production (Cows / ha) <0.84 - 1.20]	4	0,013	0,072	0,002	0,189