INTERNATIONAL JOURNAL OF PLANT, ANIMAL AND ENVIRONMENTAL SCIENCES
IJPAES

Volume-3, Issue-2, April-June-2013
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ISSN 2231-4490
Coden : IJPAES www.ijpaes.com

Received: 30th Mar-2013 *Revised: 4th April-2013* *Accepted: 6th April 2013*

Research article

DIAGNOSTICS OF STRUCTURE AND FUNCTIONING OF CATTLE FARMS AND ANALYSES OF FOOD SYSTEMS AND MANAGEMENT IN ALGERIAN HIGH PLAIN REGION

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ABSTRACT : A questionnaire-based survey was conducted among a purposive sample of 165 cattle farmers in the Semi arid region of Algerian Eastern High plains, all of whom owned three or more head of cattle. Results showed diversity in the cattle production orientation or breeders surveyed prefer majority (more than 80% of cases) mixed systems (dairy beef). Farms specialized in dairy production and beef cattle record relatively low, 15% and 5% respectively. Analysis of land ownership shows that agro-pastoralists are generally owner of land and only specialized farms are resorting to leasing land whose 50% of them exploit only leased land. Non-linear canonical analysis shows a several association between cattle farming system, herd size, commercialization policies and fodder availability and management. In fact, specialized and oriented dairy farms hold small herds' cows dominance led on grass and monoculture or without forage. Mixed farms exploit more effective of cattle always associated with small ruminants. The fodder system is based on diversity of several species of fodder leads to dry and irrigated system with generally proper grassland. Indeed, beef system characterizes large herds without fodder crop and without meadow. However, place of livestock mainly cattle in conduct and marketing strategies varies depending on livestock-crop integration level and the diversity of incomes comes from various speculations.

Keywords: Cattle farming system, crop-livestock integration, Fodder management, commercialization policies, semi arid area.

INTRODUCTION

The development of livestock production especially dairy cattle has been receiving significant priority as well as research attention in Algeria in the last two to three decades. In the wake of various development programs of milk production begin in 1995 by program of rehabilitation of milk production then National plan of agriculture development in 2000 and agricultural and rural revival program in 2009, agriculture and livestock sector record now a high level of growth [16]. Like in several under development countries [5] the area of maximum livestock concentration in Algeria is its semi-arid region, where difficult climate represent the major constraint. In this constraint environment, the integration of livestock and crops in a flexible mixed system contributes to the sustainability of agriculture activities and viability of livestock farming systems [13,17,19]. Farming diversity is so a crucial aspect of several issues in rural development and land management [8]. In morocco, Srairi et al. [25] reported that more than 80% of farms in irrigated perimeters were smallholders' units adopted crop-livestock mixed system. However, Chandel and Malhotra [5] report that 60% of Indian farms are mixed and less than 20% exploit cattle only. A cattle production system is a complex system comprising biological, economic and social factors [15]. Several models have been published to provide comprehensive descriptions of the biological, characteristics of a herd or other specific components of the systems, such as Land management and forage [8], nutrition [6], reproduction [9], health [18] or genetics [21]. Other models emphasize management strategies [20] or replacement decisions in relation to production and prices [3,9]. This work aims first to be characteristic of cattle and livestock production systems in farms of Algerian East high plains region. Then reveal the underlying connections between farmers tend to specialize in animal production and cattle production system adopted. This work also addresses explicitly to demonstrate possible links between cattle farming system and feed system and management to reach argue zootechnical point of view the technical and economic actions used by farmers in view of replicate to of the local environment peculiarities.

MATERIALS AND METHODS

A total sample of 165 farms was randomly selected for questionnaire interviews in the two departments of Algerian eastern high plains during July 2009 to April 2010. The questionnaire which breeders have responded has more aspects namely, socio-economics of farms', functioning and practices of conduct and food system and management. The information collected was valued by different statistical procedures; our concern was mainly demonstrating any relationship between the variables modality developed after the first data processing. The method CATPCA acronym *Categorical Principal Components analysis* and Two-step classification were performed simultaneously to identify the cattle farming systems via a structure - function typology. Variables introduced in typology are structural describing the composition of cattle herd per farm (number of cows, beef, heifers and calves) and practice - functioning explain selling policies cattle products (marketing of milk and sale of calves). The method OVERALS acronym nonlinear canonical correlation analysis was mobilized thereafter, the target of this approach is to determine graphically how similar categorical variables are related. Two graphical representations have been produced by this method: the first focuses on demonstrating the relation possible between cattle farming system produced by typology and diversification of farming activities. The second is a test to adjust relations possible between cattle management system and fodder practices purely controlled by the status of exploited natural grassland and forage cropping system implementation. These exploratory multivariate analyzes and descriptive univariate analyzes were established using SPSS procedure [24].

RESULTS AND DISCUSSION

Typology of cattle farming system

Typological vision that has been methodically applied in diagnosis systems on the functioning of agricultural farms is an effective analytical tool to schematize and simplify the complex reality [2]. Really, the question of type of cattle production in semi-arid conditions is composed of many elements that form a group difficult to understand. Under the constraints that characterize the local production environment, it is reasonable to equate that agro pastoral farmers moved into the area, shape their strategies of cattle herd conduct in decisions and actions in order to meet the needs purely economic but also technical. Analysis of regional livestock systems showed a diversity in the cattle production orientation, something largely responded in difficult environments [4,12]. This determines the decisional selection for a farm management ie techniques of conduct and processes transaction products [26]. Five types of cattle farming system (Figure 1) have been identified, three are mixed systems (dairy, beef) and two are specialized systems dairy or beef. Breeders surveyed prefer majority (more than 80% of cases) mixed systems (dairy beef) that are either balanced adopted by less than 5% of farms, either more oriented towards milk production (20%) or to fattening beef (56%). Farms specialized in dairy production and beef cattle record relatively low, 15% and 5% respectively. Exploring of cattle herd structure for each system reveals the tendency of farms adopting dairy mixed systems to exploit more dairy cows in average (10 cows / farm).

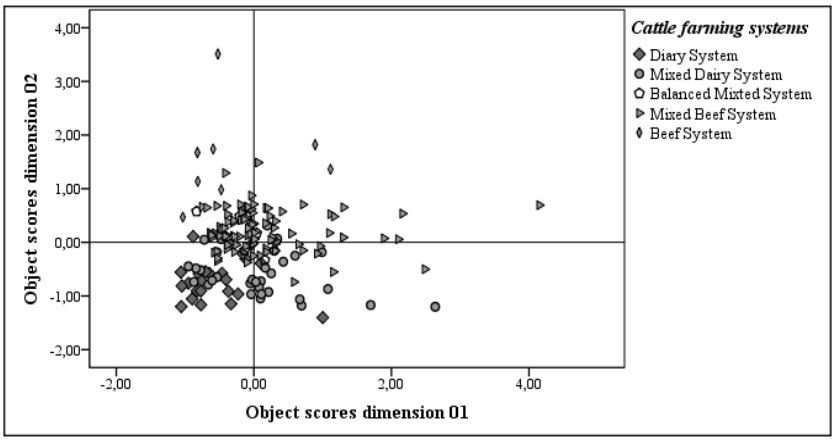

Fig 1. Cattle farming system established by CATPCA and Tow step classification

Land availability and management

The analysis of land ownership shows that agro-pastoralists in the region have on average 24±33ha. The high standard deviation expressed a wide variety of land ranging from 0ha (without land) to over to 200ha (large farms). However, 25% of the farmers are resorting to leasing land and 50% of them only operate leased land. Figure 2 summarizes the use of land in cattle farming systems identified. In fact, own large farms generally adopt balanced mixed farming systems (Table 1). Diversity of income is not conducive to the development of a particular speculation. However, the mixed systems oriented to milk or beef production are mainly medium-sized farms own. The part of rented land is less than 20%. However, the land lease is a policy adopted mainly by specialized systems of milk and beef. In fact, are systems including young investors in the agriculture development plans generally without land or other wanting to increase their capitals.

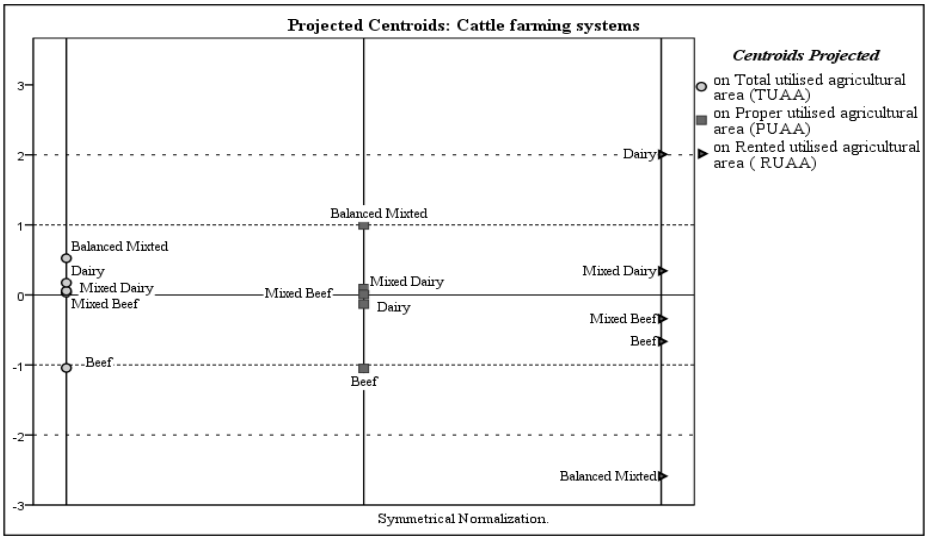

Fig 2. Cattle farming systems Centroids projected by status of agricultural used land

Table 1. Agricultural used land in different cattle farming system

Cattle farming system	TUAA		PUAA			RUAA		
	Mean	***SD***	***Mean***	***SD***	***% TUAA***	***Mean***	***SD***	***%TUAA***
Balanced mixed system	41.5	71.9	40.9	72.3	98.6%	0.6	1.5	1.4%
Beef mixed system	23.9	33.2	19.2	29.6	80.1%	4.7	13.6	19.8%
Dairy mixed system	23.6	29.9	19.9	28.7	84.2%	3.7	9.7	15.8%
Dairy system	24.7	23.9	18.2	23.1	73.9%	6.5	15.3	26.2%
Beef system	11.9	9.9	4.7	4.4	39.4%	7.2	10.6	60.6%
Total	**24.1**	**33.0**	**19.4**	**30.8**	**80.5%**	**4.7**	**1.0**	**19.7%**

***TUAA** : Total used agricultural area ; **PUAA** : Proper used agricultural area ; **RUAA**: Rented used Agricultural area*

Place of cattle in farming system

Characteristics of cattle farming

Data on the structure of the cattle herds are summarized in Table 2. Analysis of the results shows that large herds usually owned by farms adopting a beef system or mixed-oriented system. However, dairy or mixed dairy systems have more dairy cows and replacement heifers (> 72%) but less than beef and calves (<30%). In addition, balanced mixed or beef mixed system record numbers relatively similar between cows and beef (50%). Nevertheless, beef systems exploit more beef (63%) than cows (38%).

On the sales strategies of livestock products, we see a divergence of practice between production systems (Table 3). In fact, 100% of dairy farmers sell all calves born on the farm before weaning and 85% of them sell all the milk produced on the farm. However, mixed dairy farmers delay the sale of calves after their weaning (61%) or sell them according liquidity requirements. This strategy of fattening at least one beef per year favored by the presence of food possibility provides a constant and support source of income. The sale of milk is partial in 36% and total in 64% of farmers confirming the mixed type production. Nevertheless, more than 70% of farmers in balanced mixed systems or oriented beef sell their beef on lean or after fattening at a late age and 60% of these farmers sell a part of the milk produced on the farm. These farms were considering milk as a secondary product compared to beef which 2 or 3 are still present on the farm. Finally, beef breeders use all the milk produced for nursing calves and family consumption but never sold. Calves born on the farm and / or bought from outside undergo conformational selection after weaning and higher are kept, fattened and sold at a later age.

Table 02. Structure of cattle herd in divers' cattle farming system

Cattle farming system	LU Cattle	Cows	Heifers	%CH	Beef	Calf	%BC
Balanced mixed system	10 ±04	06 ±03	02±01	57%	02±01	04±01	43%
Beef mixed System	13 ±09	07 ±05	02±03	56%	03±03	04±03	44%
Dairy mixed system	14 ±10	10±08	03±03	72%	01±01	04±02	28%
Dairy System	09 ±07	07±06	02±02	75%	01±01	02±02	25%
Beef System	18 ±23	06±06	00 ±00	38%	06±14	04±05	63%

LU : *Livestock unit;* ***%CH*** *: part of Cows and Heifers in Cattle herd;* ***%BC****: part of Beef and Calves in Cattle herd*

Table 3. Practice of cattle product trade

Cattle farming system	Age of calf sale				Milk soled		
	Pre weaning	After weaning	Old age	As needed	Total	Part of	Never
Balanced mixed system	00.0%	00.0%	71.4%	28.6%	42.8%	57.1%	00 %
Beef mixed System	00.0%	00.0%	100.0%	00.0%	41.6%	58.2%	00 %
Dairy mixed system	00.0%	60.6%	00 %	39.4%	63.5%	36.4%	00 %
Dairy System	100 %	00 %	00 %	00 %	85.0%	15.0%	00 %
Beef System	00.0%	14.3%	71.4%	14.3%	00%	00 %	100%
Total	**12.5%**	**13.5%**	**64.4%**	**10.0%**	**45.4%**	**49.7%**	**4.9%**

Place of livestock in farming system

Livestock farming in the study region is always associated with cereal crops and rarely alone (Table 4). The nonlinear canonical correlation analysis reveals several crop-livestock associations according to the system adopted (Figure 3). Indeed, the association Livestock poly-culture characterizes farms adopted balanced mixed system (60% of cases), against the cereal dominates a dairy and mixed oriented systems (50%). However, livestock only is widely practiced by suckling systems (63%). Indeed, the potential benefits of crop-livestock integration are borne out only if effective coordination between livestock and crop, with use of production of speculation as inputs for another [10,7]. This association is defined by Seré et al. [23] as a" Livestock system in which at least 10% of the total production came from activities other than livestock and at least 10% of co-products of crops were used for animal feed". This is actually the system adopted by most farms both in temperate countries [22] and tropical and subtropical countries [11,7]. A scale of animal production, we observe that specialized or dairy mixed systems exploit more cattle alone (60% of cases) or associated with small ruminants (20%) or poultry (16%). Theses were more or less specialized farms saw its small areas. A cattle are conducted on own grassland, and benefice of a small mono-crops fodder area. However, the balanced mixed system combines cattle to small ruminants (71%) or more species (29%) but never exploit alone. This is favored by foraging opportunities offered by high available agricultural land. However, in the beef mixed system, Cattle is used alone (43%) or associated with small ruminants (42%) in an agro-pastoral system where cereal residues (stubble, fallow and straw) are a principal source of herds feeding.

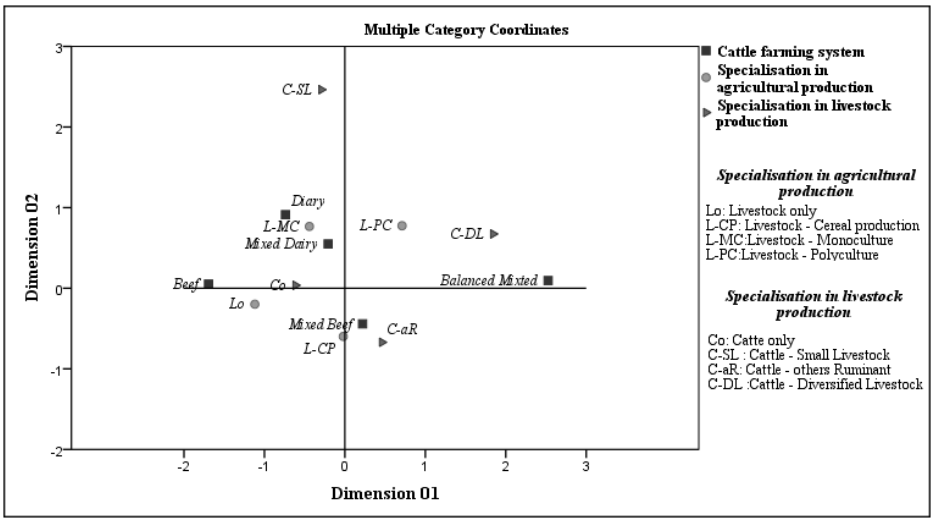

Fig 3. Correlation between Cattle farming system, agricultural activities and livestock

Table 4. Description of Farming system components

Cattle farming system	Farming System			Livestock Farming System			
	LO	**L-C**	**L-Pc**	**CO**	**C-SR**	**C-P**	**C-DB**
Balanced mixed system	00%	42.9%	57.1%	00%	71.4%	0.0%	28.6%
Beef mixed System	16.5%	51.6%	31.9%	43.0%	41.9%	5.4%	9.7%
Dairy mixed system	25.0%	40.6%	34.4%	63.6%	24.2%	3.0%	9.1%
Dairy System	25.0%	45.8%	29.2%	62.5%	20.8%	16.7%	0.0%
Beef System	62.5%	25.0%	12.5%	62.5%	25.0%	12.5%	0.0%
Total	**20.6%**	**46.7%**	**32.1%**	**46.7%**	**35.7%**	**6.7%**	**8.5%**

***LO** : Livestock only ; **L-C** : Livestock cereal ; **L-Pc** : Livestock poly-culture ; **CO** : Cattle only ; **C-SR** : Cattle small ruminant ; **C-P** : Cattle poultry ; **C-DB** : Cattle divers breed.*

Food resource and management in different cattle farming systems

Availability of feed is the most important factor in livestock production. Without optimum feeding, the animals do not produce up to their production potential and are vulnerable to various diseases [1,14]. Indeed, fodder crops diversity, availability of grazing areas and the possibility of fodder storage oriented Livestock production systems and characterize the choice of animal species and speculation. However, the nonlinear canonical correlation (Figure 4) shows associations between fodder crops system and status of the meadow. Indeed, farms with grassland surfaces were oriented to mono-crops fodder especially oats without irrigation. Were generally mixed dairy farmers where the meadow present in 30% of them (> 1 ha on average) is used as a seasonal or annual pasture (Table 5) and oats cultivate by 60% of them (2.5 H average) is used to constitute a stock of fodder for late season (Table 6).

However, those without natural grassland (Absent in more than 60% Table 5) diversify their fodder crops depending on the season. In addition to annual fodder crops cultivate in more than 70% of farmers (oats alone or associated, Table 6), they benefit from irrigation to ensure food green during the summer and autumn by the use of low area of corn, sorghum and alfalfa. This group of farmers conducts their herds in balanced or beef mixed system. However, most specialized systems are without fodder crops and proper grassland area (> 60% of cases, Table 5). However, farmers in dairy system are oriented to rental meadows of 1.5ha in average from neighbors' farmers to ensure during the spring grazing space. Thus, feed autonomy is and purchase of fodder is always reported.

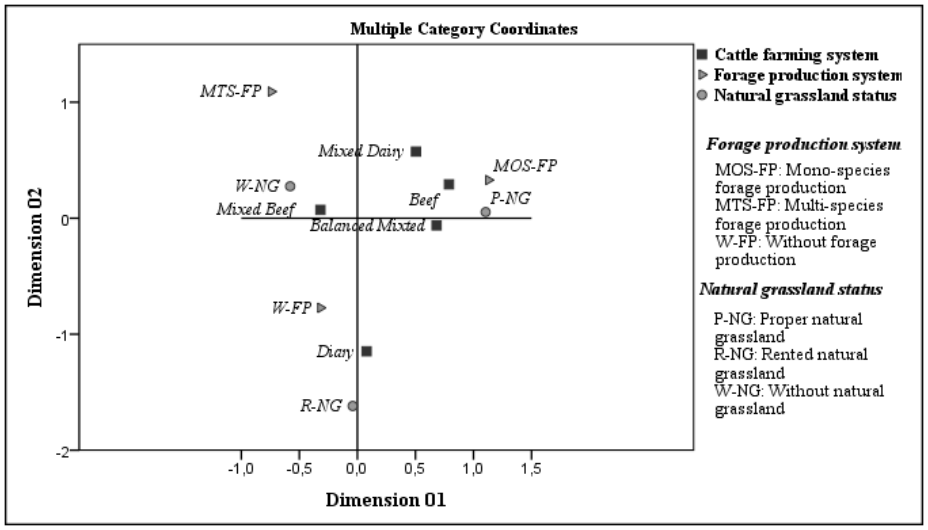

Fig 4. Correlation between fodder availability and management and cattle farming systems

Table 5. Feed availability and management in different cattle farming systems

Cattle farming system	Fodder crop system			Meadow Statut		
	WtFC	MFC	SFC	PM	RM	WtM
Balanced mixed system	42.9%	28.6%	28.6%	42.9%	14.3%	42.9%
Beef mixed System	48.4%	28.0%	23.7%	28.0%	9.7%	62.4%
Dairy mixed system	36.4%	36.4%	27.3%	33.3%	15.2%	51.5%
Dairy System	58.3%	25.0%	16.7%	33.3%	12.5%	54.2%
Beef System	50.0%	37.5%	12.5%	37.5%	0.0%	62.5%
Total	47.2%	29.7%	23.0%	30.9%	10.9%	58.2%

WtFC : *Without Fodder Crop* ***; MFC :*** *Mono Fodder Crop* ***; SFC :*** *Several Fodder Crop* ***; PM :*** *Proper Meadow* ***; RM :*** *Rented Meadow* ***; WtM :*** *Without Meadow*

Table 6. Availability of fodder area in different cattle farming system

Cattle farming system	PFA	CFA	GA	PFA/LU	PFA/Cow
Balanced mixed system	3.6±3.1	2.0 ±2.6	1.6 ±1.8	0.3 ±0.2	0.5 ±0.4
Beef mixed System	3.4 ±4.8	2.5 ±4.3	0.9 ±1.6	0.3 ±0.6	0.5±0.7
Dairy mixed system	3.5 ±5.8	2.5 ±4.6	1.0 ±1.9	0.2 ±0.2	0.3±0.3
Dairy System	3.7 ±4.9	2.2 ±4.7	1.5 ±2.4	0.5 ±0.8	0.6±1.1
Beef System	1.4 ±1.4	0.9 ±1.5	0.4 ±0.7	0.1 ±0.1	0.6±1.2

PFA : *Principal Fodder area ;* ***CFA*** *: Crop Fodder area ;* ***GA*** *: Grass area ;* ***LU*** *: Livestock unit*

CONCLUSION

Results of this study show that mixed crop-livestock production system was the dominant farming system in the study area. Livestock especially cattle serves as a source of food and source of income who provide a cash and assure a financial security of many farmers. However, the extreme heterogeneity of the choice of management and marketing practices should encourage public authorities, livestock professional organizations and feed firm taken in consideration for this variability for the establishment of agricultural development programs adapted to a multiple needs of farmers.

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