

CHARACTERISTICS AND TYPOLOGY OF DAIRY CATTLE FARMING SYSTEMS IN WEST REGION OF ALGERIA

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Abstract

The aim of this study was to show the characteristics and to carry out a typology to define the different types of dairy cattle breeding in the state of Relizane, through an analysis of multiple correspondences, followed by an ascending hierarchical classification. The study was carried out in 73 dairy farms with 2,454 cattle including 1,432 dairy cows. The results show that 16% of farmers have not owned agricultural land, and that the utilized agricultural area of the surveyed farms is small on average to 7.47 ha, with an average fodder agricultural area of 3.9 ha which influences negatively on the feed self-sufficiency of farms and plays a preponderant role in poor feed management. The use of corn silage is practiced on 18% of farms. Breeders have an average cattle herd of 33.6 heads, 58.3% of which is represented by dairy cows. The racial composition of the cows is dominated by the imported breeds mainly the Holstein and the Montbéliarde with 57% and 34% respectively. The average number of human work units is 2.21 HWU/farm and in 47% of the farms the staff is exclusively family. The typology revealed six types of farms; these farms are mainly differentiated by the full agricultural area, the utilized agricultural area, the Forage area, the irrigated agricultural area, and by the cattle and dairy cow's population.

Key words: dairy farm, survey, system, typology

INTRODUCTION

Algeria has a herd size of 911,401 dairy cows, of which imported cows represent more than 30% [18]. According to the study by [1], National dairy production remains unable to meet market demand for milk, and that local production of raw milk only covers around 40% of demand. The public authorities are applying a policy favoring the establishment of dairy farms by the importation of heifers with high genetic potential. The goal is to increase production and thereby reduce the import bill [2]. In parallel, and in order to cover the growing milk needs, Algeria imports more than 60% of its consumption of milk powder, knowing that the average consumption of milk is 120 l /citizen /year [12]. Considerable amounts are allocated for the import of dairy products in 2017, the Algerian government imported 465,000 tons of dairy products made up of more than 90% milk powder for a value of 1.41 billion USD

[5], and this places Algeria as the second importer of milk after China [15].

Many tries on the part of the government to achieve self-sufficiency in milk production, by some plans, contrary to what was expected it could not make the projected results. This is mainly linked to a deficiency of knowledge of the general milk production system and farm conditions, particularly by the absence of data proportional to their structures and their operations. However, perfect knowledge of the conditions of the farms is necessary to achieve progress in improving the dairy sector in Algeria. The factors that influence the reproducibility and productivity of cattle herds depend on the characteristics of the cows, as well as on herd management practices [11, 14].

In this context, the purpose of the paper is to provide knowledge on dairy cattle farming in the study region. To characterize the functioning of farms and the diversity of farming systems practiced, By creating a

typology that will allow to distinguish the types of dairy cattle farms in the West region and to analyze the constraints which limit their productivity and thus to contribute for the development of the dairy sector.

MATERIALS AND METHODS

Study area presentation

The state of Relizane is surrounded by mountain ranges and is divided into three regions: To the north: the Dahra mountains; to the south, the Ouencheris mountains extending from east to west south of Relizane, the valleys of Mina and lower Chéiff occupy the central part of the state. All of these areas are covered with vegetation and different kinds of trees.

The full agricultural area of Relizane state is estimated at 285,473 ha, 99% of which is represented by the utilized agricultural area. The irrigated agricultural area is 17,632 ha, and The forage area is very small 22,503 ha by comparing it to that of cereal cultivation which is 149,409 ha, the different cultivated forages are vetch-oats, corn, sorghum, clover, alfalfa, barley, rye in green and forage oats [8]. The state of Relizane has 38,578 heads of cattle of which 58% is composed of dairy cows; it has 10,127 dairy cows of imported breeds mainly composed of the Holstein and Montbéliarde breed, 12,117 improved dairy cows and local dairy cattle type. The state of Relizane recorded a total milk production during the 2017/2018 campaign of 70,582,000 liters [8].

A survey was carried out from February to August of 2019 in dairy cattle farms in Relizane state. The total sample of our study consists of 73 farms, chosen randomly while respecting certain criteria:

- a) The focal vocation of the farms is the breeding of dairy cattle.
- b) Breeders with a breeding license.
- c) Availability and cooperation of the breeder.
- d) The choice is also based on the concern for a wide diversity in terms of herd size.

The farms were subjected to a questionnaire, which contains general management of farm and these variables (FAA: Full agricultural area, UAA: utilized agricultural area, FA:

Forage area, CP: Cattle population, DCP: Dairy cow population, DPA: Dairy production average per cow, NB Number of buildings).

Statistical analysis

All the data collected were organized and calculated in Excel software (2016). The data processing was carried out by a multiple correspondence analysis (ACM) using SPAD version 5.5 software, carried out on all the variables, which refer to the different questions of our survey. The ACM is followed by an Ascending Hierarchical Classification (CAH), which allows individuals to be grouped into different homogeneous classes based on the modalities. Out of 31 qualitative indicator variables (both structural and functional), twelve active variables made it possible to carry out a factorial analysis of multiple correspondences. Namely full agricultural area (FAA), utilized agricultural area (UAA), Forage area (FA), the irrigated agricultural area (IAA), cattle population (CP) and dairy cows population (DCP), the practice of grazing, training in the field of cattle breeding, the type of building, type of housing, human work unit (HWU). The main factorial axes are kept for the hierarchical classification, the result of which is in the form of a dendrogram.

RESULTS AND DISCUSSIONS

General organization of farms

The age of farmers varies from 22 to 76 years with an average of 45 years, we found that 57% of farmers are under 45 years, and that in 43% of farms the age of farmers is higher at 45 years (Fig. 1).

About Level of education of breeders, it was noted that 14% of them are illiterate, while 81% have a level between primary and secondary education, and only 5% of them have a university degree (Fig. 2).

The majority of breeders (74%) have as their main activity the breeding of dairy cattle against 21% who are farmers and we observe that only 4% are traders and 1% veterinary practitioners.

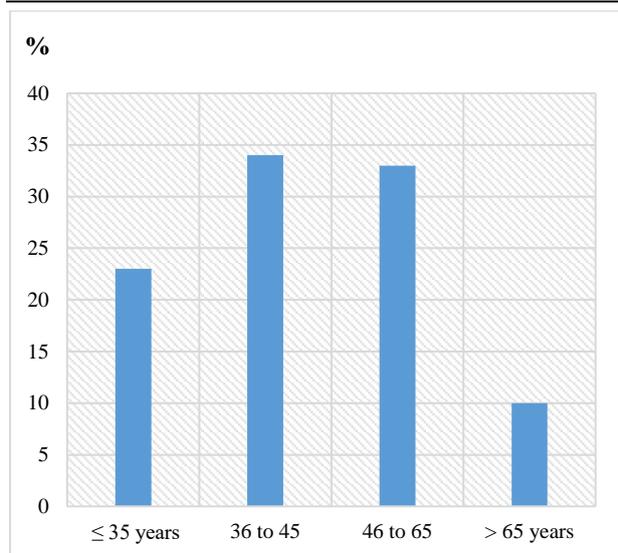


Fig. 1. Distribution of breeders by age
 Source: own calculation.

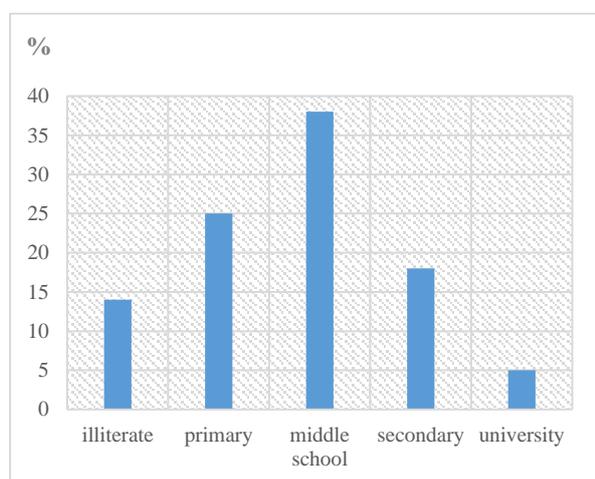


Fig. 2. Distribution of farmers according to their level of education
 Source: own calculation.

We note that in 26 farms, the farmers work themselves while in 47 farms several people take care of the cattle, on average 2.21 ± 1.6 workers per farm. On farms that use labor, 47% of these farms have exclusively family staff, while in 36% of farms it are made up of employees. Only 17% of the farms have both family and paid staff.

Most breeders (78%) have no initial training in dairy farming. Only 22% have received training, including 12.5% in feeding management and 87.5% in feeding and zootechnics. Only one person has additional training in artificial insemination.

Generally, the breeders have a service provider with the veterinarian consisting of the provision of a service against payment,

and have recourse to him only in case of pathology, which they cannot treat themselves. This is why there are only 12% of farms that have a partnership service (arrangement with a veterinary practice), against 88% as a service provider.

In (82%) that is the majority of farms, the age of sale of calves for fattening is between one and two years, 11% are sold at an age less than 1 year, and in 7% of farms, the sale is greater than 2 years. The breeders who have another animal species in addition to cattle breeding are 38%, on these farms in most cases 96%; the farmers aggregate a sheep farming and 4% practice poultry farming.

Heifer farming is one of the essential points but is often overlooked by breeders. Heifers are also the future of the herd; they are bred for the renewal and extension of the herd. Pre-herd management is practiced in 84% of farms; breeders keep heifers for the renewal and extension of their herd.

Characteristic of farms

Farmers breed many imported breeds, with two dominant cattle's breeds, which are Holstein and Montbéliarde (Table 1). There is a mixture of races in most of the time. Twenty six percent of farms have exclusively Holsteins and in 12% of farms, there are only Montbéliarde and in 42% of farms, these two cattle's breeds are mixed.

Table 1. Classification of the different breeds in the surveyed farms

Bovines breeds	Population	%
Holstein	812	57
Montbéliarde	490	34
Pie rouge	114	8
Fleckvieh	15	1
Local	1	0
Total	1,432	100

Source: own calculation.

The size of the dairy herds on the surveyed farms varies from two to 315 heads of cattle's with an average of 33.6 heads per farm. The number of cows per farm averages 19.6 heads (Table 2). The percentage of dairy cows in relation to the cattle population on the farms

varies from 22% to 100% with an average of 60% of the size.

Table 2. Characteristics of farms in the study region

	MIN	Mean	SD	MAX
CP(heads)	2	33.6	47.5	315
DCP(heads)	2	19.6	30.15	220
DCP/CP (%)	22	60	17	100
FAA(ha)	0	7.8	13.1	100
UAA(ha)	0	7.47	11.5	85
FA(ha)	0	3.9	3.92	18
IAA(ha)	0	1.43	3.04	17
DA(ha)	0	6.04	11.1	85
FA/FAA (%)	0	63	43	100
FA/UAA (%)	0	64	43	100
IAA/UAA (%)	0	17	34	100
DA/UAA (%)	0	68	44	100

CP: cattle population. DCP: dairy cow population. FAA: full agricultural area. UAA: utilized agricultural area. FA: Forage area. IAA: the irrigated agricultural area. DA: dryland area
 Source: own calculation.

The utilized agricultural area of the surveyed farms varies from zero to 85 ha with an average of 7.47 ha. About 16% of breeders do not have own agricultural land, while 58% have FAA less than 10 ha and only 26% have land with an area greater than 10 ha. The Forage area varies from zero to 18 ha with an average of 3.9 ha, and with an average percentage in the FAA and the UAA of 63% and 64% respectively. Only 26% of the surveyed farms irrigate their land, in fact 17% of the UAAs are managed as “irrigated”, the average being 1.43 ha. The animals are taken to all of the farms, in free stall system; the number of cattle premises varies from one to six buildings with an average of 1.57 ± 0.86 . It should be noted that 58% of farms have only one building. The buildings are of three types: open, semi-open and closed.

In most of the surveyed farms, there is not really a rationing system for cattle; the cows are not fed a ration according to their needs. Only 4% of breeders distribute a total mixed ration. The essential forages distributed on farms are oat hay, straw, corn silage and green alfalfa. The fodder being mainly of mixed origin (produced in farm and bought from the trade), only 25% of the breeders produce their

own fodder The concentrate given by breeders is mostly bought from the trade; it is distributed to cows daily with an average of $11.3 \pm 2\text{kg /cow/ d}$. A minority, 5% of breeders, supplement the ration distributed with licking stones, multivitamins and a hepatoprotective drugs

Description of the identified groups

We have limited ourselves to the first two axes, which explain 23.45% of the information that is 12.65% and 10.80% respectively. From the ACM results reported in Figure 3, we can determine that:

The first axis expresses 12.65% of the inertia, and mainly characterizes the structure of the farms, represented by the following methods, the full agricultural area (FAA), the utilized agricultural area (UAA), Forage area (FA) and human work unit (HWU). According to Fig. 3, we can deduce that this axis distinguishes, on one side, the farms with significant potential whatsoever, in agricultural land (utilized and forage), labor, and on the other side, opposes the small farms.

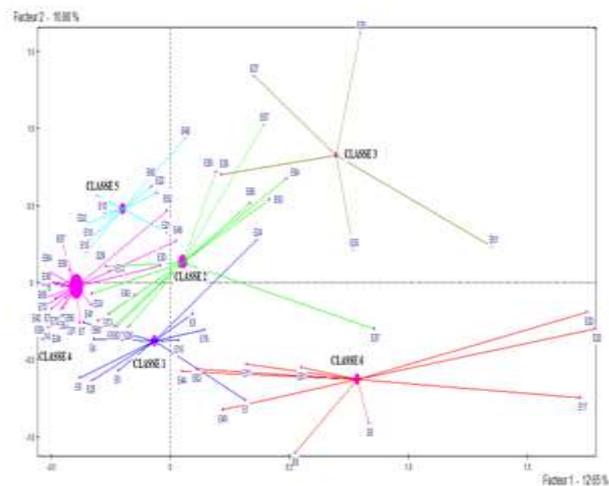


Fig 3. Graphic representation of the six typological groups identified in the state of Relizane
 Source: own calculation.

The second axis explains 10.80% of the inertia and mainly characterizes the irrigated agricultural area, as well as the practice of grazing and the cattle population. This axis distinguishes at the bottom, the farms who IAA represent a considerable part of their UAA and who practice grazing while their cattle herd size are reduced and at the top of

the farms of larger herd size and less IAA, and not practicing grazing.

An Ascending Hierarchical Classification (CHA) was performed on the results of the

ACM. The result obtained is in the form of a dendrogram (Fig. 4).

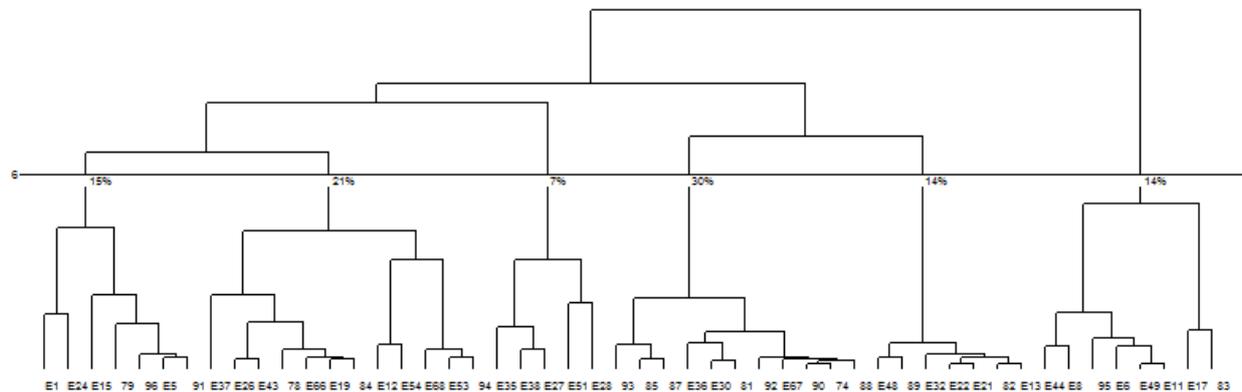


Fig. 4. Dendrogram of identified groups
 Source: own calculation.

Six groups were distinguished by typology; Fig. 3 and Table 3 represent these groups. We can distinguish:

Group 01: this group corresponds to medium-sized farms with irrigated fodder crops, it is made up of 10 farms (class 1/6) or 13.7% of the total surveyed farms. These are farms with an average UAA of 5.9 ha. With a large irrigated agricultural area on average 4.85 ha and a forage area of 4.15 ha on average, this type of farming has fodder crops consisting of sorghum and alfalfa as well as oats, these crops are dominant. This type of breeding is located in the central region of the state, where water is much more available, these are well-equipped farms in semi-open type buildings. The cattle population is 26.4 heads on average including 14.5 dairy cows, which represents 54.9% of the population. The farmers in this group who practice grazing is around 60% with a low number of HWUs employed with an average of two HWUs. The majority of these breeders (60%) have received training in the breeding field.

Group 02: this group corresponds to medium-sized farms with a more cereal vocation. It consists of 14 farms (class 2/6), or 19.18% of the surveyed sample. These are farms which have an average of 8.25 ha of UAA with fodder crops which represent a large part of their land, i.e. an area of 5.39 ha on average, and a very small irrigated area

which represents only 0.28 ha. These farms mainly cultivate oats and cereals for grain production. and are located largely north and south of the study area of 57.1% and 35.7% respectively, the number of HWUs employed is 2.6 HWU on average, 57.1% of the farmers practice grazing, and 71.4% have no training in dairy cattle breeding, the cattle population is on average 35.6 heads, including 21.4 dairy cows, or 60.2% of the sample.

Group 03: This group corresponds to farms with large cattle population. It has five farms (class 3/6) or 6.85% of farms, these large farms have a high dairy cow population, the cattle population is 154 heads on average including 95.8 dairy cows or 62.2 % of the group's population, which attests to the orientation of animal husbandry towards milk production. The UAA is 6.2 ha on average, the Forage area of five ha on average with the absence of irrigated areas. The number of HWUs employed is high among others in this type of groups with an average of 5.4 HWUs. These farms are found in 80% of the cases in the southern region, and those, which do not practice grazing, represent 80%, among the breeders of this group 60% were trained in the field of dairy cattle breeding. This group of breeders is well equipped and efficient in terms of type of building and housing, with the presence of a large workforce.

Group 04: This group corresponds to small farms with a small cattle population, it is the largest in number of farms, 24 farms (class 4/6) or 32.8% of farms, for this category, breeders have very little agricultural land, 2.62 ha of UAA on average with an FA of an average of 2.41 ha. The forage crop is mainly represented by forage oats, the irrigated area is very limited, 0.08 ha on average. The cattle population is 19 heads on average with an average of 10.9 dairy cows, or 57.3% of the population, these are traditional farms, and almost all breeders have no training. These farms are concentrated in the northern region (58.3%); the number of HWUs employed is very low, 1.5 HWUs on average. The breeders of these farms (54.1%) practice grazing.

Group 05: This group corresponds to dairy cattle farms without agricultural land, there are 10 farms (class 5/6), or 13.7% of the total surveyed farms, these farms are without agricultural land, forage areas are nonexistent. The size of the herd is an average of 22.9

heads, including 12.1 dairy cows, or 52.8% of the population. These farms (60%) are in the central region and 30% are in the north. No breeder in this group has training in the field and the majority do not practice grazing.

Group 06: This group corresponds to large farms with a small cattle population. This group is made up of 10 farms (class 6/6), or 13.7% of the total population surveyed. They are characterized by the small size of the herd, however, with a large agricultural area. The UAA is important, on average 27.7 ha, with a reduced FA compared to the UAA 8.6 ha and an average IAA of 4.9 ha. Most of the forage crops grown are oats, alfalfa and grain culture. The cattle population is 23.5 head on average including 12.5 dairy cows, or 53.1% of the workforce. These farms are located in 50% of the cases in the central region of the state, these farms are of old-style type, 60% of them practice grazing, and the number of HWU employed is reduced on average 2.2 HWU, 80% of breeders have no training in the field.

Table 3. Average characteristics and standard deviations of the variables for the different groups of farms identified

Variables	Mean ± SD					
	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6
FAA(ha)	6 ± 2.66	8.25 ± 1.47	6.2 ± 6.57	2.64 ± 1.57	0	30 ± 25.5
UAA(ha)	5.9 ± 2.80	8.25 ± 1.47	6.2 ± 6.57	2.62 ± 1.58	0	27.7 ± 20.8
FA(ha)	4.15 ± 2.21	5.39 ± 3.14	5 ± 5.74	2.41 ± 1.59	0	8.6 ± 5.66
IAA(ha)	4.85 ± 2.21	0.28 ± 0.72	0	0.08 ± 0.40	0	4.9 ± 5.48
Cattles	26.4 ± 16.5	35.6 ± 37	154 ± 144	19.0 ± 10.2	22.9 ± 21.0	23.5 ± 19.8
Dairy cows	14.5 ± 8.74	21.4 ± 21	95.8 ± 77.2	10.9 ± 6.59	12.1 ± 9.74	12.5 ± 11.0
HWU	2 ± 0.47	2.64 ± 2	5.4 ± 2.88	1.5 ± 0.65	2 ± 0.94	2.2 ± 1.03

FAA: full agricultural area. UAA: utilized agricultural area. FA: Forage area. IAA: the irrigated agricultural area.

Source: own calculation.

The results of this study show that a majority of young people whose age does not exceed 45 years holds the dairy cattle farms, which shows the interest given by this young generation to the breeding of dairy cattle. However, mastering the management of these farms requires a certain level of knowledge and training in the field. It has been observed that the university level of heads of farms represents only 5%; therefore, the majority of breeders do not have the appropriate level of education for the management of dairy cattle farm. Indeed, most breeders have no basic training, neither in feeding nor in zootechnics and this is the reason why the management of

herds is carried out in an archaic and irrational way, which does not allow exploiting the full potential of bred cattle breeds.

The size of herd in the surveyed region is on average 33.6 cattle and 19.6 dairy cows, which is significantly higher than that reported by [3] in the eastern region of Algeria and which is in average of 24.8 cattle and 12.3 dairy cows. The average UAA in the study region is 7.4 ha, which is lower than the UAA of farms in the state of Mascara 11.6 ha on average [17], and in central region of Algeria which is on average 9.3 ha [13]. Moreover, it is slightly larger than that reported by [16] in Morocco, where breeders

use an average UAA of 6 ha. On the other hand, the Forage area of herds surveyed is on average 3.9 ha, lower than what is observed in the Southwest region of Algeria where the FA is on average 5.3 ha [6]. It has been found that 73% of farmers have little or no agricultural land. Indeed, 59% of them have less than 10 ha of FAA. Feed self-sufficiency corresponds to the proportion of food intended for animals and which is produced on the farm, the lower this proportion, the more intensive livestock farming is [9]. The area devoted to fodder is very small and does not meet the feed requirements of the animals on most of the surveyed farms, which has a negative impact on the breeding of dairy cattle in the region and leaves the breeders dependent on the trade.

The less self-sufficient the farmer is to feed his animals; the more he is forced to buy animal feed. Only 25% of the farmers produce their own fodder, which partly explains the intensive farming method practiced in the region.

We have seen that the feed ration distributed to dairy cows is not based on any formula, and there is an absence of a rationing system based on the needs of dairy cows according to their physiological stage.

Unlike in Italy, According to the study of [4] Farmers reformulate, their diet every 48 ± 7 days and the feeds are tested every 52 ± 2 days in Italy. Breeders distribute high amounts of concentrate to the detriment of fodder, in order to increase milk production.

On average, 11.3 ± 2 kg of concentrate is distributed per dairy cow in the study area. This quantity is greater than what is distributed in the north of the country on average 8.47 kg /cow/d on average [7], and lower than that presented to dairy cows on farms in Morocco, and which is on average 14 kg /cow/d [16].

Corn silage is used only in 18% of farms, which differs from the Northeast and western regions of Algeria where there is no use of corn silage according to [10] and [17] respectively.

CONCLUSIONS

This study made it possible to show the reality of the situation of dairy cattle farms in the state of Relizane. Mainly agricultural land and livestock population distinguished six groups of farms.

These results underline that many of these dairy farms have little agricultural land, in particular fodder areas, which is a limiting factor in the field of milk production and at the origin of dependence on concentrate. Indeed, these farms practice a forage crop that remains partial, to this is added the problem of lack of land irrigation, which is much more noticeable in the northern region of the state where there is a low water potential.

Faced with this fact, the constraints and mismanagement that preside over dairy farming must challenge the economic sector. Strengthening and optimizing national milk production requires the implementation of a plan based on a scientific and technical approach founded on adequate criteria.

Finally, the development of cattle breeding in our country is linked to an increase and an improvement in fodder production, in particular, the production of quality silage, to have qualified breeders efficient monitoring and supervision for breeders in the technical field is required, so that to they can manage their farms in a suitable manner and have a livestock adapted to the region, and capable of facing the constraints of the sector integrating good farming practices.

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