Status, Characterization and Typology of Dairy Cattle Farms in Northern Algeria

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Abstract:

The aim of this study was to make a finding about the structural, functional and performance aspects of 217 dairy farms in northern Algeria through a survey, then to establish a diagnosis and a typology of these farms.

The results showed that farms had an average size of 42.7 ± 102 ha, of which 34.5% was fodder area (FA), and an average of 28 ± 34.5 livestock units (LU) per farm, of which 65% were dairy cows (DC) dominated mainly by the Holstein and Montbeliarde breeds (74.8% of the total herd). The average number of annual work unit (AWU) was 2.98 ± 1.92 AWU/farm of which 78 ± 35% was a family labour. The farms' performances were generally low. Dairy production (DP) average was 14.3 ± 4.77 kg/cow/day/farm, while fertility represented by calving interval (CI) was 397 ± 20.2 days/cow/farm. The use of multidimensional statistical methods has identified five types of farms.

This study revealed a poor exploitation of the dairy potential of cows raised in Algeria, with the dominance of archaic breeding practices that oppose the welfare of these cows. To optimize dairy farming, solutions have been proposed.

Keywords: agricultural area, dairy production, feeding, fertility, productivity.

Introduction

In Algeria, and despite the tremendous efforts made by the actors of the dairy sector since the country's independence, dairy production doesn't meet the needs of the population, and this problem is still relevant (Kalli *et al.*, 2018). Statistics showed over time, a continuous increase in population, consumption of milk per capita (considered the highest in the Maghreb), as well as imports of cows, feedstuffs but also milk powder (Kali *et al.*, 2011 ; El Hassani, 2013). It is rather the farms productivity (first link of the dairy sector) that did not follow this dynamic. According to Kalli *et*
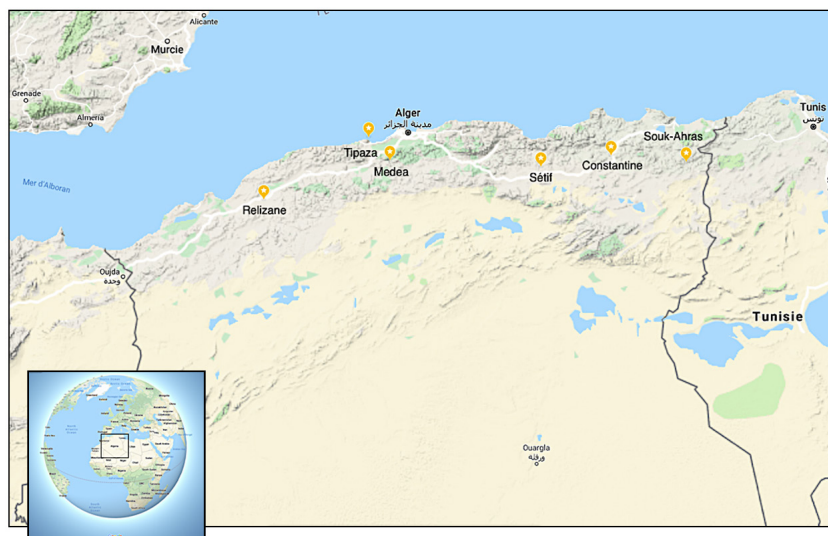
Figure 1. Geographical location of study sites

al. (2018), these are subject to strong constraints limiting their overall performances.

The limited diagnoses results made by Algerian researchers indicates the presence of structural, technical and economic lags, which are linked to the farms, the cows and the farming methods (Makhlouf *et al.*, 2015; Kalli *et al.*, 2018). The majority of these authors recorded a poorly valued production potential and performances that are similar to those obtained decades ago in countries that are today major milk producers. Soukehal (2013), explained this by the unequal farms' distribution across the country, as well as the farming methods which remain mainly extensive (according to a 2011 census, 86% of farms practiced a family breeding with 2 cows on average).

In order to create a reflection dynamic on the development of the upstream dairy sector, and as a first step, we have chosen to make a dairy farms inventory of their structure, functioning and performances, followed by a typology based on multidimensional statistical analysis to draw a real picture of the practices that are adopted.

Materials and Methods
Study area
The study was conducted on 217 farms of different sizes, totalling 6084 LU across 6 regions in northern Algeria (Figure 1, Table 1) on a period from 2014 to 2018.

Northern Algeria climate
The north of Algeria has a Mediterranean climate (hot dry summers, wet and cool winters), with transitional bioclimatic stages, notably the semi-arid climate of the highlands in the centre of the country. The north-eastern and central curbs are the most rain receiving, with an average annual rainfall amounts ranging between 600 and 1150 mm, while the North-western margins record an average annual amount ranging from 250 to 500 mm (ONM, 2019).

Methodological approach
To carry out this study, we adopted an investigative approach by looking through several parameters such as the farms' inventory, the performances, and the degree of technicity of the farmers. A survey was conducted with a frequency of one or two visits for each farmer with the aim of collecting all the data that seemed interesting. For this, the development of a questionnaire was essential. The collected data is split into 4 categories:

the structural aspect of the farm which includes the housing systems, the agricultural areas and the herds composition;

the functional aspect, including feeding, reproductive and milking managements;

the human aspect that consist of the labour force and the farmers experience;

the performance aspect, including the dairy production and fertility.

Table 1. Characteristics of the studied sample

		Number of farms	Herd size (LU)	Number of cows	Proportion of cows	Number of Cows per farm	Number of bulls
	Total	217	6084	4036	66.3	18.6	181
Region	East	65	1823	1216	66.7	18.7	50
	Center	3	515	472	91.6	157	5
	West	149	3745	2348	62.7	15.8	126
Status	Public	4	364	297	81.6	74.2	5
	private	213	5720	3739	65.4	17.6	176

The analysis of the raw results led us to develop a database and to identify 26 variables with 24 explanatory variables (8 qualitative and 16 quantitative) and 2 variables to explain. The results were first compared to standards (Wallet and Lagel, 2011; Humblot and Grimard, 1996) and then to those presented by different researchers.

Statistical analysis

Statistical analysis of the data is a keystone in this type of study.

First, the descriptive statistics were performed by the R software (version 3.5.2).

To study the effects of certain qualitative factors on farms' performances, Analysis of variance (ANOVA) were performed with GLM procedure in SAS (Statistical Analysis System ; SAS Release 9.1). The used model is of the following form:

$Y_{ijklm} = m + R_i + ST_j + SZ_k + SB_l + RM_m + IM_n + CR_o + e_{ijklmno}$

m = general mean

R_i = region effect (i = 1 to 3)

ST_j = effect of the farm status (j = 1 to 2)

SZ_k = season effect (k = 1 to 4)

SB_l = stabling mode effect (l = 1 to 3)

RM_m = effect of reproduction monitoring (m = 1 to 3)

IM_n = effect of mode of insémination (n = 1 to 3)

CR_o = effect of calves rearing (o = 1 to 3)

$e_{ijklmno}$ = residual error

To study the effect of some quantitative factors, we used the CORR procedure by the R software (version 3.4.4) for calculating the Pearson correlation coefficients.

Finally, using the R software, we carried out a principal components analysis (PCA) to establish a typology of the dairy farms.

Results and discussion
Characterization of the farms; The structural aspect; State of the stables.

The cowshed has a major impact on the technical and economic performances of the farm, the quality of the farmers' work, the financial equilibrium and the evolution possibilities of the farm (Wallet and Lagel, 2011). In our sample, buildings housing the dairy cattle had an average age of 15.4 ± 14.9 years, and a living space of 11.4 ± 7.7 m² per LU, which is higher than the minimum recommended for an adult cow of 9 m² (Wallet and Lagel, 2011). Therefore, living spaces do not seem to be a problem, rather, it is the design of these spaces that does not comply with zootechnical standards.

In addition, and even with the considerable number of disadvantages it represents, the tie-stall remains the dominant housing system, and was found in 76% of the visited farms, far ahead of the free stall system, which was adopted only in 6.45% of farms. A similar proportion (7% of breeders practicing free stall housing) was reported by Kaouche *et al.* (2012) in Medea. The rest of the farms followed a mixed housing system (tie-stall with regular outdoor exercise).

Agricultural areas. The surveyed dairy farms were characterized by an average size that was represented by the utilised agricultural area (UAA) of 42.7 ± 101 ha. This value is higher than all of the results recorded in Algeria: in Mitidja by Ouakli and Yakhlef (2003) and Bekhouche (2011) (31.2 ± 59.2 and 17.7 ± 3.35 ha respectively), in Setif by Bir *et al.* (2014) (30.7 ± 46.9 ha), in Tizi Ouzou by Belkheir *et al.* (2015) and Allane *et al.* (2011) (11.4 ± 7.13 and 12.6 ± 11.5 ha respectively), and in Annaba by Bekhouche (2011) (18.8 ± 3.38 ha), and also higher than the ones recorded by Srairi (2004) in Rabat-Salé (18.4 ± 61.4 ha), by Srairi
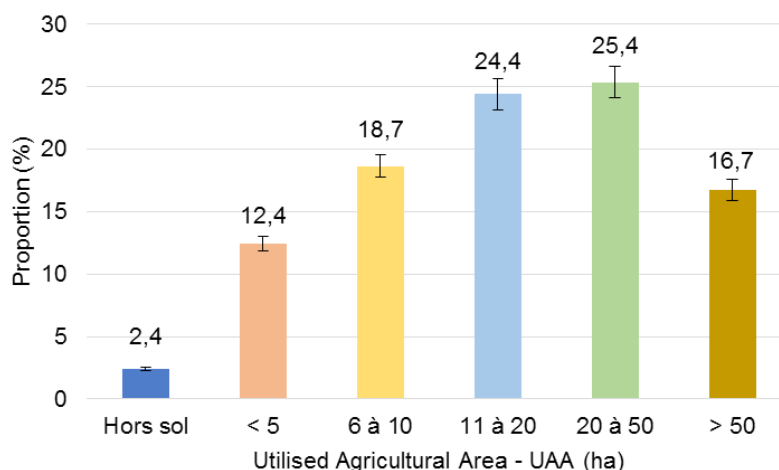
Figure 2. Distribution of farms according to their sizes (UAA)

et al. (2003) in perimeter of Gharb (17.5 ha) in Morocco, by Hammami *et al.* (2008) in Bordj Etaouil (8 ha) and by Hanafi *et al.* (2008) in Bordj Toumi-Tonguar (7 ha) in Tunisia. However, if we only count the owned agricultural area, the results would be medium (25.9 ± 89.6 ha).

Smallholder farms with an UAA less than or equal to 5 ha accounted for 12.4% of the total, while those with an UAA between 6 and 10 ha accounted for 18.7%. In total 33.5% of farms had less than 10 ha. Makhlouf and Montaigne (2017) reported relatively close result in Tizi Ouzou (48%), however, our results were much lower than the national average (78.8%) reported by Bir *et al.* (2014). It is worth noting that 2.4% of the farms had no agricultural land (Figure 2). Which is far lower than what was reported by Makhlouf and Montaigne (2017) in Tizi Ouzou (40%).

The farm size does not seem to be an obstacle to the development of the farms (42.1% of farms had more than 20 ha). Rather it is how these surfaces are used to benefit the livestock, where the forage area (FA) represents 34.5% of the UAA for an average of 14.7 ± 28.3 ha/farm. These results are similar to the ones registered by Bekhouche (2011) in the regions of Mitidja and Annaba with 14.1 ± 2.16 and 13.3 ± 3.42 ha respectively, by Ouakli and Yakhlef (2003) in Mitidja with 13.14 ± 18.20 ha, a bit higher than the one reported by Allane *et al.* (2011) in Tizi Ouzou (11.2 ± 10.9 ha) and much superior to the ones obtained by Bir *et al.* (2014) in Setif (7.60 ± 10.3 ha). The proportion of FA to UAA decreased as the size of the farm increased.

Farms where FA was lacking and where dairy cattle rearing was only a marginal activity, accounted for 1.96% of the total sampled farms. Similarly, farms were the FA represented less than 30% of the UAA reflecting that dairy cattle rearing was secondary to agriculture accounted for 28.4% of the total. Dairy cattle rearing played a primary role in 48% of farms, where FA accounted for more than 50% of the UAA in 29.4% and reached 100% of the UAA in 18.6% of the total sample.

The cultivated agricultural area averaged 8.47 ± 16.8 ha. This observation and despite the difference in relief complies with that of Belkheir *et al.* (2015) and Allane *et al.* (2011) in the Kabylia (9.12 and 9.23 ha respectively), but it is higher than the one recorded by Bir *et al.* (2014) in Setif (4.92 ± 5.79 ha).

As for the irrigated area which was 1.40 ± 4.09 ha, it is comparable to 1.94 ha recorded in Tizi Ouzou by Belkheir *et al.* (2015). The irrigation rate of 14.5 ± 29.1% of the FA is comparable to the result recorded by Bir *et al.* (2014) in Setif (14.3%) and very low compared to the rate recorded in Mitidja (66.95%) by Ouakli and Yakhlef (2003) and in Bordj Etaouil (66% de la SAU) by Hammami *et al.* (2008).

The mean stocking rate is equal to 4.20 ± 7.25 LU/ha of FA (from 0 to 75 LU/ha), which is higher than the one reported by Allane *et al.* (2011) in Tizi Ouzou (2.13 ± 2.15 LU/ha) and lower than the one reported by Bir *et al.* (2014) in Setif (7.29 ± 11.3 LU/ha), Ouakli and Yakhlef (2003) in Mitidja (7.08 ± 6.97 LU/ha) and by Bekhouche (2011) in
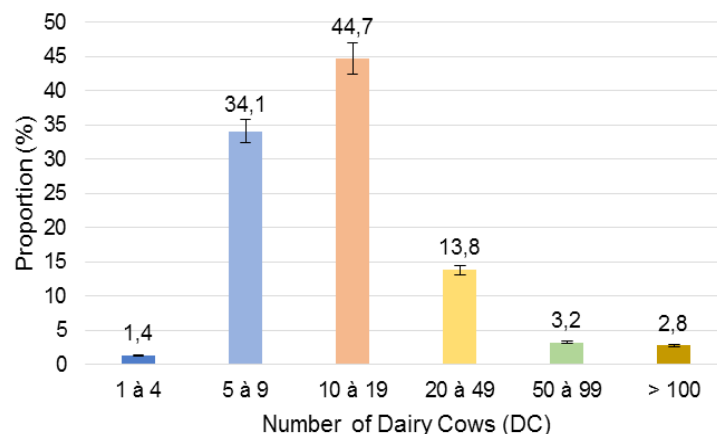
Figure 3. Distribution of farms according to their cow herds

Mitidja and Annaba (6.57 ± 1.4 and 5.96 ± 1.40 LU/ha respectively).

Herd composition. The average herd sizes was between 5.2 and 267 LU with an average of 28 ± 34.5 LU/farm, a relatively high number which requires a certain amount of seriousness and organization in the work. DC rearing remains the main activity in the farms (65 ± 15% of the herd and an average of 18.6 ± 27 DC/farm), other activities such as raising of dairy replacement and/or meat animals are also practiced.

The average number of DC in the sampled farms is lower than those recorded by Ouakli and Yakhlef (2003) and Bekhouche (2011) in Mitidja (27 et 20.7 DC respectively), however, it is higher than the numbers recorded by Bir *et al.* (2014) in Setif (14.4 ± 12.18 DC), by Srairi (2004) in Rabat in Morocco (12.6 ± 15.6 DC), by Bekhouche (2011) in Annaba (10.3 ± 2.16 DC), and by Allane *et al.* (2011) and Belkheir *et al.* (2015) in Tizi Ouzou (10.2 ± 6.35 and 8.25 ± 5.57 DC respectively).

The distribution of farms according to the number of their DC showed that 44.7% of them had between 10 and 19 DC ; 35.5% had less than 10 DC and only 19.8% had more than 20 DC in the herd (Figure 3). Farms with small herds (less than 5 DC) accounted for 1.38% of the total of farms, while those with more than 50 DC accounted for 5.99%. This differs from what Chehat and Bir (2008) have reported, with proportions of 95% et 0.3% respectively and which, according to Makhlouf *et al.* (2015), was the main constraint to the modernization of cattle farming.

The renewal rate of DC represented by the proportion of primiparous cows was estimated at 22 ± 31%. Which is higher than the one found by Ouakli and Yakhlef (2003) in Mitidja (11.94 ± 12.97 %).

As for the herd's ethnic composition, although diversified, it was dominated by the Holstein and Montbéliarde dairy breeds, which accounted respectively for 45.9% and 28.9% of the total number of DC of the surveyed farms. These two breeds are not only sensitive but also demanding in terms of comfort and therefore are the less adapted to the farming conditions in Algeria, whereas the local breed "Brown Atlas" represented only 1.24% of the total DC (spread over 11 farms).

The functional aspect; Feeding management

The average dry matter intake of the distributed rations was correct (16±5 kg/cow/farm). However, the proportion of the concentrate in the intakes is high (44.8±15.6 %), which increases the risk of metabolic diseases and consequently penalizes production and contributes to the production cost increase.

Green fodder feeding was practiced in 60.4% of farms during a short period of the year, while the silage was distributed only in 6.19% of farms. This complies with what Kadi *et al.* (2007) found in Tizi Ouzou (98.75% of farms had a lack of silage). In 9 out of 10 farms (89.6%) and throughout the year, the basic rations consisted only of dry fodder (hay and/or straw) which contain low nutritional value. This is in line with the finding of Houmani (1999) who confirmed the excessive use of dry
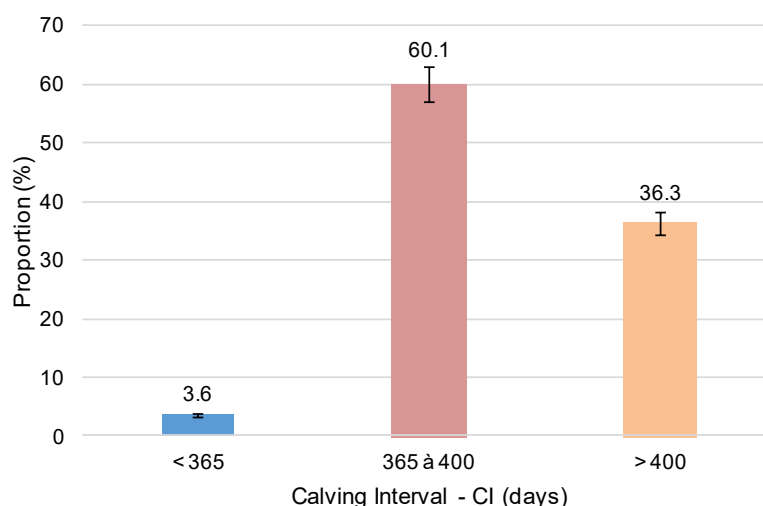
Figure 4. Distribution of farms according to their CI

hay and concentrates in Algerian dairy farms over silage and green fodder.

Reproductive management

41.5% of the farms had a rigorous reproduction monitoring through the recording of calving, inseminations and the drying cows dates, while in 12.9% of farms, the monitoring was partial. This component does not seem to be a priority for farmers in almost half of the farms (45.6%) where reproduction monitoring was lack.

Natural service remains the insemination method of choice to the farmers, as it was observed in 73.3% of the farms (more than 7 farms out of 10) which accounts for 71.7% of the total DC, thus far dominating artificial insemination method that was only practiced in 7.8% of the farms, which accounts for 6.3% of DC. Farmers prefer the natural service for its ease and relatively high success rate, without taking into account the delay or the decline of genetic progress caused by this insemination mode.

A mixed insemination method was adopted in 18.9% of the farms. The use of natural service often occurs after repeated artificial insemination failures. Which was different from what Kaouche *et al.* (2012) has reported in Medea with 35.7% of farms practicing natural service, 30% practiced artificial insemination, and mixed mode in 34.3% of farms. On the farms that practiced natural service, the sex ratio was 17 ± 17.6 cows/bull (ranging from 2.5 to 176 cows / bull). Of these farms, 18.9% had no bulls.

Milking management

The degree of milking mechanization in Algerian farms has increased significantly to reach 90.3%, either through milking trolley which accounts for 84.3% or milking parlors in 6% of the farms. In a study carried out by Kaouche *et al.* (2012) in Medea, 73% of farmers own a milking machine. It should be notes that the milking remains manual in 9.7% of the farms which hold 181 cows or 4.5% of the total livestock.

Calves rearing management

15 farms (6.9%) did not practice calf rearing, where calves are sold within a week of birth. In farms practicing this type of farming, calves were separated from their mothers in 111 farms (51.2%) to be fed powdered milk in 6.3% (7 farms), or like in the majority of cases cow's milk (93.7%), It is important to note that in 41.9% of the farms (91), calves are raised with their mothers.

Given its negative impact on the recovery of the ovarian activity of cows after calving, rearing the calves under their mothers penalizes fertility (Humblot and Grimard, 1996). This is the main cause of calving - first insemination interval prolongation, and therefore CI prolongation. The mean weaning age of calves was 4.12 ± 1.29 months. This value is close to the recommendations for calves of beef breeds. As for raising of dairy replacements heifers, it was recorded in 43.8% of farms (95 farms).
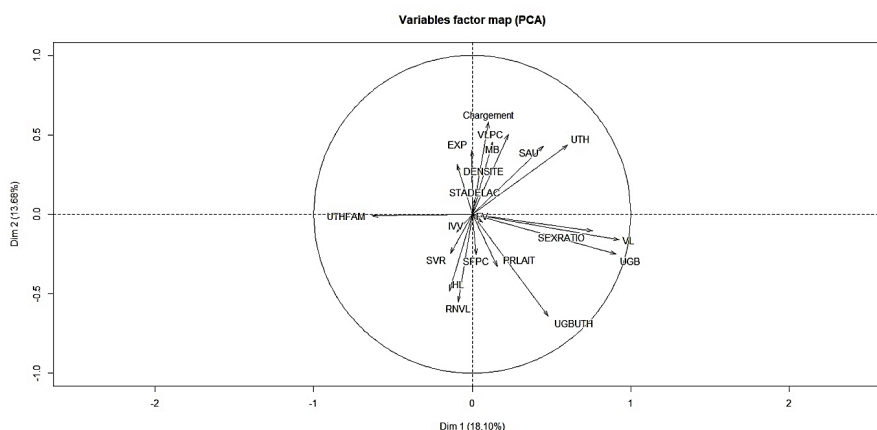
Figure 5. Principal Component Analysis Variables factor map. in abscissa : the herd sizes (UGB) and dairy cows (VL), the sex ratio (SEXRATIO), the labour (UTH), the proportion of the family labour (UTHFAM), the farms' sizes (SAU), and on the ordinate : the average number of LU per AWU (UGBUTH), the proportion of Holstein (HL) and Montbeliarde cows (MB), the stocking rate (Chargement), the percentage of dairy cows (VLPC) and the renewal rate of DC (RNVL)

Human aspect

The average number of labour per farm was estimated at 2.98 ± 1.92 AWU/farm of which 2.08 ± 1.51 were family AWU (78 ± 35% per farm). Thus, one AWU supported an average of 9.96 ± 7.09 LU/ farm. This number of labour is comparable to what Mouhous *et al.* (2014) found in Tizi Ouzou (2.5 ± 2 AWU) and lower to what Bekhouche (2011) has reported in Mitidja and Annaba (5.5 ± 0.5 and 3.68 ± 0.5 AWU respectively).

The family nature that dominates the farms labour may indicate relatively traditional farming methods, as well as a lack in the "know-how" of people who are in contact with the animals. On average, the owners (or managers) of these farms accumulated an estimated experience of 11.3 ± 9.15 years in the field of farming. This however does not necessarily mean good practices.

Performance aspect

Farms' Dairy yields ranged from 2.76 to 28 kg/ DC/day/farm, with an average of 14.3 ± 4.77 kg/ DC/day/farm, for an average lactation period of 5.40 ± 2.08 months. This production is comparable to the one recorded by Belkheir *et al.* (2015) in Tizi Ouzou (14.4 ± 4.6 kg/DC/day), Srairi *et al.* (2014) in Morocco (14 kg/DC/day) and higher than the one reported by Ouakli and Yakhlef (2003) in Mitidja (11.48 liters/DC/day). In comparison to the norms, the average farms' performance is low, and this is undoubtedly a reflection of poor welfare of the cows at these farms. Applying Pearson correlations on the average farm milk yields showed that they were independent of all explanatory variables, exception the area factor (p = 0.002) where the best yields were recorded in the west of country (Table 2), the stalling system (p = 0.04) where the best results were recorded in the farms adopting the free stalls (17.8 kg), and the calf rearing method (p = 0.004) where the best results were observed in the farms where the calves were separated from their mothers.

Cows fertility, represented by the calving interval (CI), was estimated to be 397 ± 20.2 days on average. These results are clearly higher to those has been reported by Ouakli and Yakhlef (2003) in Mitidja (14.5 Months), by Bouamra *et al.* (2016) at the ITELV Farm (422.4 Days), by Ben Salem *et al.* (2007) in Tunisia (422 Days) and by Srairi (2004) in Rabat-Sale (429 Days).

The distribution of farms according to their average CI showed that in 3.6% of the farms that accounts for 3.1% of the DC, this parameter was less than or equal to 365 days, while 60.1% (holding 69.9% of DC) of the farms recorded average CI between 365 and 400 days. And lastly, this parameter was greater than 400 days in 36.3% of the farms that hold 27% of the DC (Figure 4). It is worth noting that the average CI was estimated to be 395 ± 18.9 days in farms that adopted natural service.

Table 2. Dairy farms characterization and typology

Parameters	UAA (ha)	FA (ha)	Number of DC	AWU	DP (kg)	CI (day)
Means ± SD	42.7 ± 102	14.7 ± 28.3	18.6 ± 27	2.98 ± 1.92	14.3 ± 4.77	397 ± 20.2
East	94 ± 171[a]	26.2 ± 41.9[a]	18.7 ± 16.2[a]	4.12 ± 2.19[a]	12.8 ± 4.61[a]	395 ± 28.9[a]
Center	100 ± 141[ab]	100[ab]	157 ± 38.5[ab]	7.0 ± 2.0[ab]	20.9 ± 9.30[ab]	393 ± 6.11[a]
West	19.4 ± 21.9[c]	8.50 ± 8.26[b]	15.8 ± 23[b]	2.35 ± 1.36[b]	14.9 ± 4.60[b]	398 ± 14.9[a]
Public	695 ± 298[a]	121 ± 86.7[a]	74.2 ± 29.8[a]	7.50 ± 0.58[a]	16.5 ± 1.44[a]	394 ± 6.65[a]
Private	33.2 ± 57.3[b]	13.2 ± 23.9[a]	17.5 ± 25.9[b]	2.89 ± 1.82[b]	14.2 ± 4.79[a]	397 ± 20.5[a]
Cluster 1	17.9 ± 26.9[a]	7 ± 5.55	10.7 ± 5.34[a]	2.24 ± 1.21[a]	14.9 ± 4.26[a]	405 ± 23.4[a]
Cluster 2	19.0 ± 16.2[a]	8.74 ± 7.65	13.3 ± 8.17[ab]	2.17 ± 1.22[a]	15.8 ± 5.09[a]	398 ± 12.8[a]
Cluster 3	47.3 ± 48.3[b]	16.7 ± 14.6	15.6 ± 9.68[b]	3.61 ± 1.84[b]	12.6 ± 4.25[b]	389 ± 19.1[b]
Cluster 4	675 ± 246[c]	153 ± 95.7	49.2 ± 28.4[c]	8.50 ± 1.73[c]	14.2 ± 4.04[ab]	392 ± 5.48[ab]
Cluster 5	59.9 ± 86.5[ab]	38.3 ± 72.1	128 ± 54.2[d]	6.43 ± 1.72[d]	18.3 ± 7.61[a]	394 ± 7.48[ab]

Different letters in columns (a-d) indicate differences in p <0,05.

Farms' average CIs were not correlated with any explanatory variables, with one exception that is the mode of insemination (p = 0.01), where the best CIs were recorded on farms adopting the natural service.

Farms typology

A principal component analysis (PCA) for the 217 farms was conducted taking into account 20 quantitative variables contributing to a total inertia of the first 3 axes of 40.7%. The main plan (defined by the first and second axes) allowed for a good graphic discrimination (Figure 5).

The hierarchical Ascending Clustering (HAC) performed on the 20 variables allowed to identify from the analysis of the first three axes, five clusters (farms types), which explain 40.7% of the variance (Table 2, Figure 6).

The Cluster 1 (**SF**) accounts for 37.3% of the total. These farms include **small family farms** where labour is 90.6 ± 24.1% family, agricultural areas are reduced (UAA = 17.9 ± 26.9 ha and FA = 7 ± 5.55 ha), herds are small (15.2 ± 7.77 LU/farm including 10.7 ± 5.34 DC/farm). These farms' dairy cow herds are younger (renewal rate of DC = 6.82 ± 10.2%), consist mainly of Holstein cows (68.4 ± 29.1% per farm) and benefit from the best sex ratios (11.5 ± 6.15 cows/bull/farm). Nevertheless, the performances recorded in this type of farms were low (DP = 14.9 ± 4.26 kg/DC/farm, CI = 405 ± 23.4 days/DC/farm).

The Cluster 2 (**NF**) makes up 21.2% of the total. They are the **newly** established **farms**, given the highest cow renewal rate (68.5 ± 30.0% per farm) and the lowest manager experience (6.31 ± 5.73 years). These farms are characterized by reduced agricultural areas (UAA = 19.0 ± 16.2 ha,

FA = 8.74 ± 7.65 ha), small herds (13.3 ± 8.17 DC/ farm), and the smallest living spaces (8.21 ± 6.47 m²/LU) and a limited human workforce (2.24 ± 1.21 AWU/farm) that are mainly family members (77.9%). These farms are also characterized by a reduced proportion of dairy cows (47.8 ± 7.71% of the herd) and therefore other animal rearing workshops are present, such as the calves rearing where the average weaning age was relatively high (4.57 ± 1.55 months). Milk production of these farms was better than the overall average (15.8 ± 5.09 kg/DC/farm). This may be due to the high milk potential of the newly imported heifers. This cluster average CI is estimated to be 398 ± 12.8 days /DC/farm and is comparable to the overall average (Table 2).

The Cluster 3 (**OF**) represent 35.5% of all farms. These are the **old farms** that are characterized by high experienced owners (14.6 ± 10.4 years) and older herds (cow renewal rate of 11.8 ± 17.6%). These were also characterized by medium agricultural areas (UAA = 47.3 ± 48.3 ha, FA = 16.7 ± 14.6 ha), a relatively high labour force compared to the number of animals (7.09 ± 4.11 LU/AWU), an ethnically varied composition of herds (54.4 ± 29.0% of the DC/farm are Montbeliarde). As for the dairy performances of this group of farms, it is low (DP = 12.6 ± 4.25 kg/DC/farm) while the CI is the smallest of the clusters (389 ± 19.1 days/DC/farm).

The Cluster 4 (**LF**) accounts only for 1.8% of the entire sample. These are **large farms** with the largest agricultural area (UAA = 675 ± 246 ha, FA = 153 ± 95.7 ha). The reduced proportion of FA (24.4 ± 14.1% of UAA) indicates the presence of other agronomic activities other than livestock rearing. These farms are also characterized by the
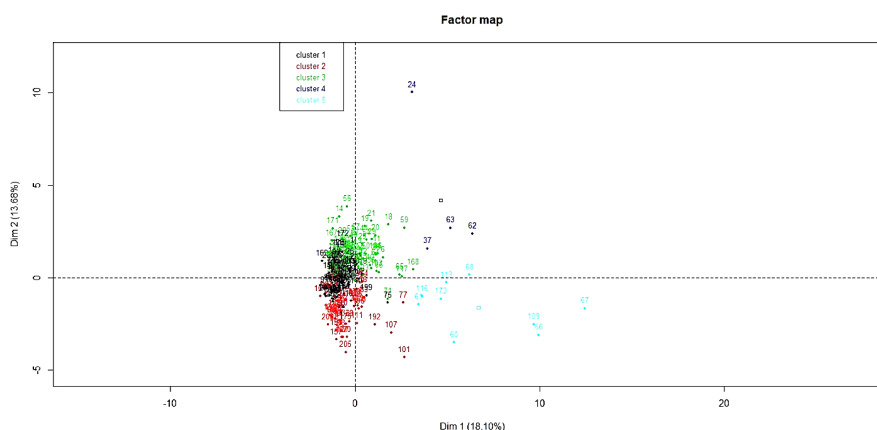
Figure 6. Hierarchical Ascending Clustering of the individuals

abundance of non-family workers (8.50 ± 1.73 AWU/farm), relatively large herds (65.4 ± 36.4 LU) composed mainly of DC (75.1 ± 3.79% are DC). DP is comparable to the overall mean (14.2 ± 4.04 kg/DC/farm) and the CI is better (392 ± 5.48 days/DC/farm).

The Cluster 5 (**DF**) accounts for 4.2% of the total. these are the specialized **dairy farms** with the largest herds (169 ± 56.1 LU, of which 75.8 ± 16.7% are DC), the largest proportion of fodder area (80.3 ± 38.6% of the UAA) and abundant labour (6.43 ± 1.72 AWU/farm of which only 2.38 ± 6.30% are family). Farms in the latter group had the highest milk yields (18.3 ± 7.61 kg/cow/farm), and the CI was high too (394 ± 7.48 days).

Conclusion

To conclude: despite the great variability, farms in Algeria have shown a poor exploitation of their land, genetic and human resources and therefore suffer from a very limited profitability (DP = 14.3 ± 4.77 kg/cow/day/farm and a CI = 397 ± 20.2 days). The following observations were made:

The areas allocated to the forage represented a small proportion (34.5%) compared to the agricultural area in the possession of these farms, finding themselves fall short to ensure the feeding of their cows and therefore rely on the concentrates to compensate (44.8%);

The surface area of the cowsheds was sufficient (11.4 ± 7.68 m^2/LU), but not compliant with the zootechnical standards in terms of comfort and ambient conditions (temperature and ventilation);

Feeding and reproductive management were done improvised rather than scientific.

It is recommended to improve and work on these errors and to optimize the management by using the resources available to the farms, to provide the cows with favourable conditions to maximise the expression of their genetic potential and to ensure a good profitability for the farmer.

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