Feed Autonomy of a Few Dairy Cattle Farms in the Mitidja Plain (Algeria)

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RESEARCH ARTICLE

Abstract

Feed autonomy of 15 dairy cattle farms was assessed during the 2019-2020 agricultural campaign. This autonomy is declined according to the food nature (fodder and concentrate) and their composition (dry matter, energy and protein). Autonomy is on average of 74.79% for dry matter, 75.10% for energy and 76.36% for protein. Fodder autonomy is on average of 93.58%, whereas for concentrate, the farms are 100% dependent on the external provision of feed. Overall, the farms produce fodder but in insufficient quantity, they therefore resort to the purchase of hay bales. This is explained by the weakness of the fodder sole and the high consumption of concentrate.

Keywords: concentrate; dry matter; energy; fodder; feed self-sufficiency; protein.

INTRODUCTION

The For a very long time, Algeria has suffered a significant deficit in milk and its derivatives resulting from low productivity of the national dairy herd (El Hassani, 2013). The same deficit problem is also observed for animal feed which causes the cost of production and thus the selling prices to increase.

The fodder deficit has negative repercussion on animal productivity and results in massive imports of dairy and meat animal products. This situation results from the fact that the production and cultivation of fodder often remain a marginal activity on farms in Algeria (Boukhechem et al., 2019a). Feeding is undoubtedly one of the major constraints to the development of livestock farming in Algeria (Ghozlane, 2018). With the increase in feed costs, the seeking for food autonomy has never been more important for all breeders to reduce production costs and improve the quantity, quality and traceability of their animal products. This study is part of this perspective. The objective is to assess the degree of food autonomy in dairy cattle farms in the Mitidja region and to propose solutions that improve the profitability of farms.

MATERIALS AND METHODS

Region and farms choice

The choice of the Mitidja plain is motivated by the importance of agricultural activity, in particular the dairy cattle breeding. It is considered a dairy basin. The surveyed farms, in number of 15, are located in the municipality of Birtouta. They were chosen mainly on the basis of two criteria: the dairy vocation of farms and data availability.

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Questionnaire elaboration

The questionnaire used to carry out our surveys includes 27 questions of quantitative and qualitative order. It was established to allow us to assess feed self-sufficiency on farms.

Data processing

The data processing was carried out as follows: using Microsoft Excel 2016 © software for descriptive analysis (means and standard deviations), in order to characterize the different farms, and Calculation of food autonomy (Dry Matter, Energy and Protein).

Food autonomy measures the degree of independence of a farm or a territory from the external provision of feed (Paccard et al., 2003b). It is defined according to the same authors as the part of feed produced on the farm relative to the feed consumed by the herd. It is expressed as a percentage and can be declined according to the food nature (fodder or concentrate) and according to their Dry Matter composition (DM), energy value (expressed in Feed Fodder Unit- UF) and protein value (expressed in gramme of Protein Digested in small Intestine - g of PDI).

Overall autonomy = $1 - [(\text{purchased fodder} + \text{purchased concentrate}) / \text{total consumption}]$

Fodder autonomy = $1 - [\text{purchased fodder} / (\text{total consumption} - \text{concentrate consumption})]$

Concentrate autonomy = $1 - [\text{purchased concentrate} / (\text{purchased concentrate} + \text{produced concentrate})]$

The nutritional values of the purchased fodder and concentrate used in our calculations refer to the tables of INRA (2010). Consumption corresponds to the valued part of the food produced on the farm and the purchased food.

Consumption can also be estimated from the theoretical needs of the herd. According to Paccard et al. (2003a), it is more precise to estimate the total ingestions and needs than to evaluate the fodder production of farms: the stored fodder is well known in quantity and composition but the evaluation of pasture production is much more difficult to do.

This method is not applicable in the case of our study because it supposes that the animals are fed in a way where all their needs are met; which is far from being the case with our farms where animal rationing is lacking.

The annual requirements for DM, energy and protein were determined as follows:

- Total DM intake (DMI) of the ration (expressed in kg): For dairy cows, it was calculated according to the usual INRA recommendations (2010) considering the herd average production ($\text{DMI} = \text{milk quantity of } 4\% \text{ of fat} \times 0.33 + 4\ 110$). A fixed value of 5 tonnes of DM per Livestock Unit (LU) has been retained for all other cattle.
- Energy and protein requirements: For dairy cows, they were calculated according to the usual recommendations (INRA, 2010). For other cattle at 3 500 UF / LU and 315 kg of PDI / LU.

RESULTS AND DISCUSSIONS

Importance of the forage area (FA) to the utilized agricultural area (UAA)

FA occupy 65.67% of the UAA of the surveyed farms. The forage sole varies from 1.5 to 60 ha with an average of 7.33 ± 14.7 ha.

Figure 1 shows that 20% of breeders cultivate FA less than or equal to 1.5 ha. The same percentage is observed for breeders who cultivate FA between 4.5 and 6 ha. on the other hand, only 13% of breeders cultivate 3 to 4.5 ha of FA, breeders who have a FA greater than 6 ha do not exceed 13%.

Figure 1. Distribution of forage areas (FA) of the surveyed farms.

Forage crops

A low diversity of fodder crops is observed on all the surveyed farms. This situation is the result of the selective use of certain species over others depending on climatic conditions. These crops are represented mainly by four forage species: Sorghum, clover, oats and alfalfa. Forage monoculture is practiced on 13% of the farms, while the rest of the breeders try to diversify their forage production using several species, 7% of the farms cultivate two crops, 20% cultivate four species and the majority of the farms (60%) cultivate three species (Figure 2).

Figure 2. Importance of forage crops diversity.

Sorghum is the most cultivated species, it occupies an area of 25.5 ha or 23.18% of the FA, distribution in green is the only mode of management in the majority of farms. If there is a surplus, it will be stored as hay, the number of cuts varies between 3 and 4 cuts per year with an interval of one month.

The clover is classified in second place with 17.25 ha, the distribution in green is the only mode of use practiced.

Oats occupy an area of 45.5% of the FA, distributed in green or most often in dry (oat hay).

Alfalfa is only cultivated on 5 farms on 34.06 ha despite its great interest and better adaptation to climatic conditions. It is sown every five years with a number of cuts ranging from 4 to 6 cuts per year. Maize is only cultivated on 3 farms on an area of 35 ha, it is little practiced because of its irrigation requirements. Barley cultivation is rarely practiced, it is found on 2 farms with a total area of 1.5 ha (Table 1), it is often mown and distributed in green.

Table 1. Types and area of fodder crops.

Cultures	Number of farms	Area (ha)
Barley	2	1.5
Oats	8	45.5
Sorghum	14	25.5
Maize	3	35
Alfalfa	5	34.06
Clover	11	17.25

Cattle herds

The total number in the 15 surveyed farms is 537 head of cattle, ranging from 8 to 130 head with an average of 35.13 head per farm. Dairy cows represent 42.27% of the total herd, they dominate the different categories. Their number varies from 4 to 35 cows with an average of 15.13 cows per farm (Table 2).

Table 2. Distribution of herds by animal category (number of animals)

Animal category	Total	Maximum	Minimum	Mean	Standard Deviation
Cattle number	537	130	8	35.8	30.81
Dairy cows	227	35	4	15.13	9.09
Bulls	60	22	0	4	6.37
Heifers	79	43	0	5.64	11.22
Bull calf	45	16	0	3	4.55
Calves	70	15	0	4.67	4.42
Calf females	82	25	0	6.83	7.51
Livestock Unit	431.15	107.55	6.1	28.74	25.48
LU/ ha of FA	106.79	18.1	1.22	7.12	4.71

These results show also that the mean stocking rate is equal to 7.12 ± 4.71 Lu / ha of FA, it varies from 1.22 to 18.1 LU / ha of FA. This mean is higher than that recorded by Boukhechem et al. (2019b) across 6 regions in northern Algeria (4.20 ± 7.25 LU / ha of FA).

Nutritional needs

These The herds' annual needs in DM, energy and protein are reported in Table 3. The DM requirements of the surveyed farms are 3 603 360.85 kg with an average of $240\,224.06 \pm 185\,638.77$ kg, ranging from 53 271.2 to 790 722 kg. The net energy requirements are 2 170 388 UF with an average of $144\,692.53 \pm 116\,925.36$ UF, they vary from 28 886 to 494 965 UF. The nitrogen requirements are 208 467.69 kg of PDI with an average of $13\,897.84 \pm 10\,865.75$ kg of PDI, varying from 3 174.18 to 46 405.05 kg of PDI.

Table 3. Annual nutritional needs of the cattle herds in the surveyed farms.

Farm number	DM (kg)	Net energy (UF)	protein (kg of PDI)
Farm 1	790 722.00	494 965.00	46 405.05
Farm 2	57 005.00	34 814.40	3 174.18
Farm 3	271 577.00	169 758.00	14 516.40
Farm 4	53 271.20	28 886.00	3 268.68
Farm 5	388 421.00	236 250.00	23 399.40
Farm 6	187 225.75	122 805.30	9 615.21
Farm 7	182 085.60	101 616.20	10 810.38
Farm 8	202 825.50	116 200.50	11 879.55
Farm 9	132 137.30	77 978.00	8 383.77
Farm 10	332 857.15	197 434.80	18 505.92
Farm 11	228 433.50	147 507.30	12 623.46
Farm 12	275 874.00	147 278.40	16 399.08
Farm 13	333 992.50	205 162.00	19 272.90
Farm 14	102 847.60	55 695.60	6 253.86
Farm 15	64 085.75	34 036.50	3 959.85
Total needs	3 603 360.85	2 170 388.00	208 467.69

The net energy needs are higher than the protein needs (Figure 3). This can be explained by the composition of the herds which are mostly dairy cows where the energy intakes are more important for maintenance, milk production but also for the growth and development of the calf. Energy is often the limiting factor in high producing dairy cows in early lactation. An energy deficit negatively influences production.

Figure 3. Graphical distribution of annual nutritional needs of herds.

Feed autonomy

Global autonomy

The autonomy degree of the surveyed farms can be qualified as high (Figure 4).

The DM autonomy is on average 76.63%, while it logically decreases a little for energy (74.33%) and decreases even more for proteins (72.08%).

Figure 4. Graphical representation of the degrees of total food autonomy in dry matter, energy and protein. DM TOT: Total dry matter autonomy, Energy TOT: Total energy autonomy, Protein TOT: Total protein autonomy.

This development is accompanied by a greater spread of values: farms are between 13.13 and 100% for DM, 9.46 and 100% for energy and 8.10 and 100% for proteins. The recorded autonomy remains high compared to farms in the region of Tizi Ouzou where the results reported by Kadi and Djellal (2009) are 43.2%, 35.5% and 42.3%.

The results obtained by Khelili (2012) in the High Cheliff region where the autonomy degree is 36.57% for DM and 26.5% for energy. In 2013, the level of overall autonomy obtained by Saidani in the region of Tizi Ouzou was very low for the DM with 41.05%. This value is low for protein (26.62%) and even lower for energy (25.65%).

These results are relatively comparable to those of Paccard et al. (2003a) for the autonomy levels in DM, energy and proteins which are respectively 86.2%, 82.2% and 71.4%, likewise compared to those reported by Rouille et al. (2014) namely: 88% in DM, 87% in energy and 77% in proteins.

Forage and concentrate Autonomy

Forages represent the major part of the ration, and according to Huchon et al. (2003), fodder autonomy allows to characterize the capacity of the farmer to valorize his resources.

The forage autonomy obtained is very high (figure 5), little different between the surveyed farms and homogeneous in terms of DM, energy and proteins.

Figure 5. Graphical representation of fodder autonomy in dry matter, energy and protein. Fod DM: Fodder autonomy in dry matter, Fod Energy: Fodder autonomy in energy, Fod Protein: Fodder autonomy in protein.

The fodder autonomy of the surveyed farms is on average 93.58%. The majority of them (80%) have an autonomy of more than 90%, five of which have an autonomy of 100% and only one farm with an autonomy not exceeding 70%.

These results are similar to those found by Paccard et al. (2003b), Rubin (2003) and Rouille et al. (2014).

The fodder autonomy obtained by Kadi and Djellal (2009) and Saidani (2013) in the region of Tizi Ouzou is lower with a rate of 65.4% and 65.16% respectively.

Autonomy in concentrate is zero for all the surveyed farms, all the breeders buy the totality of their concentrate and nothing is produced in the farms (all utilised agricultural area is reserved for fodder). Consequently, we observe a total dependence of the surveyed farms to the market and its fluctuations.

CONCLUSION

This study reveals that the total food autonomy is high for all the surveyed farms, it is on average 74.79% for dry matter, 75.10% for energy and 76.36% for protein. The majority of dairy farms are practically autonomous in fodder (or even totally for a few) because all of them cultivate it. And for those who are not, they are forced to buy the necessary quantities of hay and / or straw to fill their deficit. This high fodder autonomy and little difference between the farms, reflects the coherent choices made by the breeders. As for autonomy in concentrate, their dependence is complete, breeders' resort to external provisions.

Through this study, we have identified certain constraints which does not contribute much to improve the autonomy:

- The land and climatic constraints which are difficult to circumvent by the breeders;
- Lack of knowledge among breeders of the types and varieties of forage to be used, as well as their requirements; poorly monitored forage affects the quality of the product obtained (poor quality hay, very coarse and poor in nutrients);
- Lack of permanent grasslands and existing ones are of poor quality;
- The availability of green fodder is limited to a period of 6 months; the rest of the year, low feed hay and straw are the only basic ration for dairy cows;
- Uncontrolled grazing practice;
- Excessive purchases and irrational use of concentrate which generates a high production cost and a nitrogen imbalance of the farm, thus accentuating the pollution risk;
- Lack of labour;

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Conflicts of Interest

The authors would like to declare that there is no conflict of interest related to the publication of this paper.

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