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Case report

Strategic approach to achieving milk self-sufficiency and rehabilitation of pastoral areas

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Abstract

Biodiversity is the natural repository of all animal, plant and microbial resources. These resources are the biological basis of food security. The diversity of local species and the genetic diversity they contain play a major role in economic, social and cultural development. Algeria is considered to be one of the world's biggest consumers of milk, importing large quantities in the form of powder to supply the national market, which is seen as a drain on the public treasury's import bill. Algeria's biological diversity, in terms of both animal and plant resources, needs to be assessed with a view to integrating it into local sustainable development in order to achieve food self-sufficiency, particularly in the dairy sector, given the presence of high-value local genetic resources. Dairy animal resources suffer from fodder and nutrition problems, which makes the milk production process difficult. Algeria can find solutions for feeding livestock by investing in steppe areas and rehabilitating them with vegetation. These points have been addressed by a great deal of scientific research at both academic and laboratory level, and field application is awaiting qualitative mechanisms and approaches.

Keywords: food security, biodiversity, milk, steppe rehabilitation.

الملخص

ويلعب الغذائي للأمن البيولوجي الأساس هي الموارد وهذه والميكروبية والنباتية الحيوانية الموارد لجميع الطبيعي المستودع هو البيولوجي التنوع أكبر من واحدة الجزائر وتعتبر والثقافية والاجتماعية الاقتصادية التنمية في رئيسياً دوراً تحتويه الذي الوراثي والتنوع المحلية الأنواع تنوع للخزينة الاستيراد لفاتورة استنزافاً يعتبر ما وهو الوطنية، السوق لتزويد مسحوق شكل في كبيرة كميات تستورد حيث العالم، في الحلب مستهلكي المستدامة المحلية التنمية في إدماجه بهدف سواء، حد على والنباتية الحيوانية الموارد حيث من اجزائر في والتنوع المحلية الأنواع تنوع المستدامة المحلية التنمية في إدماجه بهدف سواء، حد على والنباتية الحيوانية الموارد حيث من الجزائر في البيولوجي التنوع تقييم ويتعين العمومية الحلوب الحيوانية الموارد وتعاني القيمة عالية محلية وراثية موارد لوجود نظرا الألبان، قطاع في خاصة الغذائي، الذاتي في الاستثمار خلال من الحيوانية الثروة لتغذية حلول إيجاد للجزائر ويمكن محمعة الحليب إنتاج عملية عنه ما والتغنية مشاكل من وينتظر سواء، حد على والمية محلية وراثية موارد لوجود نظرا الألبان، قطاع في خاصة الغذائي، الذاتي الاكتفاء تحقيق أجل من وينتظر سواء، حد على والمية المواري والتغذية، المول من ويمكن محمعة الحليب إنتاج عملية يجعل مما والتغذية العلف مشاكل من وينتظر سواء، حد على والمنية الموتوى على كثيرة علمية بحوث النقاط هذه عالجت وقد إلى المول مشاكل من

الكلمات المفتاحية :الأمن الغذائي، التنوع البيولوجي، الحليب، إعادة تأهيل السهوب.

Introduction

Algeria attaches great importance to the agricultural sector, including livestock production. It has implemented several programs to rehabilitate agricultural sectors, including the dairy and meats sectors, which are considered strategic for supplying the consumer market, and in particular for making products accessible to broad social strata, but the import bill for milk powder has a major impact on the State budget (the value of the milk powder import bill for the year 2021 is estimated at around 600 million \$ (ONIL, 2022).

With regard to milk as a consumer product, questions are often asked about the country's ability to meet the needs of its population, currently estimated at 40 million, from its production. This prompts us to attach particular importance to the development of local animal genetic resources in Algeria, which are of strategic importance because the development of the dairy sector depends on better identification and development of local animal breeds. (Lazereg, 2020).

Most of the measures taken to improve this sector have focused on cow herds, which are the main source of milk and the local dairy industry, to the detriment of other animal species (sheep, goats and camels), which have remained marginalised. These measures have involved the intensive introduction of imported cattle breeds, which are often less suited to the local Algerian environment, despite the availability of local animal genetic resources which have not benefited from development and genetic improvement programmes.

The low level of supply of local animal products on the national market, and their high cost in the face of low consumer purchasing power and insufficient animal productivity, have led state institutions to focus on supporting genetic improvement programmes, preserving local breeds and preserving the biological heritage and diversity of animal and plant resources.

The launch of programmes to develop the agricultural sector and the dairy industry must take account of previous failures to introduce exotique breeds, and these programmes must lead to the renewal and development of new, more efficient local animal resources (sheep, goats and camels) because they are capable of guaranteeing ideal production under Algerian climatic and environmental conditions. Programmes such as these can create jobs and open up new areas of craft and industrial activity linked to agriculture (start-ups specialising in animal genetic improvement, specialised services in various animal sectors), with all the added value they bring. The integration of these local animal breeds, which are well adapted to the different Algerian environments, can be beneficial from the point of view of international trade by highlighting the genetic and productive characteristics of our local breeds at agricultural exhibitions and international scientific forums, and by presenting them through documents containing scientific statistics and research proving the merit of these breeds on a global scale.

The strategic approach to increasing milk production in Algeria:

The latest report published by the DAVOS World Economic Forum on 17 January 2023 is an international tribute to Algeria's achievements in making significant gains in food security through the development of national agricultural production. Algeria first in the Arab world and Africa for three consecutive years 2020. -2021-2022 in terms of embodying the United Nations' sustainable development goals in the area of food security, as the achievements recorded to date have enabled Algeria to lay the foundations for building a modern agriculture capable of meeting the challenges of food security through local food production and the establishment of sustainable local development. These international rankings inevitably indicate that Algeria is capable of rising to other challenges in order to make the most of local production, and among these challenges, in this article we look at milk self-sufficiency in Algeria and the means of achieving it.



Figure 1. DAVOS World Economic Forum Report January 2023 (https://www3.weforum.org/docs/WEF_Food_Nature_and_Health_Transitions_2023.pdf)

Algeria's local production currently supplies only 30% of its milk needs, as it relies on imports for the remaining 70% of the foreign market's requirements, which leads us to wonder whether local production is low or whether there is something on the ground. that is not being exploited?

In the past, milk production was not just limited to cows, as the biological diversity of animal species means that the production of this substance is also linked to other animals such as camels, sheep and goats. In this context, several countries are considered to be important models in the production of milk from various animal species, such as Mauritania as an African country or France as a European country. Algeria, as a country with a rich biological diversity of dairy animal species (cows, camels, ewes, goats), can draw inspiration from the experiences of other countries, according to the scientific studies carried out, through which a new qualitative approach can be adopted far from the traditional approaches that have proved to have limited horizons. (Gaouar, 2017)

A scientific field and laboratory study of genetic resources:

The applied genetics research team at the University of Tlemcen is carrying out scientific research into the genetic diversity of local dairy animal species represented in goats, ewes, camels and cows.

The research focused on field trips to study the phenotype of breeds in the field, where the phenotypic characteristics of each animal species were classified into two categories: characteristics of a quantitative mathematical value, and specifications of a qualitative value.

All the information and specifications are collected in a database, with blood samples taken from each animal to extract the DNA. In the next step, an in-silico statistical mathematical analysis of the database is carried out using software. At the same time, the DNA is analysed in the laboratory.

In the final stage, the statistical analytical results are compared with the DNA analytical results from the biological laboratory, enabling us to make a final decision on breed classification, while documenting the characteristics of each breed, including qualitative and quantitative milk production.

Sheep: 12 local breeds were studied in the field: ouled djellal, Samiaa, Rambi, Taadamayt, Hamra, Barbarine, Berbère, Tazghzaouth, Aldhara, Alsarandi, Efilène, Sidaoun and D'men. They are characterised by low milk production, sometimes reaching 1 litre in the case of the ouled djellal breed, but in terms of quality, ewe's milk is characterised by a high fat concentration (Djaout, 2015).

Goats: Field research has shown the existence of 4 local breeds: Arbia, Makatia, Naine de Kabylie and Mozabite. Their milk production is low compared with imported foreign breeds such as Shami, Alpin, Saanen and Morisano goats. The milk production yield of local Algerian goats cannot be considered to be definitively as low as long as they are not subjected to optimal conditions such as concentrated forage feeding. On the other hand, local goats are highly resistant to disease, which reduces the cost of medication for the breeder compared to imported breeds that are highly susceptible to disease. (Fantazi, 2017) (Tifiel, 2015)

Camelin: Research has indicated that the naming of camel breeds has been adopted on the basis of the tribes to which they belong rather than phenotypic and productive characteristics from one region to another, bringing them closer to being classified as groups of them than as breeds, notably the Sha'ambi camel, the Targui camel and the steppe camel (Meghelli I, 2017) (Kaouadji Z, 2017).

Cattle: The local cows belong to a group called 'La Brune de l'Atlas'. This breed has undergone modifications depending on the natural factor and the environment in which it lives, and has given rise to branches such as Guelmoise, Al-Shorfa, Chelfienne, Tlemceniene and Setifienne. There are other groups, but with smaller numbers, such as the Djerba breed located in the Biskra region and the Kabylie and Chaouia breed located in the Kabylie region. Considering that the graphical and genetic analyses have shown that the Guelmoise breed is important to include in genetic improvement programmes in terms of its ability to produce more in a suitable environment, as well as being resistant to disease. (Abdeltif, 2022)

Gaouar et al 2025, Genet. Biodiv. J, 2025; 9 (1) DOI: 10.46325/gabj.v9i1.423 A new approach:

According to statistics from the Office National Interprofessionnel du Lait (ONIL), the majority of national milk production takes place in the WILAYA of the coastal plains, where 11 WILAYA contribute around 50% of national milk production at a production rate of over 100 million litres per year, while the remaining 50% of national production is distributed to the rest of the WILAYA, while over 60% of sheep are distributed in the steppe regions. (Temmar, 2005)

Taking into account the factor of geographical distribution and its relationship with national milk production, and taking into account the appropriate environment for each animal species, according to the scientific studies carried out, we find that moving towards new approaches to organising the milk sector has become necessary in order to rationalize expenditure and evaluate the other resources associated with the production.

The new approach consists of allocating the coastal plain areas to cow farming, the mountainous areas to goat farming, the steppe areas to sheep and goat farming, while the desert areas are allocated to camel farming. In this way, each animal species is placed in its ecological environment in which it provides the highest rate of milk production, so efficiency is greater. This process is called the ECOTYPE approach.

In terms of production quality: studies have confirmed that sheep's milk contains an estimated 6% fat content, compared with 3.5% for cows. As for the calorie content, it exceeds one thousand kcal/l in ewe's milk (1043), while its value in cow's milk is estimated at 701 kcal/l (table 1).

Milk ingredients	Cow	Goat	Sheep	camel	Buffalo
% of water	87,78	87,30	82,95	87,59	83,81
% of dry matter	12h25	12.12	17.05	12h41	16.19
% Fat-free dry extract	8,65	7,97	11.10	8.45	9.44
% fat	3,60	4.15	5,95	3,96	6,75
% proteinaceous material	3.24	3.02	5.25	3.22	4.18
% lactose	4,65	4.21	4,91	4.56	4.45
% of ashes	0,76	0,74	0,94	0,79	0,81
pH	6,68	6,70	6,79	6,55	6,70
% of acidity	0,18	0,17	0,19	0,15	0,18
Density	1 032	1 031	1 037	1 029	1 035
Energy calories (Kcal/l)	701	721	1043	665	1035

Table 1. Physico-chemical composition of different types of milk (FAO)

Comparative study:

Comparison of current national milk production with the production that could be achieved if all the other animal species on the ground were included, taking into account the number of head of livestock for each animal species.

Cattle/Sheep:

Qualitative comparison: Algeria currently supplies only 30% of its milk requirements, the remaining 70% being imported. This 30% of milk is produced by a national cattle population estimated at 750,000 dairy cows (the source?). If we consider that cow's milk contains an average of 45 grams/litre of fat, then ewe's milk can contain the equivalent of 120 grams/litre of fat, i.e. three times as much, and since one ewe produces the same amount of fat per litre as three litres of cow's milk, the nutritional value of 1 litre of ewe's milk = 2.5 litres of cow's milk.

In terms of production quantity: cows in Algeria produce an average of 20 litres of milk per day, with a daily consumption estimated at 10 kg of green herbs for 1 litre of milk, with a gestation and birth period estimated at 9 months.

Ewes in Algeria produce around a litre a day, in exchange for a daily consumption of green grass estimated at 5 kg per litre, with a gestation and parturition period estimated at 5 months.

From a qualitative point of view, the quantity of fat produced by one cow for 20 litres is equivalent to that produced by 6 milking ewes. According to statistics, there are 28 million sheep in Algeria, of various imported and local breeds, including 15 million ewes, i.e. the equivalent of 2.5 million cows (one cow for every 6 ewes). If 750,000 dairy cows guarantee 30% of the needs of the national milk market, 2.5 million cows will supply 100% of national needs, which will be offset by the production of 15 million dairy ewes.

Cows / Goats:

Cow's milk contains 45 grams/litre of fat, while goat's milk contains 40 grams/litre of fat, which leads us to the equation 1 litre of goat's milk = 1 litre of cow's milk.

A goat produces an average of 2.5 litres/day and consumes 4 kg/day for 1 litre, according to studies.

In terms of quantity, the milk production of one cow = 6 goats.

There are 5 million head of goats in Algeria, including 2 million goats of various imported and local breeds, equivalent in quantity to what is produced by 330,000 cows. If 750,000 cows supply 30% of national needs, then 330,000 cows supply 13% of national needs, which means that the number of dairy goat heads on the ground can supply 13% of national milk needs.

General summary:

The ECOTYPE approach makes Algeria a milk exporter with an estimated surplus rate of 40% instead of importing 70% of its national needs, with the integration of all milk-producing animal species (camel, goat, cattle, sheep) and respect for the environment and geographical classification of each species, which will push the milk sector to be more professional and organised than it is at present.

This strategy will create a new national economic mechanism in the agricultural field, which will open up horizons for young people to become more involved in this area, while at the same time advancing the process of organising state subsidies in the dairy production sector and making the subsidy process more efficient than it is at present.

The strategy is based on the following points:

- Rethinking the support system and granting subsidies to livestock farmers.
- Encourage breeders of other species, such as sheep, goats and camels, by providing support for collectors to collect their milk, as sheep and camel breeders complain about the collection process.
- The provision of milk collectors and their support by the State will encourage these farmers to produce milk.

Firstly, aid and subsidies are granted by adopting a new criterion, which is the quality of the milk (containing the percentage of fat) as opposed to the quantity.

This new method of support will encourage farmers to adopt a process of genetic selection within their herd, leading to an increase in the number of productions over time.

A producer who supplies high-fat milk can in no way obtain the same financial support as a producer who carries out fraudulent operations that can only be detected by biochemical laboratory analysis.

Also through the collection of milk from breeders (1 liter per ewe) the estimation of the number of head and more rigorous and therefore the subsidy more adapted and will be given to the real producers. We can do the same thing for the other species. This system will encourage breeders to produce better to have more subsidy.

Secondly, local nutrition must be integrated and adapted to the existing herds of sheep, goats, camels and cattle, by rehabilitating the steppes and Saharan pastor.

Steppe rehabilitation is in itself an agricultural project with economic and environmental dimensions, and has a direct impact on the rearing of dairy animals.

The strategic approach to rehabilitating the steppes:

The steppe rehabilitation project is subject to purely technical standards and scientific approaches inspired by the research carried out by Algerian universities and researchers in this field. The steppe rehabilitation project can be developed on the basis of the following stages:

Study of Algeria's agricultural geography:

Algeria covers an area of more than 2 million square kilometres, with a variety of climatic and ecological regions, including more than 30 million hectares of fertile farmland.

If cultivated and exploited, this fertile land makes a major contribution to ensuring food security. The steppe is a major source of food, both for humans and for animals such as small ruminants, while at the same time creating an ecological wall against desertification.

The steppe is the largest area, covering 30 million hectares, which is 8.4 per cent of Algeria's surface area. The steppes are located in Algeria in the geographical area confined between the High Atlas Mountains to the north and the High Atlas Mountains to the south (figure 2), where the geographical cradle is most suitable for sheep.





The steppes and Sahara have long been seen as the main resource for raw materials particularly for the supply of livestock, but this role has now become limited and temporary, and approaches the degree of danger, because the process of desertification in the steppe and Saharan pastoral zones is taking on an increasingly important environmental dimension and is capable not only of compromising any attempt to develop these regions, but also of severely limiting livestock activity in the steppe and pastoral activity in the region, which has a direct negative effect impact on national food security, which calls for a proactive action plan to address this phenomenon. (Hadeid, 2015)

As a matter of urgency, taking into account climate change and the food crisis, the preparation and exploitation of these lands has become a national priority.

The development of pastoral lands must necessarily form part of an overall planning and development strategy, taking into account all the environmental, geographical, soil and social characteristics of the steppe and Sahara, and based on genuine consultation with the local population

Gaouar et al 2025, *Genet. Biodiv. J*, 2025; 9 (1) **DOI:** 10.46325/gabj.v9i1.423 within the framework of development projects.

Underlined objectives:

1- Rehabilitate the pastoral zones by involving and including local plant species of high genetic value adapted to the environmental conditions of the region.

2- Solve climate problems by increasing rainfall, creating new secondary climates and reducing the region's high temperatures.

3- Increase biological diversity from an ecological point of view and fertilise the soil.

4 - Contribute to the production of food and fodder for livestock and make it a source of nutrition.

5- Economic: Integrate beekeeping into the region, set up beehives and increase national honey production, as well as making it a source of medicinal plants.

6- Social: Create jobs, preserve the region's social structure of nomadic Bedouins and herders, and improve rural life in the region.

Methodology:

1- Coordination between university researchers, nurseries, town councils, organizations and associations, mosque imams in raising social awareness and including breeders and bee keepers in order to adopt the project.

2- The project starts with 5-hectare farmland units on the high plateaux and Sahara.

3- The pastoral area will be divided and classified according to the rate of rainfall and the presence of water (areas of heavy rainfall and lots of water, areas of little rainfall and little water).

4- The soils are chosen in areas that do not cross flood plains and flood valleys.

5- The land is neither enclosed nor fenced, but rather open, with the possibility of a psychological study of the behaviour of the community and local residents towards the project and the extent of social awareness.

Technical and scientific work:

Among the main plants in the rehabilitation of pastoral paths will be the jujube, a thorny shrub capable of protecting the other species planted in our project and very resistant to drought. The process of collecting wild jujube cuttings for planting in the ground begins in the autumn:

1- The tools used are sterilized with bleach.

2- Cuttings are taken from visually pre-selected shrubs (no disease and good conformation).

3- Only 10 cuttings are taken from each bush, no more, to avoid genetic similarity between the total number of bushes.

4- The cuttings will be taken from regions that have already been rehabilitated to avoid problems of adaptation after reforestation (each cutting will be reforested in its region of origin when its possible).

5- Each cutting must contain at least 6 germinating eyes.

6- All the cuttings that will be planted in the farmland allocated to them (around 8,000 cuttings at a rate of 2,000 cuttings/hectare) must first be planted in a nursery for two years so that they reach a certain size before planting. This length allows them to be after planting an ecological wall and it has the ability to resist and survive on the one hand, and on the other hand, this length allows it to create a partial climate and a secondary environment vertically in the interface between the surface of the earth and the planted shrub. This environment allows medicinal plants and herbs to develop under the protection of the planted cuttings that will grow. To become large shrubs, these are also

chosen according to the rainfall rate for each region and their adaptation to each environment.

7- The planting process is carried out by creating units of shrubs, each unit consisting of four wild jujube bushes in the shape of a square with a prickly pear bush in the middle at the perimeter of each hectare, as one hectare is capable of accommodating 400 plants, which means that the 4-hectare floor will comprise 1,600 plants. Inerme prickly pear is grown in the centre of each unit for several reasons:

1- It is a source of food for dairy ruminants on the one hand, and for the production of vegetable oils on the other.

2- It is an ecological fire wall for areas.

The technical details of the distribution of planting sites and the classification of agricultural land are presented in the figure 3.

8- At the level of the great Sahara course, the dromedary will be used as an agent of plant dispersal since a good number of plants in this region only grow if they pass through the digestive tract of this animal (Trabelsi et al., 2023). Some regions in the Sara where even the dromedary cannot access, manual sowing will be used via the production at the nursery level of dromedary dung containing the seeds of Saharan course plants.

9- For areas with low rainfall:

- In accordance with the principle of (nature's selection) and according to the same saying (Sidra or Batma), wherever the jujubier (Sidra) plant is found in the desert and steppe, there is the Pistachier of Atlas (Batma), we harvest the seeds that have fallen from the Pstachier of Atlas bushes, and seeds from the acacia bush, based on bushes located in very dry areas, as its seeds carry drought-resistant genes and thus produce drought-resistant trees.
- The Pistachier of Atlas produces fruit and is used in medical treatments. It can also be considered to carry cuttings from the Pistachio Vera. The acacia bush is an important source of high-quality wood. (BOUBEKEUR S, 2017)

10- For areas with good rainfall:

- The emphasis is on planting carob, fig, olive, caper and prickly pear trees, with watering at least once a month for the first two crop years.
- All these trees are adapted to the climates and environments in which they are planted, and at the same time have medical, nutritional and ecological importance.
- The town hall is involved in the monitoring and follow-up process, as it will be responsible for providing the initial watering process.
- In the case of financial support, it is advisable to use new irrigation techniques.
- Each plot consists of 4 hectares planted, in the middle of which is one hectare of unplanted farmland, as a margin for nature to restore the natural growth of plant species without the intervention of human factors.
- Each 5-hectare unit is separated from the other unit adjacent to it by a 6-metre-wide lane, to make it an eco-tourist park for families, also allowing beekeepers to install behives and create transit channels for the animals.



Figure 3. Diagram illustrating the technical method for dividing pastoral farmland into units and distributing cultivated plant species

Recommendations:

- The results start to appear in the fourth year after planting, which will make Algeria a model for combating desertification and rehabilitating pastoral area in the steppe and Sahara.
- This model could be required and approved by the UN organizations and adopted as a model experiment by several other countries working to combat desertification.
- ➢ If the process is extended to the whole of the Algerian steppe region, a green belt will be created that will create a current of cold air, which in turn will improve rainfall in the region.
- Genetic improvement: for the preservation of local genetic heritage, the scientific skills exist and so does the biodiversity that forms the basis of the genetic improvement process, for sustainable local development.

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