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DOI: 10.2478/agr-2024-0011

THE ANNALS OF "VALAHIA" UNIVERSITY OF TARGOVISTE

TYPOLOGY OF LIVESTOCK FARMING IN THE OASIS AGROSYSTEMS OF ADRAR (SOUTH-WESTERN ALGERIA)

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Abstract

For centuries, the Saharan oasis agro-systems of Adrar region have fed many generations, based on an original organization, based on the efficiency of drainage water on the diversification of crop systems in association with small livestock farming. The aim of the work is to describe the systemic typology of oasis livestock farming in the Adrar region (southwest Algeria). In order to assess the livestock typology, a series of surveys were conducted on 164 farms in the oases of the study region. The analysis reveals that the production system, traditionally aimed at subsistence agriculture. The dominant production system is an intensive system, characterized by intensive mixed food crops (Phoenicuculture, arboriculture, herbaceous crops: cereals, fodder, market gardening, industrial and condiment crops), in association with livestock farming mainly of small ruminants (goats and sheep). The livestock system is characterized by a family type, small in size in traditional management. It is generally managed in stalls and its feed comes mainly from fodder crops, domestic waste and by-products of palm groves. Family livestock farming can be an important source to ensure a certain production of animal origin (milk and meat) for family self-consumption. As a result, it can contribute to ensuring food security, family financial security and improving soil fertility in oasis farm plots.

Keywords: Oasis, livestock, agrosystem, Adrar, Algeria

1. INTRODUCTION

The livestock system is the set of practices and techniques implemented by a breeder, a farmer or a community to exploit natural resources by animals and thus obtain a desired production. It is therefore a set of elements in dynamic interaction, organized by man in order to enhance the available natural resources through domestic animals to obtain varied productions (milk, meat, skins, work, manure, etc.) or to meet other objectives [1]. Livestock occupies an important place in Saharan agriculture, since it is a symbolic activity anchored in the consciousness of pastoral populations, whatever the nature of the goods they have. Family livestock farming finds its place in the perspective of economic development of the regions concerned, since it allows rural populations to live and benefit from it in an environment unfavorable to human survival and also to improve the socio-economic standard of living of rural populations, given that livestock farming is a source of subsistence for more than 30% of this population [2]. The integration of agriculture and livestock farming allows for a simultaneous and synergistic intensification of plant and animal production that meets the objectives of increasing production, income of agricultural households and more efficient use of resources [3].

The breeding of small ruminants in the oases of the Adrar region continues to be practiced despite its small-scale management and heterogeneous racial composition. This mixed breeding method constitutes a source of local supply for oasis households [4,5]. The present work aims to know the current state of livestock farming, to analyze the situation of animal production and their typology in the region of Adrar (South-western of Algeria).

2. MATERIALS AND METHODS

2.1. Study area

The wilaya of Adrar, located in the center of the Algerian Sahara in the southwest, is positioned at 27°52′00″ north latitude and 0°17′00″ west longitude, with an altitude of 259 m.

It covers an area of 222,492 km² and is approximately 1,543 km from Algiers. Adrar is geographically limited by the wilaya of Timimoune to the north, by those of Béni Abbes and Tindouf to the west, by the wilaya of In Salah to the east, and by the wilaya of Bordj Badji Mokhtar to the south. The wilaya of Adrar is divided into three large Saharan regions:

• Touat: The largest and most popular, rich in oases, foggaras, ksour and population. It extends from Tasabit to Reggane.
• Tidikelt: Extends from Aoulef to Ain Saleh.
• Tanezrouft: Extends from Reggane to the wilaya of Bordj Badji Mokhtar. Each region has unique characteristics that contribute to the diversity and appeal of this part of the Algerian Sahara.

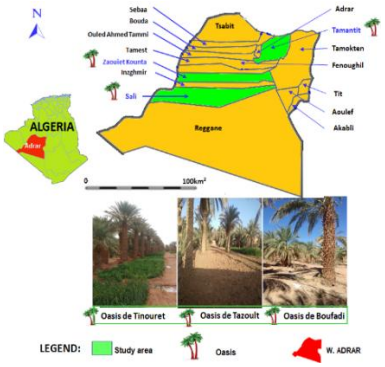

Figure 1. Location of study area

2.2. Methodological approach

The study is based on a survey carried out in 2022 on a sample of 164 mixed farms (agro-livestock).

Table 1. Characterization of the study oases

Name of Oasis	Tinouret	Tazoult	Boufadi
Commune	Sali	Zaouet Kounta	Tamntit
Geographic coordinates	26°36′8.40 ″N 0°1′5.89″ W	27°10′21.5″N 0°09′56.6″W	27°42′48.89″N 0°16′23.65″W
Area (ha)	162	105	260
Number of farms	405	120	295
Number of respondents	81	24	59

The aim is to collect information relating to the structure of the farms, the social status of the breeders and the characteristics of the livestock (types of livestock, livestock management: feeding, reproduction and habitat) in the 3 study oases (Tinouret/Sali, Tazoult / Zaouet Kounta, Boufadi/ Tamntit) of Adrar in the southwestern of Algeria.
Information was collected on the situation of the farms and the farmer-livestock farmers from the Directorate of Agricultural Services of the Wilaya of Adrar and other information was collected from the agricultural subdivisions.

3. RESULTS AND DISCUSSIONS

3.1. Agricultural situation

The agricultural area in the studied oases is 260 ha with 5340 palm trees and 295 farms in the oasis of Boufadi, 105 ha with 2110 palm trees and 120 farms in the oasis of Tazoult, 162 ha with 2590 palm trees and 405 farms in the oasis of Tinouret (Table 1). The average size of the farms is of the order of 0.5 ha in the oasis of Tazoult, 0.48 ha in the oasis of Boufadi, 0.43 ha in the oasis of Tinouret with a variation of 0.2 to 3 ha. 40% of the farms surveyed are less than 1 ha in size and 33.33% of the farms are larger than 1 ha. Concerning the main activity of the farm, 88% of the farms surveyed are mixed (crop, livestock) and 12% are of the crop-only type.

Table 2. Agricultural situation of the study oases [6]

Oasis	Tinouret	Tazoult	Boufadi
Area (ha)	162	105	260
Number of date palm trees	2590	2110	5340
Number of farms	405	120	295
Average farm size (ha)	0.48	0.50	0.43
Cultivation activity (%)	17.28	00	19
Mixed activity (%)	82.72	100	81

This phoenicicole heritage (date palm trees) is answered in all the farms playing the role of windbreak and protector of other crops against the sun.
The date palm (*Phoenix dactylifera*) is a plant known for its tolerance to extreme climatic conditions of drought and temperature; it plays a socio-economic and ecological role. It constitutes the essential element on which the entire oasis agrosystem is based [7-9] In the study oases, the workforce is completely family-based.
Women are involved in harvesting, weeding, and men take care of plowing, fertilizing, and irrigation.
For irrigating plots: the majority of respondents use water from the foggara (86.34%), with 13.66% of respondents also using water from individual wells and tap water from homes.
Water distribution is maintained by foggaras, an ingenious ancestral traditional irrigation system that is widespread in the southwest of the country [7,8].

3.2. Animal numbers of the farms surveyed

Table 3. Numbers of species surveyed in the oases studied

Oasis	Tinouret	Tazoult	Boufadi
Sheep	554	157	399
Goats	228	63	161
Poultry	113	29	72

For livestock numbers (*Table 3*), the Tinouret oasis occupies the first position with a total number of 554 sheep, 228 goats, 113 poultry, followed in 2nd position by the Boufadi oasis (with 399 sheep, 161 goats and 72 poultry) and finally the Tazoult oasis (157 sheep, 63 goats and 29 poultry) poultry).
In the study oases, the size of the herds varies between (2 to 13 heads) generally mixed (sheep, goats, poultry). The animals are kept permanently in stables (*Kouri*).

Figure 2. Types of livestock in the study oases (a- Sheep, b- Goat, c-Poultry)

In general, breeding is conducted in a traditional way followed mainly by women. The examination of the size of the herds by species, shows the dominance by sheep (2 to 9 heads per farmer-breeder) in their majority are local breeds crossed between (D'man, *Sidaouen* and *Folan*) and some head of the steppe called (*Oulad Djellal*), intended for the production of meat.

Figure 3. Sheep breeds raised by farmers (a- Sidaouen, b- Folen, c-D'men, d-Cross-breed)

According to Dollé [10], the sheep breed *D'mane* perfectly adapted to these intensified breeding systems Goats are also local breeds (3 to 6 heads per farmer-breeder) intended for the production of milk and meat. The livestock farming is integrated as an essential component of the production system and concerns sheep and goats [11]. According to Toutain [12], in the oases, livestock farming practices are quite varied more or less intensive, and revealing the availability of water and its level of exploitation.

3.3. Typology of the family livestock system in the study oases

According to Dollé, [10], indicates the presence of different forms of livestock farming are practiced in the oases around the Sahara, the most efficient ones involve on-site valorization of the oasis' fodder production. In the 3 study oases, the livestock system is of the intensive family type. It is characterized by the production method in above-ground stalls, all the feed is distributed. Small ruminants are mainly managed by two types of livestock systems:

3.3.1. Type 1: Domestic intensive livestock system (at home or permanent stall), based on sheep/goats/poultry whose numbers are small (2 to 6 heads). This herd remains all day inside the livestock housing). The three species are in permanent stalls and are raised at home (live with the family).

3.3.2. Type 2: intensive livestock system associated with agriculture in the farm, dominated by sheep farming (7-15 heads per farm) in stalls, strongly associated and linked to the crop system.

The animals are fed with feed mainly from the farm (green fodder crops: alfalfa, barley).

According to Chaabena [13], family farming consisting mainly of goats and sheep is the most practiced, as for cattle, their breeding in the Saharan zones is limited. We also find as family farming rabbits, donkeys, turkeys, mules and horses.

3.4. Livestock management (feeding and livestock buildings)

Livestock management is a sum of techniques and methods, called upon to satisfy the needs of the animals and their production, representing the know-how of the breeder, the central element of the livestock system [14].

The most common livestock management system in the study oases is an intensive system [15].

3.4.1. Feeding the herd

In the farms studied, farmer-breeders instantly use palm grove harvest waste and cereal waste to feed their animals. During the winter period and early spring, the livestock feed is based on green fodder, such as sorghum (*Sorghum bicolor*), alfalfa (*Medicago sativa*), Corn (*Zea mays*), millet (*Pennisetum glaucum*) oats (*Avena sativa*) and barley (*Hordeum vulgare*), as well as straw and cereal hay, waste from market garden crops.

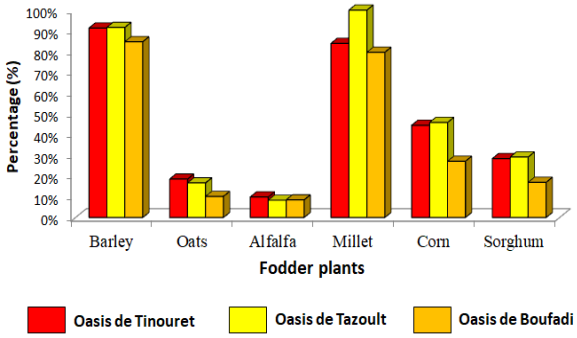

Figure 4. State of diversification of fodder crops in the study oases

Figure 5. Green fodder plants grown in the study oases (a- Sorghum, b- Alfalfa, c- Corn, d- Oats, e- Barley, f-Millet)

In summer until autumn, the main source of green fodder available is the millet (*Pennisetum glaucum*) frequently grown in the regions of Adrar and Timimoune (Touat and Gourara) Breeders generally supplement their ration with corn, wheat and barley. The supply of complementary feed is composed of mixture, palms, date waste, kernels, dried bread and waste from the food table. Sometimes barley grain and wheat bran are distributed to sheep prepared for fattening.

Watering of the animals is based on the distribution of the feed ration. Fodder resources for the surveyed herds are limited and are related to the small areas reserved for fodder.

This deficit is partly compensated by by-products from palm groves. Industrial concentrates.

3.4.2. Livestock buildings

In the study oases, livestock buildings are generally characterized by small and closed areas.

Almost all breeders (90%) house their animals in the ksar in old houses built in *toube* (clay/sand mixture), the remaining (10%) in the nearby palm grove in premises and shelters male built with zinc or palm roofs.

In general, the animals are permanently closed and do not go out, the *kouri* or livestock buildings divided into two or three parts, one to isolate the adult males, and another reserved for weaning the young.

The third for the females and the goats contains an open-air exercise area t. The breeding management of the herds is very traditional (liber), sometimes the males are permanently with the females throughout the year because of the lack of space.

Figure 6. Examples of livestock buildings in the study oases

3.5. The benefits of livestock farming

Livestock farming plays a very important role in oasis production systems [10].

Livestock farming provides multiple functions, promoting either supplementary activities to ensure household food coverage, diversification of income sources for family cash flow needs, capitalization of surpluses in the form of savings or activities to enhance the value and marketing of livestock products [16,17].

Among livestock products:

3.5.1. Milk

Milk production in the study oases appears very modest, with ewes producing between 1 and 3 liters per day (generally milk suckled by newborns), goats between 1 and 2 liters per day, In the Tinouret oasis, the 153 goats in all herds provide a quantity of 66 liters per day, with an average of 0.81 liters per goat per day. Goats are present in almost all the mixed farms studied, with a population of (1 to 4 goats). Thus, in the Boufadi oasis, the 109 goats in all herds provide 46 liters per day with an average of 0.77 liters per goat per day. Goats are present in almost all the farmer-breeders studied, but in very small numbers (1 to 3 goats). In the Tazoulet oasis, the 49 goats in all herds produce 18 liters per day, with an average of 0.75 liters per goat per day. Goats are not present in all the farms studied, the number is (1 to 4 goats per farmer-breeder) (Table 3). The goats are milked manually in the morning once a day. This milk production is intended for family self-consumption. The low milk productivity may be due to the diet or limited genetic potential [18].

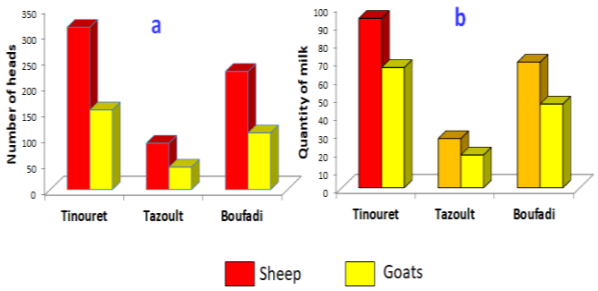

Figure 7. Milk production in the oases studied

3.5.2. Meat

The production of meat in the surveyed oases escapes any control of the services concerned. It is generally intended for family self-consumption. Because there are some clandestine slaughters (at home), the oasis farmers ensure the fattening of the sheep generally for the feast of Eid El-Adha and the socio-religious events the waada (*Zyara= Visit*), the weddings. These cases are observed throughout the Maghreb territory [19]. The slaughtered animals are of local breed with low exploits due to the lack of technical monitoring and supervision of the farmer breeders. The oasis families of this region raise their animals for self-consumption like the oases of the Maghreb countries [20, 21].

3.5.3. Organic Manure

In the study oases, livestock farming provides organic manure from herds near or in the oasis. Oasis dwellers regularly provide manure to maintain the fertilization of the plots in order to improve plant production.

According to Dollé et al. [22]; de Sainte Marie [23]; Dollé [10], indicate that livestock farming ensures the maintenance of the fertility of the oasis soils subjected to highly intensified cultivation practices. Livestock provides significant quantities of manure, used for the fertilization of agricultural land, and therefore contributes to improving the yields of the various crops. It also constitutes a source of capital available to finance the various operations necessary for the installation and maintenance of crop systems [24].

4. CONCLUSIONS

In the Saharan region of Adrar, the production systems are characterized by an oasis-type system which, since antiquity, consists of an integrated association of three strata: phoeniciculture, arboriculture, market gardening or fodder crops and small family livestock farming. The results of the study of the livestock system show the existence of small herd sizes (between 2 and 8 heads), conducted on a short-term scale with heterogeneity in the oases of Adrar (Boufadi, Tazoult, Tinouret).

The livestock management method is described as intensive. The composition of the livestock is distinguished by a remarkable racial, dominated by crossbreeds (local and introduced) of low production performance, in permanently closed habitats (stabling). Which merits the introduction of modern means of breeding (reasoning of fodder needs, food ration, breeding organization, choice of productive breeds, control of reproduction), training and popularization of farmer breeders.

Livestock breeding is generally less productive, and presents a better source of income (cash) for oasis farmers, provider of energy and local supply for the provision of animal products (meat, milk, eggs) intended for family self-consumption. It also constitutes a source of organic manure for improving soil fertility in highly intensified plots of small size.

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