Mediterranean agro-pastoral systems and agro-ecology: A cross-analysis of two situations in Corsica and in the argane tree area in Morocco

Dubeuf J.-P.

in

Capone R. (ed.), Bottalico F. (ed.), El Bilali H. (ed.), Ottomano Palmisano G. (ed.), Cardone G. (ed.), Acquafredda A. (ed.)
Pastoralism and sustainable development: proceedings

Bari : CIHEAM
Options Méditerranéennes : Série A. Séminaires Méditerranéens ;n. 126

2021
pages 35-48

Mediterranean agro-pastoral systems and agro-ecology: A cross-analysis of two situations in Corsica and in the argane tree area in Morocco

Jean-Paul Dubeuf
SELMET – LRDE –UR045, INRAE-ACT, F-20250 CORTE, jean-paul.dubeuf@inrae.fr

---

Abstract. Agro-ecology is the way of designing agricultural production systems by relying on the functionalities offered by ecosystems. Today, it stands out as the direction to take to meet the challenges of preserving natural resources and combating or adapting to climate changes. Our objective is to explore to what extent agro-pastoral systems in the Mediterranean could be involved into this agro-ecological approach.
After presenting the general principles of agro - ecology in its different environmental as well as social, economic and societal dimensions, we analyze and compare two examples of Mediterranean agro-pastoralism. The first case is Corsica, a French island located in the North-Western part of the Mediterranean, the second one is in the South- West of Morocco in the argane tree biosphere reserve.
From this comparative analysis, a holistic diagnosis of the strengths of pastoral systems but also of their challenges is proposed. Some prospective scenarios are then discussed on the possible futures of these systems and the dynamics to impulse.

Keywords: Agro-ecology, sustainable development, agro pastoralism, Corsica, Morocco, Argane tree area

L'agro –écologie et les systèmes agro – pastoraux méditerranéens : une analyse croisée de deux situations en Corse et au Maroc dans l'arganeraie

Résumé. *L'agroécologie désigne la manière de concevoir les systèmes de production en s'appuyant sur les fonctionnalités offertes par les écosystèmes. Elle émerge aujourd'hui comme la direction à prendre pour relever les défis de préservation des ressources naturelles, d'adaptation au changement climatique ou pour combattre ses effets. Notre objectif est d'explorer dans dans quelles mesures les systèmes agro – pastoraux de Méditerrannée peuvent être impliqués dans cette approche agro – écologique.*
Après avoir présenté les principes généraux de l'agro – écologie dans ses dimensions à la fois environnementales, sociales, économiques et sociétales, nous analysons et comparons deux exemples d'agro – pastoralisme méditerranéen. Le premier concerne la Corse, une île française située au nord – ouest du Bassin, le second est localisée au sud – ouest du Maroc, l'arganeraie, labellisée comme réserve de biosphère.
A partir de cette analyse comparative, un diagnostic holistique des forces du pastoralisme mais aussi des défis qu'il doit relever est proposé. Quelques scénarios prospectifs sont ensuite discutés sur les futurs possibles de ces systèmes et sur les dynamiques à impulser

Mot clés *– Agroécologie, développement durable, agropastoralisme, Corse, Maroc, arganeraie*

I - Introduction, objectives and methodology

For centuries, in a large part of the Mediterranean hinterlands and mountainous areas, pastoralism and agro – pastoralism have been the main form of animal production and the source of unique practices to use specific harsh environments and manage herds on the rangelands. Today, since the middle of the 20th centuries, these traditional systems have faced rural exodus, development of urban littoral and the competition of more productive intensified animal production systems considered as more efficient and more modern. In spite of this realty, pastoral systems are still present in many Mediterranean areas but deeply modified.

While, the awareness of the need to face climate changing and the preservation of bio diversity, and natural resource leads to think about alternative models following agro ecological models, the aim of this study is to explore if the present trends of the Mediterranean pastoralism could answer agro – ecological specifications and under what conditions.

After having reminded the characteristics of pastoralism and its diversity, the several dimensions of agro – ecology are introduced. Then, two Mediterranean situations will be presented and analyzed as emblematic examples to illustrate opportunities for pastoralism to be part of the agro – ecological movement but also their weaknesses and threats. The first one is in the Northern European part of the Mediterranean, the Corsican island, the second one is the Argane tree Area in South Western Morocco. These analyses are based on researches and surveys implemented in each of these situations

II - The principles and definitions of pastoralism and agro-ecology

Pastoralism is a form of animal production based exclusively or partly on the grazing of the spontaneous resources of natural spaces including scrubs, rangelands, etc. but its definition could be diverse according to the local situations and regions. Pastoralism involves all domesticated ruminants (cattle, sheep, goats but also camels and in some regions pigs) and according to FAO (2001), 90% of the dry matter consumed by livestock comes from pasture and pastoral animal production systems. When the production systems combine grazing and crops for feeding the animals, we speak of agro – pastoralism; for instance, agro – pastoral systems are the most common in Europe and Northern Africa where specific characteristics are for instance the practice of limited transhumance on fixed pastures and the use of local breeds. Many Sahel or Central Asia populations are nomadic pastoral shepherds. Pastoralism is considered well adapted to extreme climatic situations and fragile environments whose quality, quantity and accessibility to resources are very uncertain. Although pastoralism is often named as extensive, it is also intensive in skilled labor (Linck, 2013), which is often neglected and the shepherds have generally a low social and marginal status.

The development of animal production like all agricultural activities has been dominated by one main model based on the improvement of technical performances of the production factors. Most of innovations have led to a more intensive use of external inputs (Stassart et al., 2012) with a significant and permanent growth of production units. Their negative effects are visible on bio – diversity, eco – systems and climate change but also on working conditions, human welfare, the resilience and structural weaknesses of many farms and the cause of many disparities (Mazoyer and Roudard, 1997). Once, based mainly on the use of natural resources provided by rangelands, the pastoral production systems and particularly, the sheep and goats Mediterranean ones have been more and more artificialized with an increasing use of feed stuffs, more and more intensive grasslands, and the use of specialized breeds for milk or meat (Dubeuf et al., 2016). The awareness of these negative effects have emerged in the 80's and several concepts and frameworks have addressed the sustainability of Agriculture (agro – ecology, organic agriculture, integrated production, sustainable intensification, conservation agriculture, etc.). The application of these concepts and specially agro – ecology for animal production, has been more recent and proposed new ways of producing in favors of the integration of animals in one's agro – ecosystems (Gliessmann, 2006, Tichit and Dumont, 2016). But this integration of agro – ecology has been nearly absent for pastoral systems (Bellon and al., 2016).

A Russian agronomist, Bensin, (1928) has used the word agro – ecology for the first time in 1930. But, Altieri (1983) and other authors have conceptualised it more recently as the science to define principles, to study, design and manage productive, efficient to use natural resources, socially just and economically viable sustainable agro –ecosystems with a special emphasis on bio – diversity and to develop agricultural practices based on ecological principles.

To face the challenges of climate change and the preservation of biodiversity, agriculture needs a real alternative to so-called conventional or intensive production systems that consume pesticides and emit high GHG emissions. Agroecology offers agricultural production systems based on a logic of "management of cultivated ecosystems" (Dupraz, 2005). Agro- ecology includes several techniques such as organic agriculture but cannot been reduced to one of them..

Agro - ecology in animal production is involved in 2 types of processes:

- Ecological intensification for a reduction of the uses of not renewable resources, of GHG, pollution impacts and waste recovery optimization. A first vision of agro ecology introduces a first paradigm shift in the organization of productions systems, it advocates an "ecological intensification" (EI) and an increasing resource use efficiency, replacing chemical inputs by organic ones, developing precision agriculture technologies or even using Genetically Modified Organisms (Godfray et al., 2011). Focused on minimizing the negative impact of agriculture on the environment, the main objectives of EI are to keep on raising incrementally the limits of yields and encouraging the still dominant pathways of specialization and modernization (Duru et al., 2014). Pastoralism would be little involved in EI.

.- Agro - ecologically intensive animal production is based on the potentialities of agro systems on regulations and complementarities. Regarding pastoral systems, it involves understanding the integration of the animal in its agro – eco system to get levers and conciliate sustainably not only environmental but also economic, social and societal concerns (Gliesmann, 2006). Biodiversity based animal production could be a framework for proposing new ways of producing to meet the growing demand for food by linking food to productive practices and the production environment. This new type of agriculture and animal production must also have the status of activity of general interest. This approach would be very relevant for Mediterranean rural areas where until more recently village communities have remained perennial with locally anchored niche products and where the dialogue between society and animal production could be re - opened (Sorba et al., 2017). The challenge of agro – ecology for pastoralism would be to produce more with less input.

Requiring generally low inputs, pastoralism would have real advantages to be agro – ecologic with real adaptation and resilience capacities but it does not mean that pastoralism and its recent trends make it agro – ecological by nature. One objective of this article is to explore these trends for the Mediterranean Pastoralism to go in this direction and if it could give it perspectives for the future.

III - Main issues of pastoralism regarding agro – ecology in Corsica

Corsica is a mountainous island located in the Central Western part of the Mediterranean basin. Today, only 3% of Corsica are cultivated (including vineyards and orchards) ; 32% of the island are considered as permanent very diverse herbaceous and ligneous rangelands and scrubs than meadows.44% of the island are composed by forests and a part of them could be grazed by animals. 2500 km^2 are mountain pastures above 1000 m where the herds used to transhumant. For millennia, pastoral activities associated to subsistence crop production have influenced the organization of the social life and pastoral culture keeps still in the minds and mental models of a large part of the Society. Pastoral production in Corsica was not specialized but dairy production and cheeses were an important part of these activities. A high percentage of lands cannot be mechanized but grain was produced until high altitudes (Ravis – Giordani, 2001; Mercury, 2013). The progressive extinction of subsistence agriculture during the 20^{th} century has contracted the space used by animals with a growing and general re-in forestation. One answer for animal production has been to settle in the few lowlands areas what has also reduced the use of rangelands. The number of breeders using high summer pastures has also

decreased of the number of breeders and their practices to manage herds on lower rangelands are degraded with a loss of food autonomy (an average of less than 30%). A high percentage of feedstuffs and hay are bought in huge quantities in the south of mainland France.The high production costs in feeding are compensated for cheeses and pig meat by the high prices of the local market for traditional Corsican products and public subsidies. In Corsica, animal systems involve sheep, goats, cattle and pigs and all have pastoral components:
Dairy sheep: The 570 sheep flocks produce milk sold to dairy industry (65%) or processed in farms to make typical Corsican cheeses (35%). Most of the flocks have ewes of the local Corsican breed. The dairy sheep systems have less pastoral components than other ones but more farmers use again rangelands and transhumance for dry ewes during summer; the average performance of the dairy sheep farms is considered low with a very low food autonomy.
Goat systems: Most of the 380 herds of goats are on scrubs and rangelands. The main breed is the Corsican breed with crossed animals. Most of the farms have no crops and do not produce dry forage. Consequently, the food autonomy is very low (<25%).as the dairy yields (<200 l/doe/lactation). Most of the goat farmers are farm made cheeses. The technical assistance for goat farmers are little developed except for cheese making.
Cattle systems: Around 1100 animal farms out off a total of 1600, have cattle. A large part of them are owned to get CAP subsidies and are left free on not controlled rangelands; some cattle owners have developed a highquality production but their number is very low and most of the herds are not professionally managed.

Pig systems: Most of the pigs are said “running pigs”, the sows using rangelands with their piglets and the pigs being fattened under the oaks and chestnut trees. But these traditional practices have decreased due to the high level of demand and the pigs are more and more fed at the trough. In spite of the DOP, imposing the use of the local breed and a minimum purchase of local acorns and chestnuts many farmers do not apply the specification and import not local pigs.

Principle of the methodology to determine the agro – ecological orientations of pastoral farms

A survey has been carried out by a group of technicians, teachers and scientists to identify the agro – ecological orientations of the farms. The method used was based on indicators and criteria chosen by a multi – variables analysis (Principal Component Analysis) tested previously in a large number of situations including Sardinia (Ruiz et al., in press) and Andalusia (Mena et al., 2012, Ruiz et al., 2016) to identify the diversity of agro - ecological profiles. Regarding the choice of indicators and the discussion of criteria, we adopted a more participative framework following here the participatory approach proposed by Duru et al. (2015)

We considered that an agro – ecological orientation is based on the balance between 10 indicators:
1. Animal nutrition (*grazing; production of conserved forage and grains; part of the feedstuffs produced on farm; quantity of concentrates distributed…*)
2. Sustainable pasture management (*part of the rangelands in the total dry matter distributed; adequate stocking rate, potentialities of rangelands, mechanical interventions on rangelands…*)
3. Crops and forage practices (*soil contamination, using of organic fertilization, absence of herbicides, use of shrubs, practice and duration of transhumance...*)
4. Disease prevention (*body conditions of the herds, practice of quarantine for introduced animals, natural treatments, controls of water quality, livestock and watering facilities, closing of rangelands*) …
5. Breeds and reproduction *(autochthonous breeds, no hormones to manage reproduction, birth seasons organized to limit the dependence on purchased feed…)*
6. Animal welfare (*natural lactation of young animals, permanent access to open spaces and rangelands, conditions of slaughtering…*)

7. Food safety and hygiene (*absence of pathogen and free of controlled diseases, storage of effluents not rto contaminate the environment…*)
8. Marketing and management (*local marketing, farm processing, direct marketing…*)
9. Conditions of social and economic sustainability (*age of the farmer, positive perception of the farmer's income and standards of living, social integration, other incomes in the farmer's family*)
10. Environmental sustainability and societal contribution (*environmental integration of housing facilities, practice of transhumance, participation in actions in favour of bio-diversity*)

For each indicator, several agro – ecological criteria were discussed and chosen (table 1a and table 1b). If the criteria is applied the note is 1, if not, it is 0. The sum of the notes give the weight of each indicator. Each note is positioned on a radar to give the agro – ecological profile of the farms. The several criteria are presented on table 1a and 1b.

Table 1a - Criteria discussed during a focus group regarding pastoral systems in Corsica [indicators 1 to 4] *(adapted from Mena et al., 2012).*

If the criterion is considered as applied, the score is one; if not, it is zero. For each indicator, the score is the addition of the score of all criteria

1. Animal nutrition

1.1. Animals graze daily for at least 6 h.
1.2. At least 50% of daily ration (for milked females) and 60% (for other animals) is common forage and/or grass (fibres).
1.3. The farm has lands to produce forage.
1.4. The farm produces grain for goats
1.5. 80 % of the feed for animals have been produced on the farm or near the farm (in the island)
1.6. The farm uses only forage produced regionally (in the island for the Corsican case)
1 7. The goats receive less than 500 g/head/day concentrate

2. Sustainable pasture management

2.1 Rangelands provide more than 60% of the dry matter of the diet (Rangelands being defined as spontaneous grass or forest lands grazed freely by the herds including transhumance.
2.2. Rotational grazing is practiced on cultivated pastures (with at least 5 cm of grass before reintroducing the herds)
2.3. Stocking rate is between 4 and 5 goats per ha. (Average optimal stocking rate to valorize the potential of rangelands in the local conditions)
2.4. Stocking rate is adequate (No need for more land according to the farmer's declaration).
2.5. The farmer cultivates leguminous crops in isolation or associated with grains.
2.6. There is a mechanical intervention of the farmer on rangelands to improve them
2.7 The potentialities of rangelands are adapted for goats (more than 400 kg DM/ha with an opened environment and an high of scrubs between 60 cm and 2 meters).
2.8 The breeder practices transhumance during at least two months

3. Crops and forage practices

3.1. The farmer uses mineral or organic fertilizers <100 U nitrogen / ha) on the cultivated areas
3.2. The farmer makes and applies compost, or manure and the lands are always covered in summer (no bare grounds).
3.3. The farmer has already carried out soil profiles and analysis.
3.4. There is no proved risk of contamination soil or water reserves by white waters and manure.
3.5. The farmer uses tines and disc tools for tillage or direct seeding by over seeding or he ploughs less than 20 cm deep.
3.6 .The farmer practices rotations of different crops (including green manure)
3.7 No herbicides on forage areas (Direct seeding without herbicides)
3.8. The farmer uses woody resources as forage

4. Disease prevention

4.1. The body condition of the herd is satisfactory
4.2. The introduced animals are quarantined (a sufficiently long time).
4.3. The farmer carries out natural treatments mainly with natural products (herbalism or homeopathy)
4.4. The farmer treats parasites only when necessary and never more than twice per year (no systematic treatment, after a faeces analysis, or with natural treatments).
4.5. The farmer controls regularly water quality.
4.6. Livestock facilities are generally clean
4.7. Hygienic-sanitary control of all aspects of milking is adequate.
4.8. The watering facilities are correct (no direct access to streams, no watering in ponds, etc ...).
4.9. Sick animals are isolated and crawl spaces are provided in accordance with the regulations
4.10. The rangelands are closed (to avoid contacts with wildlife, wandering of animals and ease the rangelands managemen

Table 1b - Criteria discussed during a focus group regarding pastoral systems in Corsica [indicators 5 to 10] *(adapted from Mena et al., 2012)*

If the criterion is considered as applied, the score is one; if not, it is zero. For each indicator, the score is the addition of the score of all criteria

5. Breeds and reproduction

5.1. 75% or more of the animals are autochthonous and/or adapted to the region.
5.2. Animal reproduction is natural: no hormones are administered to synchronize heat, induce birth, etc.
5.3. Births are distributed in order to minimize dependence on purchased feed.

6. Animal welfare

6.1. The farmer uses natural lactation until 30 -35 days
6.2. Lactation period is at least 40 days (the lambs are not killed at birth).
6.3. Covered area is at least 1.5m^2 per adult sheep or goat and 0,35 m^2 per kid or lamb
6.4. Outside space is at least 2.5m^2 per adult animal (0,5m^2 per kid or lamb)
6.5. Livestock have permanent access to open spaces, preferably to grasslands.
6.6. The farmer does not systematically tie up or isolate animals and limit their stress by his practices (no electric sting, water spray in summer, soft dehorning,...).
6.7. The area for housing offspring is sufficient, protected from inclement weather and clean and well ventilated.
6.8. Adult animals have sufficient access to water, food, ventilation, light and adequate temperature and humidity.
6.9. The conditions of transport before slaughtering are satisfactory

7. Food safety and hygiene

7.1. The farm can prove the absence of pathogens and is free of governmentally controlled diseases (principally brucellosis and tuberculosis).
7.2. The farm complies with the regulatory criteria of sanitary quality and good practices.
7.3 The farmer makes tests for chronic mastitis
7.4 Analyses of milk during the past year indicate an absence of bacterial growth inhibitors.
7.5 The farmer follows waiting periods for treatments and had no inhibitors
7.6 The effluents are stored in such a way that they not contaminate the environment
7.7 The farmer disinfects the litters

8. Marketing and management

8.1. The farmer adequately records information (of vet .treatments feed management, purchases and sales)
8.2 All the products are sold locally to industry, cooperatives or regional shops
8.3 The farm closes the productive cycle (farm processing).
8.4 The farmer sells his products to local consumers directly at the farm or through local shops or markets
8.5. The milk is processed in units where local material is used and accepted.

9. Conditions of social and economic sustainability

9.1. The farmer thinks he has good standards of living and good working conditions
9.2. The farmer is less than 55 years or his succession is planned..
9.3 The farmer thinks he has a correct income
9.4. Without public subsidies (Pillar II of the European CAP), the farm could continue his activity?
9.5. The farmer has other agricultural, livestock not agricultural activities
9.6. The farmer is an active member of professional Associations or Unions
9.7. Collective works with other farms are usual (formally or not)
9.8 The farmer thinks he is well integrated socially
9.9 There are other sources of income within family?

10. Environmental sustainability and societal contribution

10. 1.The farm is well integrated in one's environment, looks clean and without visual pollution
10.2. The farmer is involved in the restoration of his heritage (old buildings, terraces, threshing areas...)
10.3. The farmer is aware of his animal (local breeds, wild species...) or vegetal (protected natural plan reserves) heritage and assumes it (for instance by participating to collective actions in favour of bio - diversity
10.4. The farmer practices transhumance regularly and follows his herd at least one a week
10.5. The location of the farm is a real contribution for maintaining local traditional landscapes
10.6. The farm is not located in natural hazard zone or the farmer tries to limit it (cleaning of rive banks against floods, firewalls area...)

To be agro – ecological production systems should meet ecological but also economic, technical, social and even societal components of sustainability. The diagnosis realized in some characteristic production systems described above give a good vision of the agro –ecological situation of these systems. Although pastoral farms have rather an environmental friendly image, the realty is more nuanced. At the opposite of the green natural image of pastoralism, many indicators show that the pastoral systems are often far from agro – ecological conditions:

- The contribution of rangelands to animal feeding is very low and most of the feed are imported from the continent with an important negative environmental effect of transportation, with a rather important use of hay and grain not compensated by the exclusive use of good quality rangelands.
- Some animal health control problems (10% loss of grazing animals, pathologies, loss of productivity, % of infertility...) are seen as a fatality by the farmers but it shows rather a lack of control of his management practices
- Another interesting point is the criterion on stocking – rate. The pastoral farm having a very low stocking rate (0,3 goats/ha), the practices of the farmer could not be adapted to control the vegetation of his rangelands with such a low stocking rate.
- The control of the productive process and the management of the farms are often very weak
- The social conditions of living in the hinterlands are often hard (lack of public services, desertification of villages, isolation)

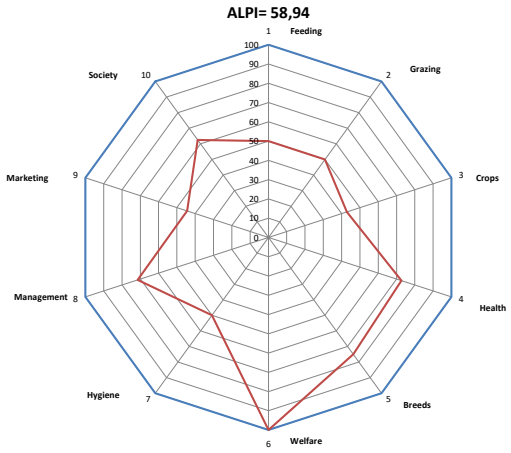
But at reverse, pastoral systems in Corsica have generally good indicators:

- on animal health with few and natural treatments,
- on the type of animals used (use of local breeds) but with few genetic improvements,
- on animal welfare (the herds have spaces and good conditions of living),
- on marketing (short value chains are well developed, farm processing)

In many cases, compromises have to be found between pastoral practices and the sustainable development of the farms.

Table 2 – An example of agro – ecological profile for a Corsican Pastoral farms

Score (%)	Indicator
50	Feeding
50	Grazing
42,86	Crops
72,73	Health
75	Breeds
100	Welfare
50	Hygiene
71,43	Marketing
44,44	Management
62,5	Society



We consider this situation is not specific to Corsica and characteristic of what happened in many Mediterranean regions where traditional pastoral systems have been marginalized, seen as archaic and doomed to disappear. Simultaneously, we observe in these areas, an important loss of bio – diversity, a degradation of pastoral landscapes with erosion and closed scrubs and an increasing risk of forest fires in less and less controlled territories. We observe both a global under grazing and local areas of overgrazing. Meanwhile, everywhere, pastoral practices and know -how, appreciated typical products as cheeses fascinate more and more both citizens, local stake – holders and the development experts are inspired to manage territorial resources and to redesign technical systems to answer agro – ecological transition issues (Dubeuf et al., 2016).
In Corsica, the regional authorities have decided to make pastoralism one of the priorities for the development of the island to face the new challenges of global changing and because more lands could be available in pastoral areas (Collectivité territorial de Corse, 2015). With a rather fantasy but not documented perception, they considered also that pastoralism would have high potentials; and they took several initiatives to define an operational pastoral strategy (Dubeuf, et al., 2018)

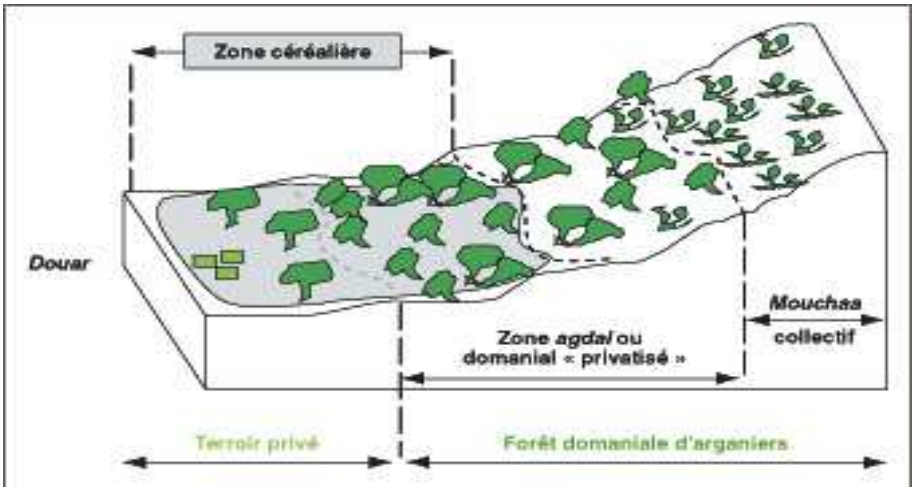
IV- Situation and changes in the Argane tree area in Morocco

Presentation of the Argane tree area.

The argan forest is a unique and endemic plant formation and is characteristic of Southwestern Morocco (see map n ° 1). The argane forest itself covers approximately 800,000 ha around Taroudant, Agadir, Essaouira, and Tiznit where are living around 1.3 million people. It is traditionally a cultivated forest for several uses: Collecting and processing argane nuts for the production of oil (food and cosmetics), goat breeding, cereal crops. Woods of the trees are also collected for heating and branches for the constitution of hedges. It is useful to remind here that, since centuries, to ensure the preservation of resources, the system of exploitation of the argane forest, a complex one, was based on a collective and structured traditional management of the territory and a sharing of the lands by right holders [*mouchaa, melk*] and an important part of the lands being *agdal* lands. Bourbouze and El Aïch (2005) described precisely the organization of the system (see figure 1). Under this organization, the argane forest was and is still administratively a national forest, the land being owned by the state and managed by the Water and Forests Department. It confers rights of use both to the municipalities (*douars*) and to a part of the population within the framework of a complex local institution, the *jmaa,* which managed the access rights. Although for private use by the rights holders, one function of the j*maa is to* decide each year the period of defense during which goats could not graze on *agdal* lands.

Map 1 – The argane tree area

Figure 1. The organization model of the argane tree area (Bourbouze and El Aïch, 2005)



But today, the *jmaa* organization has often disappeared and the argane tree area has faced important degradations due to important changes of its production systems aggravated by climate change and repeated periods of drought. The total area of the forest has decreased significantly, at a not well-known extent, but which could threaten its preservation in the medium term. From 1989, Moroccan and European scientific works launched the reputation of the oil and prompted UNESCO to classify it as a World Biosphere Reserve (WBR) in order to promote its preservation while stimulating the economic and social development of the region. The Arganeraie WBR covers 2500 000 ha and this label has impulse many initiatives with a multitude of projects involving many NGOs. From this period, the factors of degradation, and the options of ecological governance are at the heart of the discussions on the development of the Argane tree area. Simultaneously, the demand of for argane oil on the national and world market has boomed after its dietary characteristics (high in unsaturated fatty acids) of argane oil and its cosmetic properties have been highlighted. The national production of marketed oil would have practically tripled between 2006 and 2009 to reach 4000 t / year mainly towards export markets (Auclair, 2007) and the artisanal local sector, once preponderant is now only anecdotal. Once neglected and considered uninteresting, the argan forest is now the object of much attention and is becoming at the center of very important economic, social and environmental issues.

Goat farming in the Argane tree area

Goat farming, always occupied a large place in the balance of the local ecosystem and is still particularly present in the South of the Essaouira Province, in the mountainous Haha region where are 80% of the goat livestock of the Province. The traditional production system is clearly pastoral and 75% to 80% of feeding comes from pasture under the argane trees. Goats intake both herbaceous plants (rich in aromatic plants) and scrubs but also the leaves and nuts of the argane trees. The aptitude of goats to climb the trees to feed is than one of touristic attractions of the region. Once the nut is ingested, its pulp is eaten and the goats are able to regurgitate the fruits when they come back the farms where the argane nuts are collected by the farmers to make oil. This practice gives the meat a special taste with specific dietary qualities.
Goat farming in Morocco has always been marginalized. Until recently, goats had a bad image and were seen often as a relic of the past and good only for poor people. Since at least a

decade, we observe nevertheless a growing demand for the meat of the goat kids from urban consumers attracted by its lower fat content. The specific dietary and taste quality of the kids produced in the argane tree area caught the attention of public authorities who have initiated a process to certify the kid of the argane tree area. With the support of the Green Morocco Plan (Moroccan Ministry of Agriculture and Fisheries, 2009), the administration has thus formalized a project to promote and certify the kid in order to organize production and producers and increase also the income of poor rural populations which represents local social issues. Sheep and goats are present in most of the Argane tree area with about 1,2 million goat heads, mainly in the Essaouira and Taroudant Province (See table 3).

Table 3 – Animal livestock in the several provinces of the Argane tree area.

Province	Agadir	Essaouira	Guelmim	Taroudant	Tiznit	**Argane tree area**
Cattle	73 000	60 900	3 000	93 100	43 000	273 300
Sheep	194 800	510 900	67 700	528 800	157 500	1 459 700
Goats	162 500	379 100	58 700	450 300	143 600	1 194 200

Source*:* Moroccan Ministry of Agriculture and Fisheries, 2009

Several projects to promote kid meat have been implemented. For example, around Smimou in the Haha traditional area, 17 million dirhams (2,5 million €) were dedicated to the 23 000 small farms of this rural community by the regional services of Agriculture to increase the production of kids, to improve slaughtering conditions and marketing and for labelling the local kid. Extension services have been developed to improve the technical capacities of the goat keepers (sanitary and health control, reproduction and selection, nutrition).

We observe that by promoting the development of goat farming for kid meat, the balance of the complex system of the argane tree area, tends to be modified. Although goats were a part of the balance of the system by providing manure, by disseminating seeds, by eliminating weeds, the forest services still consider them as the enemies of the trees by over grazing and a cause of the degradation of the traditional agdal system. Besides, to answer the demand of the cosmetic industry, the argane nuts ingested by goats cannot be used anymore for making oil and the goats farms become more and more specialized. Enclosures for goats are built where argane cake (*alig*), a subproduct of oil making, dry figs (*Afiyach*) or barley are distributed to the goats.

Consequences of these changes on the agro – ecological properties of the production systems in the argane tree area

All the communication of the argane tree area and argane oil is based on the image of a "natural" tree and bio – tope where human intervention would be very limited which is not the truth. According to Simenel et al. (2009), recent orientations (promoted by the forest services) have favored the naturalization of the argane tree area. This term here designates the processes which have led to consider the argan tree area only as a natural space and the tree as a gift from God, relying on religious references to construct this representation, which is far from being true. Insofar, it has always undergone human intervention and goat farming contributes to the overall balance. The representation is that of a natural forest that should be preserved from any degradation by limiting human action to the strict minimum (harvesting to which regeneration plantations would be added). The argane forest would then be gradually transformed into a sort of orchard in which only the best-located plots could be cultivated, which has already been observed in completely privatized plots. Small breeders would be accepted as a trace of a tradition but without launching development projects involving innovations in breeding. The assertion of the negative effect of goats is not based on any legitimate scientific result, most of the bibliographical references highlighting the contrary This naturalistic approach

has ignored completely that the present situation is the result of centuries-old interactions between man and his environment. The representation described above therefore widely shared and tends to exclude any idea of development and certification of goat farming in the argane tree area because, according to these actors, this would cause uncontrollable windfall effects with accentuation of overgrazing aggravated by climate change and more and more repeated droughts that it causes. Conversely, the windfall effect on oil and the overexploitation of trees are hardly mentioned, except for the communication campaigns to limit the galling of fruit which damages trees. The pressure from these actors to the public authorities has largely contributed to postpone the certification of the kid with agro – ecological specifications.

Michon et al (2012) were the first to introduce the notion of dissociation within the argan tree area. They demonstrated that the process of qualification and traceability for industrial purposes has helped to simplify the heritage identity of argan oil within its territory. This patrimonial identity was thus dissociated it from local customs and often complex social and cultural operations, with a risk in the law of this dissociation. The present dynamics described above show that this dissociative logic which does not meet the objectives of agro – ecology and could contribute to weaken the system. Interviews with stakeholders also provided additional information that sheds light on the representations. At the climatic level, all the stakeholders met, including the breeders, underline the intensification of the frequency of periods of drought. The public authorities organize the distribution of subsidized food (barley) but the farmers specify also that these droughts generally lead to overgrazing of goats but also to decapitalizing the herd. Such an adaptation practice, which is usual in a pastoral system, does not promote selection practices and the constitution of genetic lines, as good reproducers can be eliminated. All interviews emphasize also the negative effect of transhumant herds. These large herds of goats and camels from the Southern provinces would be brought in the dry season, often by truck on more favorable routes but without control or grazing rights, which generates conflicts between the owners and the local actors. Although there is no direct relationship between these herds and the issue of local goat farms which also undergo these transhumances, their impact is often highlighted and it is exploited against goat farming in general.

At the opposite, at a social and economic level, pluri – activity could give more resilience to the farmers and made them less dependent of oil industry. Most of them are small farmers (76% have less than 5ha, they own less than 100 trees, and less than 40 goats). But the development of a goat sector as for oil industry is seen as an opportunity to professionalize an activity, to be more competitive. For the local Haha association, according to the interviews carried out during the study, the stake would be primarily to legitimize the goat in the argane tree area by considering the ecological stake including for the small herds and in taking into account the multifunctionality of activities and mobilizing customary mechanisms of territorial and eco-systemic governance.

V- Discussion and conclusions: Strengths, challenges and prospects for pastoralism and agro – ecology in the Mediterranean

These two examples have shown that pastoralism and agro – ecology in the Mediterranean are not synonymous and that the future of pastoralism has to build its own agro – ecological strategy. The Mediterranean area has to face important challenges at a short term dead line related to climate changing, water and food shortages and the future of animal production or the management and development of hinterlands are ones of these challenges. We have shown here that the case of Corsica is very relevant to identify and face these issues and the methodology developed in the island could be used in other situation like in Morocco. In spite of nostalgic visions, the rural societies will not be anymore what they were and the return to the

past is neither possible nor desirable. For example, no young farmer would accept to give all his time to build stone walls and terraces. It is necessary to imagine new technologies, new know how mobilizing for instance digital ones, new knowledge to answer the present environmental and ecological challenges.

We have shown also the prevalence of the dominant paradigm of progress calling for more specialization, simplification, and intensification while emphasizing the protection of the environment. These two examples illustrate the agro – ecological challenge and the complexity to promote a real agro – ecological transition. On one hand, it is important to favor innovation by promoting research and training and we need new references and formalized models and improving capacities to manage the resources. Enhancing labor and human skills is another challenge to manage natural pastoral resources. On the other hand, the local knowledge and know – how often half forgotten, have a coherence which could be mobilized for more resilient and sustainable activities which would answer the present challenges. The mobilization of both hybrid local secular and scientific knowledge and scientific ones could improve the competitiveness and agro ecological dimension of pastoral systems. Favoring pluri activity and the co – existence of several systems could be another way to consider the agro – ecological transition. To be operational, ecologically intensive pastoralism seen as a bio – diversity based agriculture requires a changing regime to reorganize this transition, change the way to face problems and find solutions.

References

Altieri AM., 1983. Agroecology, the Scientific Basis for Alternative Agriculture. Berkeley, U.C. Berkeley

Bellon, S., Alfonso Lopez, D. 2016. Comment l'agroécologie peut – elle faire évoluer les systèmes pastoraux. In: Magali Jouven, dir., L'agroécologie. Du nouveau pour le pastoralisme (p. 83-92). Avignon, FRA : Cardère éditeur.

Bensin B.M., 1928, Agroecological characteristics description and classification of the local corn varieties horotypes . Book. Qoted by Wezel A., Bellon S., Doré T., Francis C., Vallod D., David C., 2009, "Agroecology as a science, a movement and a practice. A review". Agronomy for Sustainable Development. 29:503-515

Collectivité territoriale de Corse, 2015. Plan d'aménagement et de Développement durable de la Corse ; synthèse, 5 livrets, 8 annexes. https://www.aue.corsica/Le-Padduc-dans-son-integralite_a47.html

Dubeuf, J.-P., Hassan, A. Aw, Chentouf, M., Mena, Y., Pacheco, F., Boutonnet, J-P., 2016. The Mediterranean sheep and goat sectors between constants and changes over the last decade.Future challenges and prospects, in Options méditerranéennes, In: Options Méditerranéennes, n°115 "The value chains of Mediterranean sheep and goat products. Organization of the industry, marketing strategies, feeding and production systems" pp. 43 - 52.

Dubeuf, J.-P., Sorba, J.-M., 2018. Les politiques publiques en faveur du pastoralisme en Corse: objectifs, représentations, mise en œuvre opérationnelle et visions de l'avenir. *Annales Méditerranéennes d'Economie*, n°5., 2018

Dumont, B., Fortun-Lamothe, L., Jouven, M., Thomas, M., Tichit, M. , 2013. Prospects from agroecology and industrial ecology for animal production in the 21st century. Animal, 7 (6), 1028-1043. DOI : 10.1017/S1751731112002418

Duru M., Therond O. and Fares M. 2015. Designing agroecological transition; A review. Agron. Sustain. Dev. 35: 1237-1257.

Gliessman SR 2006. Animals in agroecosystems. In Agroecology: the ecology of sustainable food systems, 2nd edition, pp. 269–285 CRC Press, Boca Raton, FL, USA

Godfray, H. C. J., Beddington, J. R., Crute, I.R., Haddad, L, Lawrence, D., Muir, J.F., Pretty, J, Robinson, L., Toulmin, L.,2010. Food security: the challenge of feeding 9 billion people. Science 327:812–818. doi:10.1126/science.1185383, New York, NY

Griffon, M., 2006. Nourrir la planète; Eds. Odile Jacob, 456 p.

Mazoyer J., Roudard L., 1997. Développement des inégalités agricoles dans le monde et crise des paysanneries comparativement désavantagées. in: Réforme agraire, colonisation et coopératives agricoles (1997) v.1 n° 1997,p.7-17

Mena, Y., Nahed, J., Ruiz, F. A., Sanchez-Munoz, J. B., Ruiz-Rojas, J. L., Castel, J.-M., 2012. Evaluating mountain goat dairy systems for conversion to the organic model, using a multicriteria method. Animal (2012), 6:4, pp 693–703

Mercury F., N., 2013, Le pastoralisme en Méditerranée, Un exemple : le pastoralisme corse, In: Bergers de Corse et pastoralisme en Méditerranée, http://www.francois-noel-mercury.fr.

Ministère marocain de l'Agriculture et de la pêche marine. 2009. Pilier II du plan Maroc vert. Pour un développement solidaire et durable de la petite agriculture. Octobre 2009 ; CIHEAM - IAM Bari , Coopération française, FAO - Groupe d'Adelboden - SARD – M FIDAI, FPRI 105p.

Ravis – Giordani, G., 2001. Bergers Corses : Les communautés villageoises du Niolu.(;) 505 pages, Albiana éditions.

Ruiz F.A., Bellido, T., Mena, Y., Castel, J.M., Puntas, J., Díaz, C., García, C., Moreno, L., Nahed, J., 2016. Evaluación de la proximidad de sistemas ovinos de la raza Segureña a un modelo de producción agroecológico. Feagas 2016, 81-87.

Sorba, J.-M., Dubeuf, J.-P., Casabianca, F., 2017. Biodiversité, alimentation et milieu de vie au regard du projet de l'agroécologie ; communication aux Assises nationales de la Bio – Diversité, Ajaccio, July, 6th.

Auclair , L., 2007; L'agdal, une pratique durable ?; Place et rôles des milieux boisés dans les systèmes d'élevage : deux exemples au Maroc (http://www.mpl.ird.fr/suds-enligne/foret/usages/elevage_med0)

Blench, R. 2001. You can't go back.. In *Pastoralists in the new millennium*, FAO, 2001.

Bourbouze, A., El Aïch, 2005. L'élevage caprin dans l'arganeraie : l'utilisation conflictuelle d'un espace ; Cahier d'Agriculture, Vol 14, n°5 ; pp.447-453

Dupraz, C., 2005. Entre agronomie et écologie : vers la gestion d'écosystèmes cultivés. In *Cahier d'étude Demeter, économie et stratégies agricoles.* 16 pages.

Linck, Th., 2013. Le pastoralisme est un système intensif en travail qualifié Synopsis du projet LRDE.pp.14. https://hal.inrae.fr/hal-02802783/document

Simenel, R., Michon, G., Auclair, L., Thomas, Y., Romagny, B., Guyon, M. , 2009. L'argan : l'huile qui cache la forêt domestique De la valorisation du produit à la naturalisation de l'écosystème. *Autrepart*, 50, 51-73. https://doi.org/10.3917/autr.050.0051

Michon, G., Romagny, B., Auclair, L., Deconchat, M., 2012. Forests as Patrimonies? From Theory to Tangible Processes at Various Scales. Ecology and Society , Sep 2012, Vol. 17, No. 3

Stassart, P., Baret, P., Grégoire, J., Hance, T., Mormont, M., Reheul, D .. & Visser, M., 2012. Chapitre 1. L'agroécologie : trajectoire et potentiel. Pour une transition vers des systèmes alimentaires durables. Dans : Denise Van Dam éd., *Agroécologie: Entre pratiques et sciences sociales* (pp. 25-51). Dijon cedex, France: Éducagri éditions. https://doi.org/10.3917/edagri.vanda.2012.01.0025"