



The Moroccan forest and sustainable development case of the argan tree (*Argania spinosa* (L.) Skeels) in Morocco

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Abstract

The argan tree (*Argania spinosa* (L.) Skeels) is an endemic species of the Moroccan Southwest, plays a major role in the lives of rural societies in a region marked by aridity and magnitude of climate change. From an ecological standpoint, it is worth noting the xerophilous and thermophilic character of the species. It grows in semi-arid and arid temperate and warm as long as the relative air humidity is sufficient. Its ability to enjoy atmospheric water distinguishes it from all other forest species. This space consists of argan fragile ecosystems accentuated ecological variation, is an open system, complex and multifunctional. However, the pressure on these areas is materialized by a worrying degradation due to malfunction of their physiological mechanisms, biological and sociological. These malfunctions, due to population pressure, overgrazing and urbanization, were amplified by the austere climate change over the past two decades. The current state of this forest area calls all stakeholders to develop sustainable management ensuring, firstly, the sustainability of forest resources and, secondly, better adaptation to climate change.

Key words: Moroccan forest, argan tree (*Argania spinosa*), degradation, climate change, population pressure.

1. Introduction

The diversity of climatic and ecological conditions of Morocco and his meeting position between the European flora, Macaronesian Saharan Africa and make it a true crossroads of floristic diversity and complexity of unquestionable. Moroccan forest areas cover 9 million hectares of natural areas, 12% of the national territory. These areas represent a large part of our natural resources and our biodiversity. Among the noble forest species, Morocco still has about 871,210 hectares of argan tree (*Argania spinosa* (L.) Skeels) second surface after the holm oak, but the average stand density is low.

Among the nobles and endemic forest species in Morocco, argan is an open and multifunctional complex system has advantages in relation to its high biodiversity and support it represents for agriculture. However, she knows forms of exploitation behind the emergence of issues and conflicting interests.

In the Moroccan Southwest region of the argan tree has been the pivot of the village economy and that since time immemorial. This forest and fruit species has remarkably played this role and continues to play while providing income for many thousands of user populations of the argan tree. These revenues are from different services and products they provide, such as firewood, the argan nuts, grazing, crops under floor etc. Thus, the argan tree is the backbone of the village socio-economic life of this part of the Moroccan Southwest (Laaribya et al., 2013).

The Moroccan forestry grossly lacks a proper forestry practices to ecological and socio-economic of our stands. But, it is clear that despite the effort to conservation development plans, the primary objective on which they have focused namely, regeneration and sustainability of the argan tree has not only not been reached, but the degradation of forest ecosystems continues with an alarming rate in terms of desertification and clearing.

The objective of this article is to present a socioeconomic and environmental diagnosis of the current situation of the argan forest and non-timber filieres and analyze the dynamics of degradation of spaces and finally present a development plan and restoration of that arganeraie.

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2. Materials and methods

The study has focused on two main components:

The study is based on chains of farms and the results of surveys conducted participatory workshops in the area of the argan tree (drill adminne Province of Agadir-Morocco) as well with usagère population of each terroir with different actors concerned (Figure 1).

Participatory workshops were held in the area with a sample of the population. They addresses the constraints to development of forest areas and forest perished at the area of the *Argania spinosa*. In addition to workshops interviews were held with the various stakeholders.

Workshop program:

- a- Introductory presentation on the objective of the workshop,
- b- Compendium of major constraints and proposals of local populations surveyed,
- c- Discussion to frame these proposals,
- d- Discussion of the argan industry: analysis, proposal...
- e- Proposals sustainable development.

3. Results

3.1 Role and importance of the argan tree

The argan tree is of paramount importance and plays several roles:

- **Economic Role:** The argan tree is of great economic interest because it is a multipurpose tree: the wood is used as fuel, the leaves and fruit constitute forage for goats and camels, and the oil extracted from the Almond is used in human food and in traditional medicine (Figure 2, 3, 4, 5) (Benchekroun and Buttoud, 1989).

- **Environmental role:** The argan tree is a bulwark of biological fight against desertification. Its ecosystem protects the soil against wind erosion and runoff against favoring water supply of groundwater, particularly in terms of the Souss-Massa. They are very resistant to desert-like conditions, survive temperatures ranging from 3°C to 50 °C and rainfalls as low as 120 to 200 mm per year (Table 1). They are the last barrier against the desert.

- **Human Role:** The argan tree ensures the subsistence of some 3 million people including 2.2 million in rural areas. Thus, the argan tree whose family income contributes about 25 to 45% depending on the area ranges from 9000 to 15,000 DH / year / household.

The different productions of the argan tree provide more than 20 million working days including 7.5 million of primarily female days for the only extraction of argan oil. The number of women's cooperatives producing argan oil rose from a few with a few hundred women in 1999, more than 100 involving nearly 4,000 women in 2010 (Charrouf, 2008).

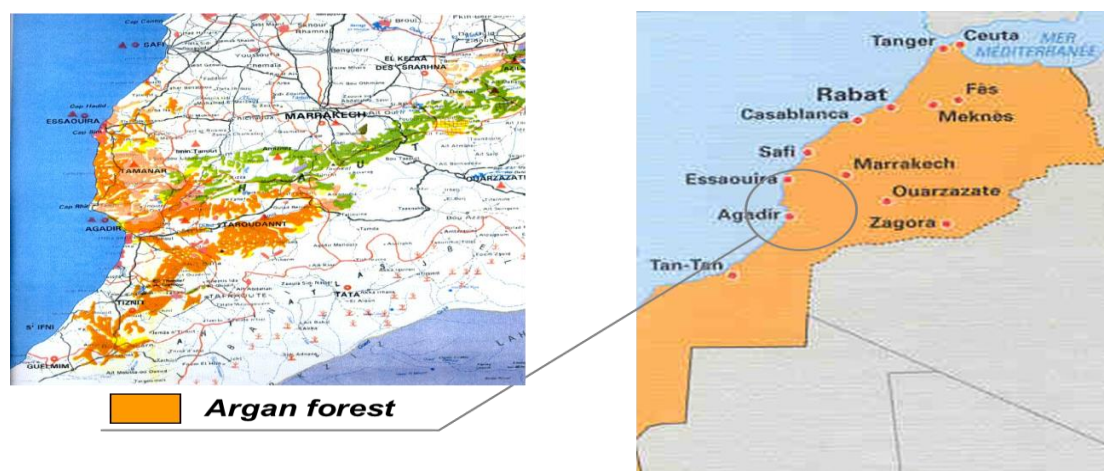


Figure 1: Location map of the argan tree in Morocco

Table 1 . Bioclimatic parameters of the argan area

Stations	Annual average temperature (°C)	M	m	M-m	Q2	Climate Emberger type
Agadir	18,7	27	7,3	19,7	35	Hot dry
Taroudant	19,8	35,8	5,5	30,3	27	Arid temperate
Ida-outanane	17	33,8	4,8	29	52,6	Semiarid temperate

Q2 rainfall quotient Emberger; M the average of the hottest month temperature in kelvin; m the average of the coolest month of the temperature in kelvin

3.2. Argan oil: Intangible cultural heritage of humanity

Argan oil, practices and know-how related to the argan tree has been inscribed 27 November 2014 on the Representative List of the Intangible Cultural Heritage of Humanity at the 9th session of the Intergovernmental Committee for the Safeguarding of Intangible Cultural Heritage. This entry is added to the 5 elements of Moroccan culture already present in this list, and so confirms the exceptional universal value of intellectual capital of our cultural heritage, giving it high visibility.

Rural women living in the reserve practise traditional methods to extract argan oil from the fruit of the tree. Different tasks, transmitted by means of imitation and through non-formal education, are required to obtain the oil, which has multiple uses for cooking, medicines and cosmetics. These include harvesting the fruit, drying, pulping, grinding, sorting, milling and mixing. The specific hand mill is manufactured by local craftspeople, and the mixing involves the gradual addition of warm water in exact quantities. All the cultural aspects of the argan tree, including the cultivation of the tree, oil extraction, the preparation of recipes and derived products, and the crafting of traditional tools for the various tasks, contribute to social cohesion, understanding between individuals and mutual respect between communities. Argan oil is given as a wedding gift and is used extensively in the preparation of festive dishes. Argan tree is the tree of multiple uses. It should be noted that (1) the majority (89%) of harvested argan fruit is processed locally by the traditional sub sector, for which the female labor and raw material are still not valued. While only 11% of all such fruits are not processed; (2) nuts ingested by goats are recovered and reused in the traditional oil extraction in a proportion of 20%, but the oil that results is of inferior quality.



Figure 2. Fruit of argan tree

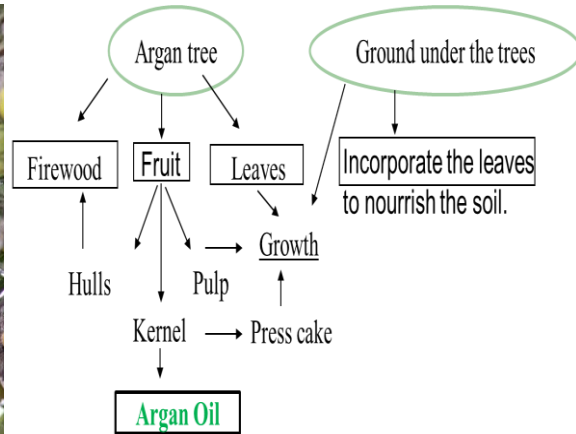


Figure 3. Various products of the argan tree

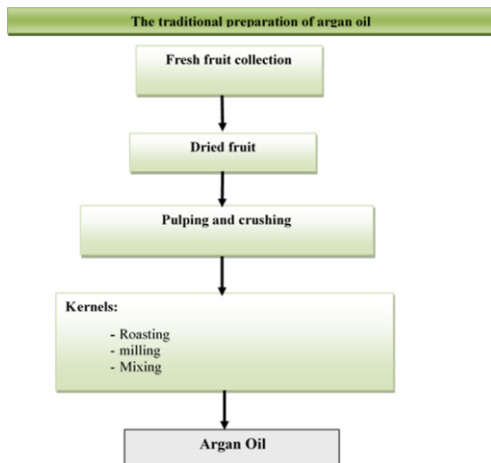


Figure 4. Production of argan oil by the local method



Figure 5. Fruit and argan oil

3.3 Evolution and degradation factors of argan tree

One of the characteristics of ecosystems argan trees is their rapid evolution due to the constraints of ecological, social and economic which cause different forms of degradation due to the gradual opening of the forest canopy. This is in fact the social function and its social and economic interests that make the forest vulnerable to anthropogenic degradation.

The argan forest provides functions and multiple uses for local people whose socio-economic activities are strongly linked to various products it provides. Thus, the argan offers diverse economic opportunities across different emerging sectors (argan oil, ecotourism, local products), can effectively contribute to socio-economic development in the study area, one of the most dynamic regions of Morocco.

However, this ecosystem on the edge of the desert, multiple pressures. Indeed, the deterioration of the climate-related areas (droughts, erosion) are the effects of rapid urbanization and development of economic sectors that have major resource needs. The over-exploitation of these resources contributes to accentuate the dysfunction of the physiological mechanisms, biological and socio-economic equity in the argan tree (Laaribya, 2015a). Livestock is only a complementary activity to agriculture in the region. But, it becomes a vital source of income for rural populations, especially in areas where farming potential is limited. Cattle ranching is the most widespread in the region. We meet again forms of transhumance, the semi-nomadic but nomadism.

The herd is made up of extensive general and mainly based on natural and forest course. The components of the argan tree in the area are subject to an operating within a systemic framework resulting in a production system dominated by farming associated with a predominantly subsistence agriculture due to very limited areas aggravated by fragmentation continuous plots. Overgrazing coefficient is estimated at 50% to 80% depending on the case (Figure 6) (Laaribya, 2015b).

Throughout the region of the argan tree, are the goats and sheep grazing in the forest. If the courses are adjacent to villages, cattle benefit from these areas for a period of the year. However, the stay of the herd on the course varies according to the distance from the village. Thus, it was distinguished by animal species, the following feed schedules (Source: socio-economic surveys and participatory workshops, 2014).

Table 2. Forage calendar in study area

Category	Food	September	Oct	Nov	Dec	January	Feb.	Mars	April	May	June	July	August
Cattle	Forest			■	■	■	■	■	■	■	■	■	■
	Supplement		■	■	■	■	■	■	■	■			
	Thatch	■									■	■	■
Sheep	Forest			■	■	■	■	■	■	■	■	■	■
	Supplement		■	■	■	■							
	Thatch										■	■	■
Goats	Forest	■		■	■	■	■	■	■	■	■	■	■
	Supplement.		■	■	■								
	Thatch										■	■	■

Supplementation is highly variable depending on the year and according to forage availability in the argan trees areas and crop fields after harvest. But, generally, the origins of these dietary supplements are meal produced locally as barley. However, other supplements are beet pulp bought in the souk, sometimes barley as if local production is not enough. However, and given the traditional character of the conduct of livestock, although the complementation is spread over a long period, it mobilizes little food.



Figure 6. Pasture in argan tree

Argan tree is highly stressed or coveted by the following:

- **Intensive agriculture:** With the experience of decades, the area has gained extensive experience in intensive agricultural production and imported new technology to comply and meet the requirements of importing countries. An acquired in relational terms, and therefore an organization which became attractive to "lobbies" of the domain. Also, the non-taxation in agriculture grows investment advantage in this sector

over others even more profitable areas. The total area have been the cultivation of object (field and greenhouse) vary from one forest to another;

- **Tourism development:** Agadir and regions are known by their diversified tourism products, and managed to get an image with different tour operators. The investment is profitable, especially with the proposed 10 million tourists by 2010, applications are numerous. The lands are sought in both mountain and plain.

- **Urbanization:** the growth rate of the cities of Agadir Wilaya is among the largest in Morocco. To accommodate this growth, requests for occupation of forest land are increasing to ensure the housing developments that meet market demand (see land use map, urbanized area).

Overall, the factors responsible for the degradation that seriously threaten the sustainability of the argan tree, are:

- The clearing for the search for new farmland,
- The energy wood harvest intended primarily for domestic and traditional uses,
- Overgrazing resulting forage samples that exceed the potential of grassland forest,
- Urbanization dramatically and continually eats away the forest land base,

3.4. Towards a sustainable development: A challenge in argan area

The fragility and sensitivity of argan ecosystems and their current evolution impose a deep reflection about the change vectors set of dynamic factors that can influence the issue of degradation and lead to maintaining the balance between conservation and development of forests and its resources.

In light of the work performed various priorities seem to be of utmost importance. This is the case among others of the importance of developing value-added products, (of local products, AGR etc.), and basic socioeconomic infrastructure. The intervention strategy comes in three complementary approaches which are: natural resources management approach; The approach of local development and the value chain approach.

- **The Natural Resources Management approach:**

The over exploitation of the forest without worrying about the regeneration of natural resources would harm the whole industry chain. The ducts silvopastoral development must involve more local people and their basic structures, according to a joint development approach (Laaribya et. al., 2011).

- **The local development approach**

The argan sector cannot be considered in isolation from social reality. The majority of usufruct live in areas that are poor and deprived of basic social services. It is important to implement local development projects, ranging from infrastructure to income-generating activities without forgetting the strengthening of capacities of the structures of operators, including cooperatives and their unions (Laaribya, 2006).

As the population has no alternative option to go direct income from logging, the problem still persist, but awareness, coupled with the establishment of income generating projects would help alleviate the overexploitation suffered the argan tree.

- **The value chain approach**

The modernization and upgrading of the Argan sector requires a consideration of the whole process; basically three phases: production, processing and marketing.

Prices for exports, following the proliferation of cooperatives and the growing interest brought by foreigners, are incentives, but require a professional structure in which private initiative must be combined with the collective initiative.

The origin of the valuation of argan oil and its by-products, the objectives are to improve the socio-economic conditions of local populations, particularly women.

• *The contribution of standardization / certification for this sector*

Because the argan oil products and by-products resulting are of high value (cosmetic products, dietary, nutraceutical, protection against cardiovascular diseases), the market demand is a niche segment are very demanding in terms of food safety, traceability, quality. The different labels are of major importance to develop this product (label, BIO, Fair Trade) (Figure 7).

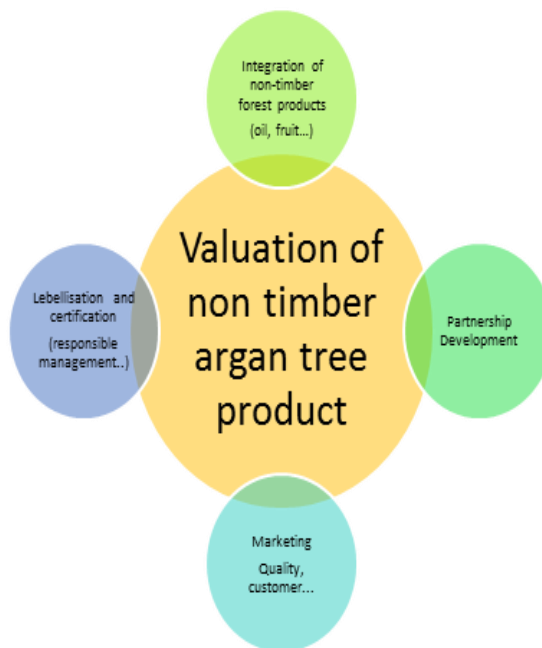


Figure 7. Key development elements of argan tree

4. Conclusions and discussion

The analysis of the dynamics of argan areas highlighted several indicators of degradation. Indeed, in addition to desertification stands and decreasing cover, the argan tree provides only a limited amount of goods and services and maintains only limited biological diversity. She lost the structure, function, and productivity. The argan tree grows in difficult conditions that constitute its ecological limits (climate change).

The complexity of the management of the argan tree, resulting from several factors, including: the expanded use rights, a strong pressure on wood and fodder resources, intensive agriculture and high demand on water resources, shows the importance of interactions between the ecosystem and human environment and represents both challenges and advantages for its preservation.

The natural conditions prevailing at the Souss Massa Draa region are characterized by rugged topography, very different substrates, and types of mostly arid and semi-arid climates. Add to this the proximity of the desert and the dominance of the strong winds which exposes the area to the threats of desertification. Furthermore, patterns of overuse (increasing demand for forest land for urban development needs, important pastoral responsibility aggravated by nomadic herds, destruction of shrub and herbaceous layers for use in agriculture argan forests) natural resources complicate the situation by narrowing their natural potential which essentially vegetation and water.

The analysis of the results shows that the forage potential of forest areas do not respond in the same terms the nutritional requirements of the livestock. The needs are well above feed offers the argan tree. Given the quality of fodder supplied by the cork oak forest, the shepherds drive their flocks to the cork forests much as to other artificial spaces, causing an unequivocal pressure on the cork forests in question.

Argan ecosystems of the region are more than elsewhere, the main bulwark against desertification. Indeed, on the mountain ranges of the High Atlas and Anti Atlas, water erosion occurs at a very alarming rate given the weakness of the plant cover, the harsh topographical conditions and especially the poor distribution of rainfall that focus shaped storms. The threats posed negatively impacts the sustainability of downstream dams, the fertility of agricultural land and other infrastructure (roads). Similarly, at the flat areas of the region, it is the scourge of silting very active and who threatens the sustainability of natural resources and invades the land and culture course in addition to housing and infrastructure (roads).

Similarly, and in order not to be content to accompany the evolution of the forest to a decline situation by merely maintain the existing, it was considered imperative to focus the bulk of interventions to renewal of forest resources. Hence the formulation of the projects should be based on the consideration of reforestation, in all its components, as the main core around which will be made of other accompanying activities to ease the better adhesion of the populations concerned.

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