Augusto Lança*
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Western Sahara Heritage

Parte 2

Nomadic Pastoral System in Tifariti and Bir Lahlou, Western Sahara

CENTRO DE ESTUDOS AFRICANOS
UNIVERSIDADE DO PORTO

* CEAUP e IPBeja

Índice

Introduction

The culture and life of the Sahrawi people are closely linked to life in the desert environment and livestock farming, as in many other societies in the steppe and desert biomes. In the old world these extended from the Atlantic coasts of the Sahara to the confines of central Asia. Also in the northern regions of Eurasia, indigenous populations base their survival on pastoral nomadism.

The bibliography on the food production system based on pastoral nomadism in the harsh environment of Western Sahara is relatively scarce. The topic was studied mainly by Guinea (1945), Baroja (1955), Julivert (2003), Volpato et al. (2017). Guinea (1945) carried out extensive field work but limited it to the study of pastures used by nomadic herds.

The invasion of the territory and subsequent occupation, starting in 1975, which led to the beginning of the war of liberation, broke the Sahrawi system of life based on the use of natural pastures and the necessary constant movement in search of food resources for livestock. The massacres of the civilian population were accompanied by the flight of the population abroad, to refugee camps in Algeria and the liberation struggle diverted young people into the ranks of the army. Many regions of Western Sahara are heavily mined (Jemia and Le Clézio, 1997), making the movement of livestock dangerous (Figure 1). All areas of the liberated zone within arms reach of the Moroccan occupation forces, installed on the separation wall, present a risk to the lives of people and animals and attacks are constant. Since the ceasefire agreements of 1991 until the resumption of the armed conflict in 2020, there has been a resumption of pastoral activity in the liberated area, but which is currently practically paralyzed.

Throughout history, sedentary populations in oases and nomadic pastoralist populations coexisted in the North African desert. With colonization and then with the creation of the current states, much of the nomadic population settled or emigrated and the service sector and mining explorations developed (Julivert, 2003).

The present study was based on our visit to the territory in February 2020 and aims to contribute to a better knowledge of the pastoral system in the interior region of Western Sahara, which is controlled by the Polisario Front. It developed along the region marked

on the map in part 1 of this work and which covers the route between the refugee camps near the Algerian city of Tindouf and the region of Tifariti, in the northeast of Western Sahara. This region is arid and covered by the reg in its border with Algeria and as we walk south it is occupied by desert savanna. Near Tifariti, the oueds (temporary rivers) embedded in the reg and particular atmospheric conditions allow there to have more moisture in the soil and the desert savannah to develop and create good conditions for grazing. This is the only way to produce food in this very arid part of Western Sahara freed from Moroccan occupation and located east of the separation wall.

Figura 1. An unexploded bomb between the Algerian border and Bir Lahlou. The war situation greatly disrupts the pastoral activity of the Sahrawis. Much livestock is killed by Moroccan forces and unexploded munitions such as mines and bombs also regularly claim human casualties.

Limitations on grazing in Western Sahara hinterland.

In Western Sahara agriculture and livestock farming are extremely limited due to the lack of water, making very difficult to produce food for human beings. This situation is even worse in the liberated zone controlled by the Polisario Front and which is the target of frequent attacks by the invading forces. The desert environment is very fragile and its exploitation by humans has contributed to the spread of the desert in many regions of the world, including the Sahara.

We can define a desert climate as one in which rainfed agriculture is impossible. In arid areas of the world, whether in developing or industrialized countries, it is mainly on very extensive livestock farming that the exploitation of ecosystems is based. In industrialized countries, this activity takes place on large fenced private properties with rotational grazing, such as in arid areas of Australia, Namibia, Argentina, or the western United States of America. In countries of the great desert that extends from the Atlantic Sahara to the Gobi Desert, in Central Asia, animals are raised in a system of pastoral nomadism in accordance with traditional customs and these populations continually move in search of pastures.

In both industrialized and developing countries, grazing arid areas is an uncertain activity and animals are often victims of prolonged droughts that decimate herds. It has also led to environmental degradation, reflected in overgrazing and loss of vegetation and the soil it protects, which contributes to further aggravating aridity (Harrington, 1981). Rognon (1994) wonders whether the Bedouins of North Africa and the Middle East are the children or fathers of the desert…

Pastures in arid regions of the old world are little or not managed at all and the reasons for this to happen are social: these environments are public domain and difficult for animals and people. These often have to choose between their survival or the irreversible destruction of the fragile ecosystem on which they depend (Harrington, 1981). In Arabian Peninsula desert, pasture land does not belong to a tribe or an owner. According to Islamic laws and traditional customs, herding is a community activity (Mandaville, 2011).

In the last century, a large part of the population in the arid zones of developing countries became sedentary, which further aggravated human pressure on the fragile desert environment. In tropical deserts, such as the Sahara, yields from pasture areas are very

low and seasonal and the population can only survive in very large areas and under a regime of traditional pastoral nomadism. This is one of the reasons why the population densities of these areas are also very low, on the order of 0.5 inhabitants per km2 in the Sahara (Spedding, 1982).

As mentioned in Part 1, the Saharan environment is characterized by aridity, with rainfall sometimes not reaching 25 mm per year in central areas, while in its periphery it can reach up to 100 mm (Volpato *et. al*., 2017). Precipitation is also irregular between years and chance rains are common. The area we studied in Western Sahara can range from hyper-arid conditions with very little vegetation from the northern tip near the Algerian border to the attenuated desert observed in Tifariti. Higher levels of aridity correspond to lower vegetation densities and this tends to be concentrated in depressions and valleys, where rainwater flows and accumulates.

The Bir Lahlou area is apparently between these two situations, showing scattered acacia and shrub populations but trees reach reduced dimensions due to lack of humidity and intense grazing (Figure 2). Here, in the interior of Western Sahara, there is a continental desert-type climate, with temperatures that can reach around 50 ºC in summer, while in winter they often drop to 0 ºC. Rainfall is very rare and irregular with average annual amounts of up to 50 mm, which means that people and animals are subject to frequent and prolonged droughts and years can occur without significant rainfall. Moisture is brought to this area of the Sahara by Atlantic cyclones coming from the west or, less frequently, by the African Monsoon coming from the south caused by the annual oscillation of the Tropical Convergence Zone. The most important rains occur between the end of summer and the end of autumn.

In the open space of the desert, wind prove also decisive for pasture survival because it increases the dessicating power of hot dry air (Mandaville, 2011). It also carries with it soil particles that have an abrasive effect on plants.

Figure 2. Attenuated desert conditions at Bir Lahlou with scattered settlement dominated by *Acacia tortilis*.

Grazing systems in Western Sahara hinterland fall into two large ecological areas: the Zemmur region to the north and Tiris to the south. They also extend across northern Mauritania and southern Algeria (Volpato et al., 2017). In the Zemmur region, where we find Tifariti, landscape is dominated by the reg, cut by the desert savannah dominated by *Acacia tortilis radiana* tree and *Panicum turgidum* grass, that occupies the valley of relict water courses or wadi (Figure 3), depressions in the terrain and small lines of water, but here with poorly developed plants. Sand rivers cut through the Saharawi peneplain and in the remaining area the rocky surface of the reg dominates the landscape, covered with pastures and flowers after heavy rains. In the southern Tiris area conditions are more arid and sand rivers become very rare, with the terrain consisting of large flat areas covered by stone or sand. The vegetation dominated by desert savannah loses importance and is replaced by halophytic shrubby vegetation (Soler et al., 1999 cited by Volpato et al., 2017). Forage availability for livestock is thus more important in Zemmur than in Tiris,

with Bir Lahlou and Tifariti benefiting from large areas of sandy rivers where the desert savannah that develops in them provides food for the animals.

Figure 3. A strip of desert savannah with abundant *A. tortilis* cuts across the reg at Tifariti.

The lack of rain and its irregularity, the intense evaporation caused by high temperatures and wind, during most of the year, and the lack of water for irrigation make it impossible in Western Sahara to cultivate forage as is known in humid areas of the world.

In the occupied territories, agriculture has increased in recent years and horticultural products are produced for export in intensive agricultural systems. Traditionally in the coastal areas of Western Sahara, *graras* are cultivated. *Graras* are depressions where rainwater accumulates and sometimes forms lagoons (*daia*) and rain-fed agriculture is practiced, based on the cultivation of barley. Other factors such as intense desert winds, sandstorms, high salinity in the soil and irrigation water or locust plagues make it difficult to cultivate pastures and forages.

Natural pastures based on spontaneous plants is the main resource for animal feeding in Western Sahara. In Tifariti extensive breeding of dromedaries and goats is the main

activity and in Bir Lahlu reg is crossed by large flocks of sheep. Donkeys are also raised as pack animals, which are very important for the frequent movements of livestock farmers (Figures 4 and 5). Some donkeys become wild and form herds that roam the desert.

Figura 4. A donkey (*Equus asinus* L.) near Tifariti. When green pastures are absent donkeys also feed on trees, shrubs and dry grasses.

Figure 5. Mixed grazing with sheep, goats and donkeys near Bir Lahlou

Communal grazing generally leads to overgrazing as each owner tries to maximize the number of their animals (Spedding, 1982) which makes managing these fragile ecosystems very difficult. It would be necessary to use fences to control the intensity of grazing, a method impossible to apply

when the land is a public asset but the livestock is owned by families, and the state has scarce resources, as occurs in the interior of Western Sahara.

Improvements such as the creation of water points (reservoirs or wells) are quite useful but can also have negative consequences, such as an increase in areas subject to excessive grazing, as it becomes possible to maintain a greater number of animals. Protecting or reconstituting the vegetation cover in these regions, through the planting of trees and shrubs, has proven to be very difficult to achieve as sooner or later the fences are torn down and livestock uncontrollably consumes the vegetation, which leads to its elimination (Le Hoérou, 2002). Despite this, Ozenda (1983) recommends the planting or sowing of trees in the Sahara desert around urban centers, wells and water reservoirs, where irrigation in the first years of plant growth is facilitated by the proximity of water. It presupposes, of course, that young plants are protected from livestock in the first years of life with mesh fences installed by state services, community authorities or private individuals (Figures 6 and 7). Recent studies point to a greater number of trees in the western Sahara desert than expected (Brandt et al., 2020).

Figure 6. A vegetable garden with broad beans irrigated by drip irrigation and associated with *Acacia tortilis*. These legumes trees fixes nitrogen in soil and increases its organic matter and

show good development as they benefit from irrigation water. The land is fenced with a 2 m high metal mesh to prevent animals from entering. Saharawi refugee camps in Tindouf.

Figure 7. Uncontroled grazing increases aridity trough decrease of vegetation cover. Metalic net 2 m height proves very efectiv against desertification. Saharawi refugee camps, near University of Tifariti buildings, Tindouf, Algeria.

Pastoral nomadic system

The desert environment is mainly suitable for breeding camels and small ruminants and agriculture is only practiced in small oasis areas and under irrigated conditions. The herding of small ruminants, first the goat and then the sheep, would have made its appearance in sedentary settlements in the Fertile Crescent of the Near East, in the middle Euphrates and in Palestine, around 8200-7500 BC. It was a consequence of the Neolithic Agricultural Revolution when humans began to practice agriculture and pastoralism. Pastoralism then expanded into the surrounding desert and steppe areas, where pastoral nomadism gradually developed in 7500-7000 BC (Cauvin, 1999). Sahara experienced several humid episodes during de Quaternary period, resulting in the greening of the desert and savannah expansion. The last humid period occurred during the early Holocene from 11 700 to 5000 years BP (Skonieczny et al., 2015) and it is well recorded in marine sediments around north Africa, from eastern Mediterranean shores to the Gulf of Guinea. Paintings made by desert herdsmen on the rocks of the Sahara, showing scenes of herding herds of cattle are from this period.

The occurrence of prolonged droughts, typical of the arid climates of deserts and steppes, had a dramatic effect over time on the lives of populations and their grazing system. In various parts of the arid world, efforts have been made to settle these populations since the borders of current countries were drawn. However, it is considered a complex process, generating social and political tensions. Strong political will is also needed to implement the measures necessary to stop desertification, restoring soils and vegetation cover degraded by overgrazing, as well as cooperating with local communities and creating jobs as an alternative to emigration (Rapp et al, 1976 in Spedding, 1982). Cutting wood for domestic fuel is also one of the causes of increased desertification both within desert areas and on their margins (Harrington, 1981; Rognon, 1994). An eloquent example of the negative consequences of uncontrolled grazing comes to us from todays Mongolia. During the period of socialist governance, the number of animals authorized for each breeder was fixed by public services and calculated in order to make the nomadic system sustainable. With the political changes registered in that country in recent years, breeders are now able to pasture the number of animals they can acquire and this has led to the collapse of the ecosystem and the general lack of pastures (Liang et al., 2021).

As in other areas of North Africa, the traditional pastoral system in Western Sahara is based on private ownership of animals, the communal use of pastures and the continuous migration of herds and transhumance to areas richer in pasture, such as neighboring Mauritania, according to information collected locally in Tifariti. The movement of herds can be carried out over short or longer distances, up to several hundred kilometers.

As in other geographies, young populations in the Sahara have felt the appeal of large cities and urban life, with the consequent abandonment of traditional systems of pasture exploitation and oasis farming systems. As in Western Sahara, numerous military conflicts increasingly afflict the populations of this region, preventing a normal life for its inhabitants (Figures 8 and 9).

Figure 8. Female camels closed in a old cars fence is saharawi campments where they are feed on barley and barley straw. They have to be kept in captivity when calves are very young and can be put in danger by thives, cars or dogs (Tindouf, Algeria).

Figure 9. Camel and its suckling calf in a pen, feed with barley and barley straw in a saharawi refugee camp near Tindouf (Algeria) at sun set.

The most important animal for the Sahrawis from both a dietary and cultural point of view is the camel or dromedary (*Camelus dromedarius* L.). This animal would have been domesticated on the southern coasts of the Arabian Peninsula 3000 to 4000 years ago and introduced to the arid areas of Africa with the spice trade 2500 years ago (Volpato et al., 2017). The majority of camels bred in the world belong to the species *C. dromedarius*, but in the colder conditions of Central Asia *C. bactrianus* predominates. It is debated whether these animals belong to different species or whether they constitute two subspecies, given that their crossing produces fertile hybrids (Schwartz, 1992). The dromedary supports severe arid conditions, as well as a better adaptation to the grazing of desert plants, feeding mainly on the arboreal stratum for most of the year (Figure 10). Sahrawi camels are of the "heavy pack" or "baggage" type (Schwartz, 1992).

Camel meat and milk are fundamental foods for Sahrawi population and the camel is also an important mean of transport, particularly when moving between camps, where they

serve as pack animals. Camel leather and hair are used in the artisanal manufacture of various utensils and fabrics: sandals, saddles, chairs, ropes, tent fabric and carpets.

Figure 10. Nursing camels feeding on *Acacia tortilis* trees in Tifariti.

In the northweast of West Sahara animals feed on natural pastures, either on ephemeral plants that complete their life cycle quickly after rain, or on perennial grasses, shrubs and trees. The latter mainly include acacias but also other trees, such as *Maerua crassifolia* or *Tamarix* sp., well adapted to the desert environment and whose young branches, leaves, fruits and flowers provide plenty of nutrients for animals. Desert trees are also the main source of fuel for domestic use in Western Sahara, both for food preparation and heating (Figure 11).

Figure 11. Preparation of tea in a j*aima*, in a Tindouf Saharawi refugee camp.

Nomadic populations of the Sahara do not store fodder for camels and are in continuous movement in search of pasture, water and sometimes salt (Spedding, 1982). Despite being

ruminant animals, camels do not belong to the ruminant group, as the organization of their stomach is different. The camel's adaptation mechanisms to the arid environment of Western Sahara are diverse and include: the ability to survive without drinking for 15 to 20 days (3 to 4 in cattle); the production of very concentrated urine; a reduced flow of urine; feces poor in water – 35% in camels, 50% in goats, 60% in cattle - (Figure 12); reabsorption of water in the colon; tolerance to fluctuations in body temperature between 34 and 42 ºC, dissipating the heat accumulated during the day at night; ability to reflect solar radiation from the hair coat; ability to select and ingest parts of plants richest in water and nutrients, such as tree leaves and fruits; ability to graze the tops of trees and shrubs, in the absence of herbaceous pastures for prolonged periods; ability to feed on a very diverse number of plants (Schwatrz, 1992) (Figure 13 and 17).

Figure 12. Camel (*Camelus dromedarius*) dung as very low water content.

Figure 13. Altought its toxic latex *Pergularia tomentosa* can be severely grazed by camels, like here near wadi Tifariri .

Dromedaries are the most efficient animals in producing milk in the desert environment (Schwatrz, 1992). Therefore, milk is one of the most important products offered by these animals and a staple food for populations. The high concentration of vitamin C makes it a very important food for human health, given the lack of fresh vegetables in the desert environment (Figure 14). A camel can provide from 3.5 to more than 20 liters of milk daily, depending on the availability of food and water. The period in which it produces milk can vary from 8 months to 2 years with total productions of 800 to 4000 l, but the most common in the desert environments of Africa are productions around 3 to 6 l per day, for 15 to 18 months (Schwartz and Walsh, 1992). Milk production ceases during the first months of pregnancy. As milk production is the main objective of breeders, the mating of females is delayed as much as possible and simultaneously the offspring are prevented from having continuous access to their mothers' milk (Figures 15, 16) (Schwatrz, 1992). In Tifariti, camel milk is normally drunk immediately after milking.

Figure 14. Advertisement for camel milk consumption for girls and pregnant womans, in Bojador refugee camp.

Figura 15. Camel calf sucks after milking in Tifariti.

Figure 16. A young camel pastures on a talha tree (*Acaciaia tortilis*) near Tifariti. Outside wadi, namely in regs or dunes, these trees never grow very much and have a bushy form like here.

However, camels reproduces slowly as the age at which young camels first give birth occurs at 4 to 5 years old, gestation lasts one year and the interval between two births is 2 years, under traditional breeding conditions. The fertile lifespan is, however, long, reaching up to 25 years, during which a female can give birth to 8 to 10 offspring if accompanied under the best nutritional and sanitary conditions. These numbers normally drop to 6 to 7 under normal conditions of pastoral nomadism (Schwartz, 1992). Camels have important mineral needs, showing a special attraction to halophyte plants, brackish water and saline soil. In Tifariti we had the opportunity to observe adult camels chewing bones, a source of calcium and phosphorus (Figure 17).

Figure 17. Camels grazing mrobka (*Panicum turgidum*) and talha trees (*Acacia tortilis*) near Fedrat el Erkeiz (Tifariti). Talha trees are legumes, fixe nitrogen from the air in the soil and increase its organic matter. This improve mrobka growth, wich is a graminae, what makes this ecosystem a very sustainable one.

Due to the lack of pastures in periods without significant rainfall, in Tifariti camels are supplemented with wheat flour mixed in drinking water so that their body condition does

not reduce significantly and milk production does not decrease (Figure 18 and 21). Water is pulled from the wells with a motor pump to a tank where the animals go to drink. Nowadays, there are no veterinary services in Tifariti, unlike what happened before, and some animals still wear identification earings from health checks. The herds are made up of around 100 animals, including their young, and they drink every 2 days at this time of year (February). Live camels or meat are sold, sacrificing them at any age and many animals are sold to Mauritania. Camels are kept until they are 30 years old.

Figure 18. Camels beeing suplemented with wheat floor mixed in water, next to a well (*bir*) in Wadi Tifariti. This energetic suplement is given during the periods when pasture is scarce and complements the protein rich acacia leaves.

The camel herds in Tifariti have castrated males for carrying people and material and another uncastrated male for reproduction. Uncastrated camels are dangerous to strangers and herds can only have one entire male to avoid permanent fights between the animals. Unknown people who approach the herd may be attacked by the dominant male. The attack can be deadly and the animal tries to lie on top of the intruder, killing by crushing

it. During periods females are with their offspring, the male is separated from the camels. Camels are killed by pressing their head against the left side and stabbing a javelin into the heart. Camels are successively empty for one year and pregnant for one year. Travel to neighboring Mauritania is also used to sell young animals, where Tifariti camels are normally sold for a good price. For the Sahrawis, spotted camels ("piebald") are the most valuable due to their rarity and beauty (Volpato et al., 1997). The accumulation of animals worsens overgrazing with the consequent destruction of natural vegetation, as can be seen in some places visited (Figures 19 and 20).

Figure 19. Talha (*Acacia tortilis*) bark eaten by animals in Wadi Sluguiat.

Figure 20. Overgrazing of talha (*Acacia tortilis*) near Tifariti hospital. Steam bark have been eaten by donkeys.

Figure 21. Milking the camels in Tifariti. Camels transform plants from the desert in high nutritious feed.

The Sahrawi nomadic population lives in tents (*jaima*, in Hassania Arabic) and these are normally made from the hair of animals such as goats, sheep or camels (Figures 23 and 24). Nowadays, they are also used made from synthetic materials (Figure 25). Groups of 3 to 5 tents or more form a *frig* or temporary camp (Julivert, 2003)(Figure 22).

Figure 22. Beduin campment in Tifariti. Beduin is a word originated from *bedi*, wich means countryside. So "beduin" means people from the country. Beduins raise camels, sheep, goats and donkeys and they leave in tends wich they move according to pasture disposal.

Figura 23. Jaima seen from outside in Bojedur Saharawi refugee camp (Tindouf, Algeria)

Figura 24. The interior of a *jaima* made of wool in the Sahrawi refugee camp of Bojdour, in Tindouf (Algeria).

Figure 25. Jaima made of synthetic materials in a refugee camp in Tindouf.

In Bir Lahlou, large flocks of sheep were observed and, according to information collected on site, they were of the Tkraan and Ideman breeds. These sheep are of the tropical type, with little wool and long limbs well adapted to searching for food, traveling long distances through rocky terrain (Figure 26). Also in the Sahrawi refugee camps, in the backyards of their homes, the population raises some sheep, which allows them to improve the families' diet and complement the food provided by international aid (Figure 28, 29). In arid to semi-arid areas, small ruminants have greater potential for meat production, along with considerable milk production. Camels, despite their greater resistance, have lower reproductive capabilities, producing one calf every 18 months and this under the best conditions (Schwartz and Walsh, 1992).

In the Sahrawi fields milk from goats and sheep after milking is left to acidify for one or two days and is drunk mixed with water. This is a form of liquefied cheese that is very common in Africa and allows the milk to be stored for a few days at room temperature. The microbial decomposition of lactose creates lactic acid, which coagulates the protein and lowers the pH, preventing the temporary development of other microorganisms.

Figure 26. A ram in Bir Lehlu. Desert sheep breeds have well-developed limbs that are adapted to long hikes and the rocky soils of the region.

Figure 27. A flock of goats grazing on *Acacia tortilis* near wadi Tifariti. *Salsola imbricata* shrubs are also presente but less consumed.

Figure 28. Sheeps and goats flock is saharawi campments near Tindouf (Algeria **).**

Figure 29 . Small herd of sheep in Bojdur refugee camp where they are mainly feed from home residues.

Small-scale farming

Small-scale agriculture with irrigation was developed in the refugee camps (Figures 30, 31) and in some parts of the interior of Western Sahara that we visited, such as in Tifariti. As mentioned in part 1, the refugee camps are located in the geological zone of the sedimentary Tindouf Basin, where it is possible for water to accumulate in very deep layers of the subsoil and be used by surface pumping. But inside the liberated zone, the granite rocks of the Reguibat shield predominate and water accumulation is very limited (Mulay, 2014). In these soils small areas can be cultivated with water accumulated at the bottom of relict water courses. But this little water is mainly used by local populations for domestic use and watering animals. Soil conditions are also adverse for agriculture due to the accumulation of salts such as sodium chloride, gypsum and others.

In some parts of the coastal northwest of Western Sahara, where it rains more and there is greater atmospheric humidity due to Atlantic storms, traditional cereals cultivation is carried out, predominantly with barley, and this region is the one where agriculture assumes greater importance (Guinea, 1945). *Graras* are depressions in the land where rainwater accumulates and the soil is enriched in clayey sediments and organic matter, which provides farmers with fertile soil. These depressions are also a favorable environment for the development of many shrubby plant species such as *Acacia tortilis, Rhus tripartita, Atriplex halimus, Salsola ssp., Launea arborescens, Asparagus altissimus* or *Lycium intricatum* (Guinea, 1945). According to our observations on the ground, these species are also found in the more arid interior relict water courses, such as in Tifariti. Farmers cultivate *grara* center, keeping the bushes on the periphery as protection against the wind. Nearby *grara* can join together allowing for larger agricultural fields. Most of them are located between the Imiriki el Hamar region and the coast, south of Cape Bojador, and north of the Saguia el Hamra river valley where they follow it to Smara. In these coastal areas with fertile soil, the Moroccan occupying authorities have developed intensive export-oriented horticultural farms with irrigation.

In Western Sahara locusts are a difficult pest to control and greatly harm agriculture. After heavy rains, the eggs females have buried in the sand hatch and clouds of locusts form, destroying everything in their path. The FAO program to combat locusts in Africa is an important help for farmers (Figure 32).

Figure 30. Agroforestry system of carots and *Acacia tortilis* at Smara refugee camp *hortus*.

Figure 31. Smara *hortus*, in Smara refugee camp. Hedges of *Arundo donax*, date palms (*Phoenix datilifera*) and *Acacia tortilis* protect crops against hot and sandy desert wind. Salty soil had to be removed and good soil was brought from other areas.

Figure 32. Locust plague is a major threat to Sahara desert plant cultivation. Foto from FAO/UN.

Final considerations

Pastoral nomadism system in Western Sahara is largely conditioned by the insecurity experienced in rural areas. The Moroccan army of occupation prevents the peaceful life of the population and their permanent movement in search of pastures for livestock. The soil is mined in many areas, causing the death of many animals and their owners every year, despite demining efforts carried out by RASD military forces.

Acacia tortilis, the desert tree of life, is essential to ensure survival of animals in the Sahrawi fields and, consequently, of their inhabitants. Its conservation is also important to combat desertification. Western Sahara has many trees in the desert savannah ecosystem of relict water courses, mainlly *Acacia tortilis*, *Maerua crassifolia* and several species of *Tamarix* sp.. Small forests of these woody species create favorable conditions for the infiltration of water from torrential rains and the increase in underground water sources that are essential to desert life. The Sahrawis know that it is in these wooded areas that they must dig their wells to water their animals, as presence of trees indicates presence of springs. It would be important to create areas protected from grazing to allow an increase in the populations of these woody species and to develop other protected areas with new green spaces with these trees by planting, particularly in places where there is some groundwater used through wells, which allow for easy watering of the young plants. Demand for wood for domestic use is also a threat to the desert savannah ecosystem. The cutting of trees is not accompanied by the planting of new plants, which favors desert expansion.

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