

THE PASTORAL DEVELOPMENT OF THE STEPPE RANGELANDS IN NAÂMA (WESTERN ALGERIA)

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Abstract

Naâma province occupies 3 million hectares, rich in natural resources (biological, edaphic and water), but unfortunately it undergoes a process of continuous degradation due mainly to clearing, overgrazing, overexploitation, desertification and sand encroachment. This requires the development of steppe rangelands (protection, rehabilitation and restoration) by adopting biological measures (pastoral plantations, creation of protected areas, dune fixations, as well as afforestation and the large green dam project). The result of this approach is characterized by a particular adaptation of different measures to the biophysical characteristics of the environment and different actions undertaken for restoration and rehabilitation that are part of a national strategy for pastoral improvement of degraded steppe rangelands. The sustainability of the various measures taken requires participatory management of the local population in rehabilitation programmes.

Key words: protection, steppe, arid, Naâma

Introduction. Restoration and rehabilitation is part of the possible remedies both to limit the spread of harms and to erase or mitigate the consequences in any unique ecosystem. It is necessary to highlight the performance of the steppe ecosystem [1]. The restoration objective is the sustainable management of natural resources in areas severely degraded by desertification in order to safeguard rangeland.

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The South Oran steppe rangelands of Naâma have a vast steppe area that covers three million hectares (i.e. more than 74% of the area of the province), including 577 244 hectares of alfatier rangelands [2, 3].

The current situation of steppe rangelands of Naâma province is alarming, the state of degradation has been shown in several studies to diagnose the current circumstances and highlight the fragile features of the steppe ecosystem accentuated by natural constraints (climatic aridity, silting) combined with human activities (grazing, land clearing), exerting strong pressure on natural resources [4–7].

Due to its position at the heart of a fragile ecosystem, the South of Oranian steppe area (in Naâma) is characterized by an environment that is heavily subjected to several scourges: degradation and regression of plant cover, risks of sand encroachment floods, and water erosion. The steppe area is a representative example of arid zones threatened by the scourge of desertification, strong anthropogenic pressure, and climatic constraints. Therefore, this area has undergone profound modifications, under the effect of climatic aridity, the overload of steppe rangelands and anthropogenic action characterized by land clearing, illegal ploughing, abusive and irrational exploitation of rangelands, intensive overgrazing, fires and some unsuitable development work, combined with aridity, sand encroachment and wind erosion.

Faced with this worrying situation of degradation, the Algerian State through various organizations High Commission for Steppe Development (HCSD) and Forest Conservation (FC), Directorate of Agricultural Services (DAS) has implemented several actions and programmes of pastoral development likely to have the aim of reducing the fodder deficit in order to remedy this degradation by the rehabilitation and restoration of the steppe rangelands that are heavily degraded.

The present work aims to evaluate the ecological benefits of pastoral development work carried out in the Naâma region (South-west Algeria).

Materials and methods. Study area. The study area (Naâma province) is part of the high steppe plains of southern Oran, it extends between 32°08'45" and 34°22'13" north latitude, and from 0°36'45" east to 0°46'05" west longitude. Naâma province extends over an area of 3 million hectares located in the south-western part of the highlands (Fig. 1).

Naâma province has a large set of ecosystems and biological diversity. It is located between the Tell Atlas and the Saharan Atlas in the western part of Algeria. It is limited to the north by Tlemcen province and Sidi Bel Abbes, to the east by El-Bayadh province, to the south by Béchar province and to the west by the Algerian-Moroccan border.

Naâma possesses a pastoral and agro-pastoral vocation which has resources in steppe pastures and fairly significant groundwater, and more recently, in lands favourable for the development of agricultural production.

The climate of the Naâma region is characterized by low and irregular rainfall (100 and 250 mm/year) and a fairly long dry period of 6 to 7 months, characterized

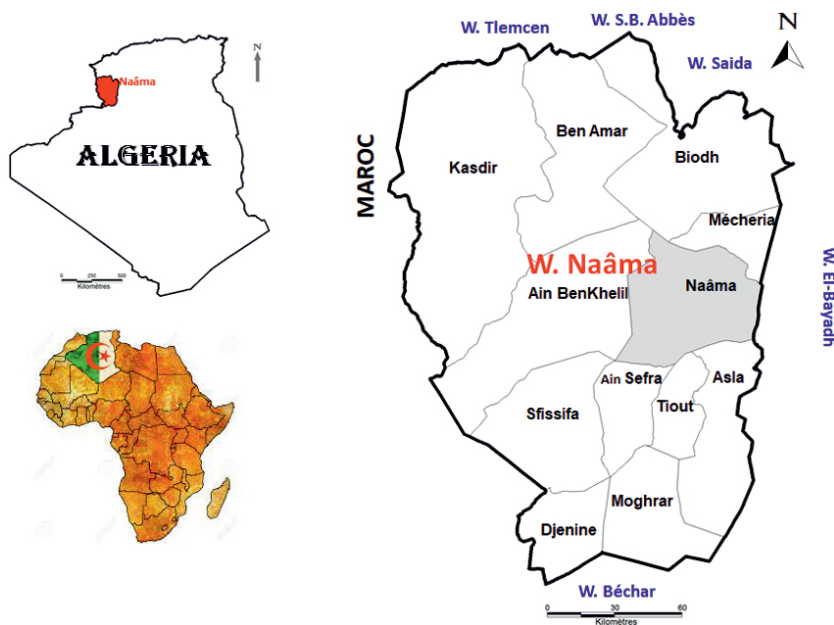


Fig. 1. Geographical location of the study area

by low temperatures generally falling below -4°C . This explains its belonging to the arid bioclimatic stage. The irregularity of precipitation from one year to the next combined with prevailing and dry winds causes a degradation of the plant cover and accelerates the phenomenon of aridification [5–7].

Study procedure. After analyzing and understanding the main causes of degradation of the steppe environment, appropriate means of control are carried out by the Algerian state to mitigate or even eliminate, under realistic feasibility conditions, the harmful effects on the natural environment.

The Algerian state, through various organizations (FC, DAS, HCDS), has undertaken several pastoral development actions to preserve the steppe plant cover and combat desertification, through actions to protect and create protected areas, while launching various programmes for agricultural development and intensification, pastoral development, promotion and diversification of livestock farming, reforestation operations and fruit plantations.

Results and discussion. 1. Floristic characterization of Naâma province. Naâma is a province with a vast area rich in wooded vegetation, it is occupied by steppe paths, forests and scrubland. The steppe area of Naâma covers an appreciable pastoral area of 2 200 000 ha. It is characterized mainly by very diverse plant formations with an abundance of cespitose grasses, a shrub layer (chamephytes) and an herbaceous layer including therophytes (annual species).

According to LE HOUÉROU [8], the steppe of the Mediterranean region is a low and open formation, dominated by xerophytes in tufts, revealing the bare

soil in varying proportions. The dominating plants can be herbaceous (grass: *Macrochloa tenacissima* (L.) Kunth, *Lygeum spartum* Loeff. ex L.) or woody (subshrubs: *Artemisia herba-alba* Asso). The Algerian steppe constitutes a vast agro-ecological space that extends over more than 20 million hectares. It is limited to the north by the Tell Atlas and to the south by the Saharan Atlas. The steppe is a plant formation, primary or secondary, low and opens in its typical physiognomy and mainly dependent on the bioclimatic, arid and desert stages (between the 100 and 400 mm isohyets). It is characterized by agropastoralism where sheep breeding is the primary means of economic activity.

Unlike the Eurasian steppe or high steppe of Russia, European grassland is distinguished from all other grasslands in the world by the relative weakness of Gramineae compared to other grasses. It is a shrubby plant formation with few grasses, typical of extreme climates and rare precipitation associated with a cold desert. The Eurasian steppe can be also called Great steppe or pseudo-steppe; it designates in biogeography several types of plant formations composed of expanses of small grasses devoid of trees, which can be dense or sparse, under various latitudes (temperate to tropical). It consists of the biome of more or less wooded grasslands mixed with deciduous forests, savannas and temperate shrublands in central Eurasia and in the sub-arid Mediterranean zones.

This area is mainly composed of:

- alfatier courses (*Macrochloa tenacissima* (L.) Kunth) including 577 244 ha;
- espartier courses (*Lygeum spartum* Loeff. Ex L.) including 500 000 ha [5];
- psammophytic courses with Drinn (*Stipagrostis pungens* (Desf.) De Winter) including 100 000 ha [5];
- In the pre-Saharan area, the remth courses (*Haloxylon scoparium* Pomel) including 800 000 ha form chamaephytic shrubby steppes with very little cover [5].
- The forest heritage (forests, scrubland and undergrowth) covers an area of 178 523 ha and presents a mosaic of biological environments which are rich in perennial sources covered with forest vegetation (*Juniperus phoenicea* L., *Pinus halepensis* Mill., *Quercus ilex* L., *Eucalyptus globulus* Labill., *Ceratonia siliqua* L., *Fraxinus excelsior* L., *Olea europaea* L., *Populus nigra* L., *Populus alba* L., etc.) [3].

2. Strategies for the rehabilitation and pastoral restoration of degraded steppe rangelands. To address this alarming degradation situation, the Algerian State has implemented several actions and pastoral development programmes likely to address the fodder deficit to remedy this degradation through the rehabilitation and restoration of severely degraded steppe rangelands. Interventions are necessary to control the process of degradation of steppe rangelands, to develop the means that ensure the rehabilitation of natural resources and to im-

plement programmes aimed at pastoral improvement of the productive potential of the rangelands.

The pastoral development actions carried out are as follows: the major Green Dam, Green Strip and Belt project, pastoral land development, pastoral plantations, fixing mobile dunes, reforestation, shade groves and fruit plantations, banning ploughing in pastoral areas, mobilizing surface water, as well as actions to combat desertification and exploit steppe resources, in particular through systems for protecting and setting aside hundreds of thousands of hectares of steppe rangelands [9].

2.1. Green dam and green belts. From the 1970s, Algeria carried out the major national project of the green dam through reforestation actions of Aleppo pine on an arid east/west strip of 3 million hectares that can reach more than 1500 km. The objective of the green dam is the protection of arid areas against silting and desertification and for the increase of Algerian forest heritage. The objective is to restore and maintain the ecological balance of the environment by rationally utilizing resources to promote the economic and social welfare of the populations.

Naâma is one of the regions benefiting from reforestation within the framework of the “Green Dam” project (Fig. 2). The purpose of these green belts of trees around urban areas is to safeguard cities, their suburbs, and public infrastructure. The main green belts were carried out at the level of five Algerian provinces – El Biodh, Naâma, Mecheria, Ain Sefra, and Ain Benkhelil – with a density of 2500 plants/ha. Aleppo pine (*Pinus halepensis* Mill.) is the main species used, rarely associated with other species such as cypress [3].



Fig. 2. Reforestation in the Naâma region (green belts through reforestation of *Pinus halepensis* Mill., *Eucalyptus globulus* Labill. around the city of Naâma)

2.2. Implementation of a strategy to combat land clearing. The appropriate strategy to combat land clearing of steppe rangelands must be carried out through the following actions:

- Raising awareness among the rural population concerned about the dangers and risks of degradation caused by irrational agricultural practices, particularly ploughing and land clearing in areas where rainfall barely exceeds 200 mm/year and in steep slope areas.
- Limiting mechanized ploughing in “fragile” areas.
- Demarcation of potential land for agriculture (case of dayas) and materializing their limits to stop any extension of land clearing to the detriment of rangelands.
- Prohibiting cereal crops in rangelands that are at risk of desertification and imposing the sylvo-pastoral system on them.
- The establishment of a zoning of pastoral ecosystems by specifying those within which any action of ploughing or clearing will be prohibited [3].

2.3. Implementation of a strategy to combat overgrazing. To better preserve the pastoral vocation (sheep farming) of this steppe region, it is essential to consider participatory actions with the population which would make it possible to stop the degradation of pastoral rangelands due to overgrazing.

- Pastoral organization and rational management of rangelands by more rigorous control of the load by better control of herds.
- Respect and control of the pastoral load by pastoral underload or undergrazing to promote the regeneration of species.
- Herd control and rational exploitation of rangelands by controlling the animal load, rotation, choice of grazing periods, organization of grazing periods, food supplementation in deficit periods and not relying too much on green fodder, management of fences and water points.

2.4. Strategy for combating sand encroachment. The primary concern of any strategic fight against sand encroachment is to understand the dynamics and functioning of the processes causing sand encroachment on the one hand, and the location of source areas that constitute inexhaustible reservoirs on the other. The current methods used to combat sand encroachment include mechanical control, biological control (Fig. 3), or both in combination.

According to the work of BERGHEUL [10], *Tamarix gallica* L. seems to be an excellent biological fixer of dunes and could promote the interesting process of progressive evolution towards a *Lygeum spartum* steppe. It offers effective and



Fig. 3. Fixation of dunes in the study area (by planting *Tamarix gallica* L. in sandy areas)

sustainable protection due to its root system, which promotes the establishment of an herbaceous layer that can be used for grazing.

2.5. Strategy to combat desertification. The strategy should respond, on the one hand, to the problems posed by desertification, and on the other hand, to the needs of the population affected by this phenomenon. The actions that will have to be carried out to combat desertification in the territory of Naâma province include:

- maintenance and protection of existing vegetation and reconstitution of the plant cover of bare or degraded areas by integrated development and restoration techniques;
- monitoring of the climatic, hydrological or pedological and ecological situation of plants;
- improvement and control of the use of fuel of plant origin (wood, charcoal) and search for alternative energy sources. Finally, the success of a programme to combat desertification cannot be effective without involving the local population.

2.6. Creation of pastoral improvement perimeters. Pastoral improvement is the set of techniques resulting in a modification of soil-climate-vegetation relationships, intended to increase the carrying capacity of the rangeland, extend the grazing season, improve annual productivity and the environmental attributes of the rangeland [4, 9].

Steppe rangelands have been removed from agropastoral exploitation with a view to rehabilitation or restoration: protection, deferred grazing, resting or nature reserve, planting of fodder shrubs, reseeding, fertilization, etc. [2, 3].

2.6.1. Exclosure. The exclosure is one of the pastoral improvement solutions proposed to combat these ecological harms, the protection has been tested which aims to reactivate the biological rise. It is through this integral protection to promote the regeneration, restoration and development of spontaneous vegetation to ensure protection of the soils [8–11].

According to Le Hou  rou [8], the protection is a natural technique that allows protecting a territory or a plot against any form of exploitation by man and/or domestic animals. It is a known technique that was practiced for centuries by our ancestors like the “Agdal” in North Africa or the “Hema” system in the Near East and Arabia.

Many studies have already proven the ecological effectiveness of this pastoral rehabilitation practice (protection) in the quantitative and qualitative improvement of pastures by the remarkable increase in plant cover, floristic composition, production, regeneration of plant cover after a period of three years or more (examples are listed in Table 1) [12–17].

2.6.2. Pastoral plantations. Pastoral plantation is one of the known management techniques and constitutes a form of restoration of degraded rangelands. This technique, aimed at the constitution of fodder reserves that can be mobilized during the period of famine and the protection of soils against the phenomena of water and wind erosion, will be continued while ensuring that the areas are large enough to facilitate their integration into rotation and rangeland management systems. The technique includes rehabilitation by planting species (fodder trees and shrubs) resistant and tolerant to disturbance (drought and aridity) such as: (*Acacias*, *Medicagos*, *Cactus*, *Atriplex*, *Prosopis*, *Agave*, *Opuntia*, etc.) [3, 18].

T a b l e 1

Effect of protection by the technique of exclosure on the improvement of the recovery and the floristic richness in Na  ma province

Authors	Locality	Recovery (%)		Floristic richness	
		Open grazing	Exclosure grazing	Open grazing	Exclosure grazing
Steppe of <i>Stipa tenacissima</i>					
Benaradj et al. [12]	Noufikha-Sfissifa	15	30	41	95
Anteur et al. [9]	Djedida	5	25	14	41
Benamara [14]	Noufikha-Sfissifa	8	30	15	31
Steppe of <i>Lygeum spartum</i>					
Benaradj et al. [15]	Touadjeur-M��cheria	5	25	27	71
Benaradj et al. [13]	Abdelmoulah-Kasdir	8	45	21	56
Benamara [14]	Boughallaba-Ain S��fra	26	58	28	79
Steppe of <i>Hammada scoparia</i>					
Boucherit et al. [16]	Zaboudja-Tiout	20	40	108	44
Benaradj et al. [17]	Bouarfa-Ain Sefra	9	25	71	26

2.6.3. Rotation of pasture ranges. According to BESSAÏH et al. [18], the use of rehabilitated rangelands, with a rotational grazing or controlled grazing (rest periods), constitutes a form of combat against overexploitation and consequently desertification. Rotational grazing is a rangeland management method that consists of controlling the animal load for short or long periods depending on the state of degraded steppe rangelands to allow forage species to complete their biological cycle between two successive farms in order to allow their pasture regeneration [19].

2.6.4. Seeding of rangelands. Seeding is a technique that aims to rehabilitate and enrich the vegetation cover. It is recommended for very degraded sites with low floristic richness. Seeding of rangelands aims to enrich the plant cover and ensure soil conservation [19].

It is a technique for artificial pastoral improvement of rangelands by sowing and reseeding degraded rangelands. It is recommended for the rehabilitation and regeneration of degraded rangelands by direct seeding of native pastoral species (either herbaceous or shrubby) perfectly adapted to the climatic and edaphic conditions of the steppe region [17, 19].

2.7. Creation of pastoral infrastructures (water points, dikes, diguettes). The action of fodder plantations and protection are supplemented by a hydraulic development programme to initially allow the irrigation of the plantations and subsequently the watering of the livestock, these actions allow a balanced deployment of the livestock on the water points. In order to rehabilitate the Naâma steppe, several natural resource conservation systems have been put in place (water retention, dike, small dike, etc.) [20].

The programme for the development and creation of water points is therefore of great importance. Indeed, an adequate network of water points will allow:

- The development of extensive livestock farming on rangelands and the maintenance of the balance of the pastoral ecosystem;
- The uniform use of pastoral space; the exploitation of new pastoral areas not previously grazed due to lack or insufficient drinking water;
- The extension of the grazing period on rangelands by organizing movements;
- Building dikes and small dikes (small Talwegs/wadis dams);
- The creation of water points and their management is another way of acting on the distribution of animals on rangelands;
- The creation, development and equipment of temporary water points which will be used for the collection and storage of rainwater, in regions where runoff water allows it, with a view to their subsequent use during dry periods. These water points will be built in regions where groundwater is scarce.

Conclusion. The Naâma steppe region is part of the Oran High Steppe Plains of Algeria, has a total area of three million hectares, largely occupied by the greatest potential in steppe rangelands, including a heritage of alfater rangelands. It is a region with an agropastoral vocation par excellence, where the practice of sheep farming is dominant. The steppe rangelands of Naâma are undergoing continuous degradation due to overgrazing and clearing. Silting and overexploitation of pastoral vegetation expose the surface soils to intense desertification. To deal with this alarming degradation situation, the Algerian State has undertaken various restoration or rehabilitation measures that are part of a national strategy for the pastoral improvement of degraded steppe rangelands, to combat silting in order to prevent desertification. Among the actions carried out are the major Green Dam project, land development, pastoral plantations, dune fixation, reforestation and fruit plantations, the ban on ploughing in pastoral areas, the mobilisation of surface water, as well as actions to combat desertification and the exploitation of steppe resources, in particular through systems for the protection of hundreds of thousands of hectares of steppe rangelands.

REFERENCES

- [1] LE FLOC'H E. (2000) Réhabilitation des écosystèmes arides dégradés: nécessité du recours à du matériel végétal adapté, Séminaire International sur la Lutte contre la Désertification, N'Djamena, Chad, 42–49, (in French).
- [2] B.N.E.D.E.R. (2009) Etude de recensement et de cartographie des nappes alfatières de la wilaya de Naama – Phase 2: affectation et classification des nappes alfatières, 17 pp, (in French).
- [3] ZAÏR M. (2011) Bilan écologique et socio-economique des reboisements dans la wilaya de Naama et perspectives d'avenir, Memoire de Magistère en Foresterie, Université Abou Bakr Belkaïd de Tlemcen, 170 pp, (in French).
- [4] BENARADJ A., H. BOUCHERIT (2014) Gestion intégrée des ressources pastorales dans la région de Naâma (Algérie), Revue Algérien de développement économique, 1, 19–29, (in French).
- [5] BOUCHERIT H. (2018) Étude ethnobotanique et floristique de la steppe à *Ham-mada scoparia* (Pomel) dans la région de Naâma (Algérie occidentale), PhD Thesis, Université Abou Bakr Belkaïd Tlemcen, 175 pp, (in French).
- [6] BENARADJ A., H. BOUCHERIT, T. MERZOUGUI (2020) Water Resources, State of Play, and Development Prospects in the Steppe Region of Naâma (western Algeria). In: Water Resources in Algeria – Part II, 253–283.
- [7] BOUCHERIT H., A. BENARADJ, S. BOUARFA, D. ANTEUR (2024) Ecological characterization of steppe formations in the Naama region (western Algeria), IntechOpen, <https://doi.org/10.5772/intechopen.115130>.
- [8] LE HOUÉROU H. N. (1995) Considérations biogéographiques sur les steppes arides du Nord de l'Afrique, Sécheresse, 6(2), 167–182, (in French).
- [9] ANTEUR D., A. BENARADJ, H. BOUCHERIT (2022) The impact of enclosure on the rehabilitation of steppe vegetation at Naâma rangelands in Algeria, J. Rangel. Sci., 12(2), 113–128.

- [10] BERGHEUL N. (1990) Contribution à l'étude des dunes fixées au niveau des mises en défens d'âges différents de Ain Benkhélil (Naama), DES, USTHB, Alger, 63 pp, (in French).
- [11] BENAMARA N., A. BENARADJ, S. BOUARFA (2023) Ecological assessment of steppe rangelands in the Ain Sefra region (southwestern Algeria), *Natural Resources and Sustainable Development*, **13**(2), 255–268, <https://doi.org/10.31924/nrsd.v13i2.133>.
- [12] BENARADJ A., H. BOUCHERIT, K. MEDERBAL (2013) Remontée biologique de la steppe à *Stipa tenacissima* L. après une mise en défens dans la station de Noufikha (Naâma – Algérie), *Annales de l'INRGREF*, **18**, Numéro spécial, 107–121, (in French).
- [13] BENARADJ A., H. BOUCHERIT, O. HASNAOUI et al. (2013) Rehabilitation of the steppe *Lygeum spartum* in the region of Naama (western Algeria), *Energy Procedia*, **36**, 349–357.
- [14] BENAMARA N. (2024) Caractérisation phyto-écologique des formations steppiques et effet de la protection sur la remontée biologique des parcours steppiques sud-oranais, PhD Thesis, Centre Univ. de Naama, (in French).
- [15] BENARADJ A., K. MEDERBAL, K. BENABDELI (2010) Remontée biologique du parcours steppique à *Lygeum spartum* après une durée de Mise en défens dans la steppe sud-oranaise de Naâma (cas de la station de Touadjeur), *Mediterranea. Serie de Estudios Biológicos. Época II*, n. **21**, (in French).
- [16] BOUCHERIT H., K. BENABDELI, A. BENARADJ (2017) Biological recovery the steppe of *Hammada scoparia* after enclosure in the region of Naama (Algeria), *Ekologia (Bratislava)*, **36**(1), 52–59.
- [17] BENARADJ A., H. BOUCHERIT, K. BENABDELI (2017) Effet de la réhabilitation de la steppe à *Hammada scoparia* dans la région de Naâma (Algérie), *Bot. Complut.*, **41**, 81–91, (in French).
- [18] BESSAÏH A., B. HELLAL, N. AYAD (2014) Réhabilitation par l'atriplex des parcours steppiques du sud de la préfecture de Saïda (Algérie occidentale), *Eur. Sci. J.*, **10**(32), 81–92, (in French).
- [19] TBIB A., M. CHAIEB (2007) La mise en défens des parcours en zones arides: Avantages écologiques et obstacles socio-économiques, *Revue des Régions Arides*, 473–476, (in French).
- [20] BOUCHERIT H., A. BENARADJ, A. BOUDERBALA (2021) Conservatory management of natural resources in the Naâma region (southwest Algeria), *Water Conserv. Sci. Eng.*, **6**(1), <https://doi.org/10.1007/s41101-021-00118-9>.

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