



A book on the rangelands of Libya

Gintzburger, G¹; Saïdi, S²

[1BadiaConsulting@gmail.com](mailto:BadiaConsulting@gmail.com), & [2Slim.saidi@cirad.fr](mailto:Slim.saidi@cirad.fr)

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Abstract

Our book cut across all aspects of arid Libyan rangelands. It addresses climate – bioclimates with statistical analysis on climate change trends and droughts recurrences, geomorphology and landforms, soils, vegetation types and landscapes, rangeland production and stocking rates, livestock systems, traditional rainfed barley cropping and Australian ley-farming implemented on large scale, common water use and valorisation by water harvesting and flood farming, forest - afforestation and charcoal manufacturing, past and present wildlife, historical tribal rangeland use, degradation and desertification, restoration and rehabilitation techniques applied to large areas all over northern Libya from passive rangeland protection to fodder shrubs /trees plantations, and agro-ecological zoning to identify land capability and suitability for rainfed barley and olive trees without encroaching current land use.

Our monograph is unique and without equivalent from Morocco to Mongolia. It is relevant to the challenges affecting the arid rangelands of North Africa, the Middle East and Central Asia. It explains the transition from subsistence arid rangeland systems to current trends in livestock feeding with imported and subsidized feed stimulating rangeland degradation and desertification. We explain rangeland degradation and recovery, and agro-ecological zoning using the most up-to-date remote sensing and GIS techniques. It covers arid rangeland rehabilitation and afforestation projects with appropriate plant material, operations unfortunately failing most time due to lack of rangeland communities' involvement.

Our Libyan book is abundantly illustrated with 759 photos including 561 photos of 220 plants with their description and pastoral use, 48 figures, 37 tables and 35 original maps. The bibliography covers Mediterranean arid zones publications with some 630 references in English, French, Arabic, and Latin.

We expect that our book will encourage pastoralists colleagues, decision makers and politicians of North Africa, the Middle East and Central Asia to act wisely before it is too late.

The Libyan Rangelands Under Siege

The Libyan rangelands, inhabited by nomads and livestock, are facing significant challenges from land clearing, hazardous rainfed cropping, unsustainable irrigation projects, expanding human and livestock

populations, urbanization, and modernity, particularly in the 100-500 mm rainfall zones, leading to degradation and desertification (Fig. 1).

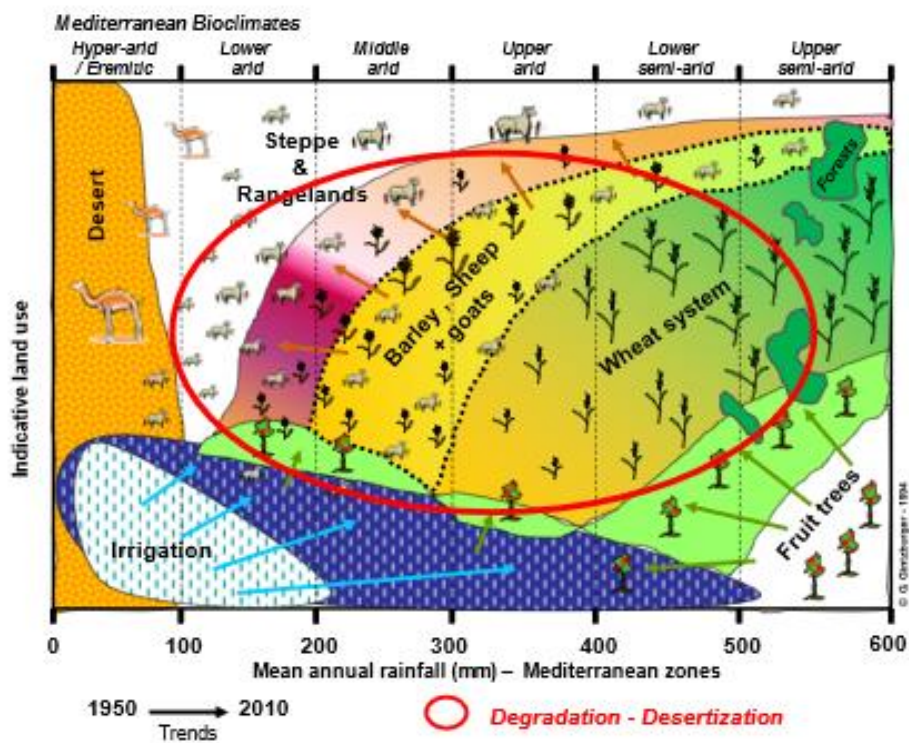


Fig. 1. Land use trends in West Asia and North Africa (Gintzburger, 1996)

Climate, Bioclimates And Droughts

Our study analyses Libyan climatic data from 1945 to 2010, revealing differences in spring rainfall between the northwest and northeast regions and rainfall variability. It examines climatic factors affecting native vegetation and rainfed cropping. Libya was not immune from long-past climatic oscillations, with evidence from paleoclimatology and archaeology.

Geomorphology And Landforms

Geomorphology is crucial for understanding arid zones' ecology and vegetation distribution. Northern Libya is dominated by Cretaceous limestone altered over millions of years. The Sirte region results from long-past marine transgressions. Quaternary terraces, saline coastal endoreic depressions, thick loess deposits, and sand deposits are common features. Wind and water erosion, along with land clearing and overgrazing, continue to alter and chisel landforms and soils.

The Libyan Soils

Based on research in southern Tunisia, we identify and classify the main Libyan soils based on the topsoil and upper horizons supporting native vegetation. Our soil description and classifications remain easily accessible to rangeland ecologists and land developers. It provides for easy soil interpretation and identification from vegetation type, ecological group, plant association, or presence of specific indicator plants. We produced a synthetic soil map of Northern Libya based on our classification and field experience.

The Vegetation Types

Libyan landscapes are shaped by geology and geomorphology, resulting in various vegetation types, and ecological groups modelled by climate, soil types, and land use, creating specific plant associations altered by land use and grazing pressure. Vegetation surveys require detailed phyto-sociological studies necessitating a deep understanding of environmental parameters and plant taxonomy. It necessitates incessant field trips and surveys, herbarium collection and accurate plant identification, complemented with local knowledge collected from shepherds and farmers.

The Most Common Libyan Rangeland Plants

We illustrate 262 plants from 51 families commonly found on Libyan rangelands with their scientific and vernacular names, life form, description and morphology, reproduction, pastoral importance, palatability and fodder value, toxicity, economic interest, habitat, distribution, and endemism.

From Rangeland Vegetation Standing Biomass To Stocking Rates

Sustainable rangeland management necessitates biomass field measurements, Rain-Use-Efficiency evaluation, satellite imagery processing and GIS. However, grazing decisions based on western concepts of carrying capacity and stocking rates are not suitable for shepherding in arid zones due to logistical constraints, water availability, flock management, and land tenure issues.

The Rainfed Ley-Farming System On Rangelands In Western Libya

The Australian ley-farming system, implemented from 1973 to 1984 on 50,000 hectares of Western Libyan rangelands, improved rainfed cereal yield and sheep production compared to the traditional system as long as annual rainfall was about 250-275mm. However, the Australian system was difficult to manage due to low erratic rainfall and required constant Australian expertise and Libyan colleagues' training. The technology transfer to private farmers failed due to lack of community participation, small farm size, and complexity of the input system. It was abandoned for more profitable irrigated vegetable and fruit tree production or reverting to free rangeland grazing.

Livestock On Libyan Rangelands

For centuries, Libyan rangelands have been home to herded small ruminants and dromedaries supported by native vegetation and scanty water resources, both limiting livestock numbers. Droughts would occasionally reduce their numbers, taking years to restock. Today, degraded Libyan rangelands are not producing the necessary feed to sustain rocketing livestock numbers. Feed and barley grain production are insufficient despite expanding rainfed cropping targeting the best rangelands. Livestock are now mostly artificially fed under open-air feedlots using subsidised imported barley grain. With overstocking causing desertification, it also stimulates the spread of infectious diseases barely controlled. The livestock situation is dire and cannot be solely attributed to climate change.

Water On Rangelands

Water availability is vital for arid rangelands communities. Since antiquity, they dug shallow wells, built cisterns and developed efficient water harvesting and flood farming. Widely spaced watering facilities was the norm up to the end of WWII, but perceived as a limitation to modern rangelands management, hence uncontrolled implementation of legal and illegal wells and cisterns. Modern drilling and pumping stations accessing deep aquifers with hauling water to the most remote rangelands accelerated rangeland degradation. Without strict control and policing water resources, Libyan rangelands will be totally degraded, leading livestock to be exclusively fed on stationary open-air feedlots.

Tribes And Territories

Berber and Arab Libyan tribes managed their rangelands despite endless battles, invasions and colonisations, fiercely defending and controlling their territories. Each tribal territory covers a diversity of landscapes and rainfall zones allowing for balanced resources and sustainable land management. Tribal rules about territory and shared resources are reviewed with examples from the West, Sirte and the East extending deep into the southern desert. With the discovery of oil reserves by 1959, the Libyan tribal system and economy gradually evolved, leading impoverished nomads and semi-nomads to quit the rangelands for financially secure but humble employment. Yet, the *esprit de corps*, traditions and rules within and between tribes remains strong to these days. The weaving art composing the elements of the customary bedouin tent is portrayed as steadily disappearing.

Forests, Afforestation, Fuelwood And Charcoal

Libya still benefits from a wealth native trees and shrubs. The use of fuelwood and charcoal is a part of Libyan culture. Native forests, woody shrubs, and afforestation are relentlessly threatened from illegal logging and charcoal manufacturing. Current forestry and rangelands legislations are inefficient. Without policing, accurate mapping and monitoring, fuelwood resources will continue to be plundered. Alternatives to fuelwood harvesting and charcoal manufacturing are reviewed. Afforestation projects must be encouraged using native and appropriate exotic species. Without immediate actions to remedy illegal logging and charcoal manufacturing, Libya will soon see its native forests, exceptionally drought resistant trees, and forestry plantations decline, widening already rampant rangeland desertification.

Past And Present Wildlife On Libyan Rangelands

Wildlife is an essential element of rangelands and forests, and a sign of good health of the ecosystems. These days, in Libya, even in the most desert remote areas, native herbivores, carnivores and birds are mercilessly hunted. Hunting, not anymore a vital necessity, is replaced with indiscriminate illegal sport hunting leading to wildlife massacres. We review, describe and illustrate the Libyan wildlife from prehistoric to modern time.

Assessing Rangeland Recovery, Degradation And Desertification

Rangeland bio-physical recovery, degradation or desertification are azonal and affect all arid Libyan rangelands. The anthropogenic reasons are well known with climatic high variability and possible climate changes. We review the methods and tools to assess rangeland health from simple site- and date-specific measurements to the most advanced complex satellite imagery time-series processing allowing monitoring and mapping trends over large areas. Rangeland degradation, often over emphasised in media, is not inescapable as many examples confirm rangeland recovery. Libyan rangeland managers, decision makers and scientists could benefit from these technologies to accurately identify, locate rangelands recovering and prioritise treatments of degraded areas under threat of desertification.

Recovery, Restoration And Rehabilitation Of Degraded Rangeland

Rangeland rehabilitation techniques were implemented on tens of thousands of hectares in Northern Libya. Rangeland passive protection and deferred grazing remain the cheapest and most efficient techniques well accepted by shepherds. Active means of rehabilitation, such multipurpose shrub plantations combined with water harvesting techniques and phosphate fertilization may be necessary. Reseeding with native rangeland species remains to be explored, especially with annual *Medicago* sp. (Medics) pods. Reallocating the best rangelands to fodder shrubs plantations is labour-intensive, and expensive, and is neither valued nor accepted by rangeland communities. Rangeland protection, multipurpose shrubs plantations, reseeded,

low-cost water harvesting techniques, and minimal fertilisation produced satisfactory technical results on Libyan rangelands. They remain doomed unless supported by local communities.

Agro-Ecological Zoning Of Libya: The Case Of Barley And Olive Tree

Considering the barley grain deficit and current plans to expand olive tree production, is there some agricultural land still available for rainfed farming in Libya ? We developed an agro-ecological zoning methodology based on algorithms and GIS mapping filtering limiting climatic, soils, and barley and olive tree agro-ecological and agro-biological factors. We produced maps of western and eastern Libya excluding current land use and accurately locating suitable land for the two crops. The methodology could be improved providing up-dated land use map and refined limiting factors. Cropping, planting new trees on additional suitable land would have to remain with identified communities, property rights and traditional laws.

Overall Conclusions

Despite their apparent monotony, the Libyan rangelands are ecologically extremely diverse due to a rich geology and climate shaping landscapes supporting various soil types, in turn defining plants associations. For centuries, plant associations provided free feed and wildlife resources to rangeland communities. There was a fragile equilibrium between resources and demand. This equilibrium, often broken by droughts or unrest, tilted towards creeping land degradation past WWII and accelerated by 1970 with the oil discovery, increasing human and livestock population, wealth and urbanisation. The Libyan rangelands are these days in a crisis, unable to sustain the current livestock numbers. This is unsustainable without importing vast quantity of complementary subsidized feed, illegally drilling wells and constructing countless new watering places, all contributing to more rangeland desertification. The culprit is not climate change, but simply the man.

Reference

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