IDRC CRDI

IFAD

Knowledge Access in Rural Interconnected Areas Network

International Center for Agricultural Research in the Dry Areas

ICARDA 1977–2007

Rangeland Improvement and Management

in Arid and Semi-Arid Environments of West Asia and North Africa

Title:	Rangeland Improvement and Management in Arid and Semi-Arid Environments of West Asia and North Africa
Prepared by:	A. Nefzaoui & M. El Mourid
Format and Layout:	Mustapha Malki
First Published:	July 2008

Knowledge Access in Rural Interconnected Areas Network

International Center for Agricultural Research in the Dry Areas

Rangeland Improvement and Management in Arid and Semi-Arid Environments of West Asia and North Africa

PREPARED BY:
ALI NEFZAOUI & MOHAMED EL-MOURID

FOREWORD

KariaNet is a regional network that aims at enhancing knowledge-sharing and promoting exchange of experience and information among IFAD-funded rural development projects in the MENA) region. It strives to strengthen networking - at various levels – among all its member projects through an intensive use of ICTs for knowledge sharing. However, in order to enhance knowledge sharing, KariaNet undertook a Needs Assessment Study in the early stage of its first phase in order to identify valuable knowledge available within the Network that should be shared among members, and to "locate" knowledge gaps that have to be prioritized and filled through mobilising "external" efforts.

This study helped in identifying substantive technical content needed to support technology transfer activities of KariaNet member projects. One of the most highly prioritized issues is the improvement of reproduction and husbandry of small ruminants, given that sheep - and to a lesser extent goats - in MENA are mostly concentrated in dry areas in which they play an important socio-economic role. They represent the main source of income for populations in these areas, and contribute to a large extent in the livelihood of vulnerable and resource-poor farmers of the region. In addition, they traditionally play an important role in reducing risks associated with climate variability and vulnerability.

Given that KariaNet should fill the knowledge gaps identified among its members, and that its task is not to accomplish content development per se, its Regional Coordination Unit had to identify potential content sources in the region; and partner with them in order to identify the content available for them and see how it can repackage it and use it to fill some of the knowledge gaps already identified.

In addition to the technical substantive content it provides, the present publication tells the story of a successful partnership in content development between KariaNet and ICARDA. It shows the positive outcomes of connecting - on one hand - a leading research institution and source of content in the region that regularly produces, since more than 30 years, valuable research findings; with agricultural and rural development projects in need of useful content to back-up their agricultural development activities, on the other.

By publishing this document, and beyond the mere technical character of the topic, KariaNet seeks to simultaneously achieve different objectives: (1) contributing to the nurturing of the culture of useful content development in order to achieve sustainable agricultural and rural development; (2) fostering dissemination of useful content available at renowned sources to development projects in need of such content; and (3) helping these developmental projects improve and enhance their operations, especially their technology transfer activities.

Dr. Mustapha Malki
Regional Coordinator of KariaNet

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

ACSAD	Aran Center for Studies in the Arid Areas
ICARDA	International Centre for Agricultural Research in the Dry Areas
ICTs	Information and Communication Technologies
KariaNet	Knowledge Access in Rural Inter-connected Areas Network
MENA	Middle East and North Africa
M&M	Mashreq-Maghreb
WANA	West Asia and North Africa

1. Introduction

The WANA region enjoys vast territories of steppe and Saharan grazing lands. The primary vocation in this region is livestock production. Pastoralism was the traditional mode of resources utilization, but the society is experiencing profound changes throughout the last decades. These changes are visible through the regression of traditional organizations, increasing inequalities in flock holdings, the privatization of common rangelands, development of barley cropping and arboriculture (e.g. olives), regression of animal mobility and the sedentarisation of the population. Rangelands are subject to increasing pressure leading to their degradation. In order to cope with these changes, pastoralists seek other jobs in large cities or abroad, diversify their sources of income, or adapt their livestock production system to rely more on intense and purchased supplements.

Each of Morocco and Algeria has 20 million ha of steppe, almost 40% of their territory, covering most of their rangeland areas. Tunisia follows with 25% of the rangeland, while Libya and Egypt are desert countries where rangelands represent 1-2% of their territory. In absolute figures, Libya has about the same acreage of rangeland as Tunisia (see Table 1).

Rangelands in WANA face both area reduction and degradation (productivity reduction). From mid-1970's till mid-1990's, rangeland areas have decreased by 10-15% in Morocco, Algeria, and Tunisia (Abdelguerfi and Marrakchi, 2000).

Several factors are responsible for rangeland degradation, but the most significant ones are the increasing number of livestock population and the cropping of the steppe (Nefzaoui, 2002). During the last four decades, livestock in Tunisia has tremendously increased, i.e. female sheep increased from 1.3 to 3.9 millions, while goats increased from 250,000 to 750,000 heads. At the same time, about one million of good rangelands have been converted to tree planting and cereal cropping. Nowadays, these rangelands contribute between 10 to 25% of livestock needs with some variations from one year to the other, while they were up to 65% in 1960s.

In addition to these economic aspects, environmental and ecological issues should be taken into consideration because rangeland degradation ineluctably leads to intensification of the desertification process, and ecological unbalance, particularly biodiversity erosion. Best rangelands are ploughed and converted to cropland, thereby destroying the protective plant cover. Soils become prone to erosion and within few years the land is abandoned, reverting back to poor rangeland. In fact, native species are slow to return, and the vegetation consists mainly of few native weeds. Overgrazing is the other factor of degradation; the most palatable species are not given enough rest to survive and invader plants are developing. Overgrazing, especially when combined with frequent droughts, leads also to the decrease of perennial species (Nedjraoui, 2004). All these phenomena are exacerbated by the changes in pastoral systems, as the decrease of mobility and introduction of mechanization to transport livestock, livestock, feeds and water.

Livestock production relies heavily on imported feed grain; rangelands cover today 5 to 30 % of feed requirement of the total population of small ruminants, compared to70 to 80 % in the 1960's.

Achieving efficient, equitable, and sustainable rangeland management depends on the costs and benefits of alternative systems. These costs and benefits, in turn, depend on agroecological, socio-cultural, and economic factors. The conservation and management of rangelands require not only tenure security, but also an understanding of local livestock production and risk management strategies, as well as factors that promote collective action which can be integrated into national policy formulation strategies and project designs (Ngaido and McCarthy, 2004).

Table 1 - Importance of Pastoral Zones in North Africa (from various sources)

Economic indicators	Morocco	Algeria	Tunisia	Libya	Egypt
Livestock share in agricultural GDP (%)	26	48	30	30	
Rangelands (*% of country total area*)	42	39	25	2	1
Population of the steppe and desert zone (*% of country total area*)	37.9	37.8	28.1		
Share of small ruminants population in pastoral zone (*% of country total*)	75	48	20		27
Contribution of range to total feed balance (%)	30	10	10		5

2. Basic Principles

The objective of rangeland management is to reach the closest possible equivalence between seasonal feed requirements of livestock and range production. Such equivalence can be achieved through two main complementary groups of interventions, one is to be implemented on the herd and the other one on the rangelands.

2.1 - Basic Principles of Livestock Use of Natural Vegetation

We need to understand animal-plant interactions before undertaking any action on rangelands. Some of the common questions are:

- How animals utilize the rangeland?
- How animals behave on the rangeland (daily activities)?
- What animals are taken off from the rangeland?
- How vegetation reacts to animal action?
- What is the effect of grazing/browsing on plants?
- What is the nutritive value of pastoral plants and what is the level of intake by animals?

2.1.1 - What are the effects of defoliation?

For a good re-growth, we need to keep enough reserves and protect basal buds. Adequate storage of reserves depends of the following factors:

- Duration between two defoliations;
- Defoliation period in relation to physiological stages;
- Number of meristems left after defoliation;
- Climate conditions during the re-growth period (light, temperature, moisture, etc.).

Plants will have a good re-growth and develop sufficient carbohydrate reserves, if defoliation is happening at early blooming (high level of reserves).

2.1.2 - What are the practical consequences?

Grazing frequency and intensity should not be high and must take place at the right physiological stage.

2.1.3 - Some rules

- Systematic over-grazing should be avoided in order to allow plants to develop reserves;
- Grazing during March and April is the most harmful;
- To encourage re-growth, perennial grasses should be consumed before blooming;
- Annual species should be consumed rapidly;
- Proportion of yearly buds consumed should not exceed 25-50 % for fodder trees and shrubs;
- Take-off higher than 50 % reduces the vigour of woody species;
- Simple rule: take half and leave half!

2.1.4 - Effects of animal behaviour

- Rhythm of activities (eating, resting, ruminating);
- Territorial behaviour;
- Feeding behaviour;
- Difference in behaviour between sheep, goats, and camels (woody species represent 50% of goats diets, while only 20% of sheep diets).

The grazing duration depends on the following factors:
- Day length,
- Maximum temperature (night grazing is necessary during hot days);
- Vegetation availability (grazing duration increases with the scarcity of vegetation).

2.1.5 - Mobility and watering: two strongly linked activities

- Mobility can be restricted to the quest for water.
- Effect of stamping occurring by livestock,
- Natural spreading of in the rangelands improves soil fertility.

2.2 - How to intervene in rangelands?

The nature of intervention will depend of land tenure.

2.2.1 - Basic Principles

- Intervention in factors affecting the mode of rangeland use by livestock (load capacity, period of grazing, organization of grazing system, fences, water points, etc.) ;
- Intervention in factors directly affecting the management of biomass (over-seeding, fertilizers, resting, etc.).

2.2.2 – Assessment of the Current Situation

Prior to any intervention, there is a need for assessing the current situation of a rangeland. Several factors related to the land. Socio-cultural conditions, livestock, market, feed availability, and the climate have to be taken into consideration in decision making related to improving the productivity and the management of the rangeland (see Figure 1).

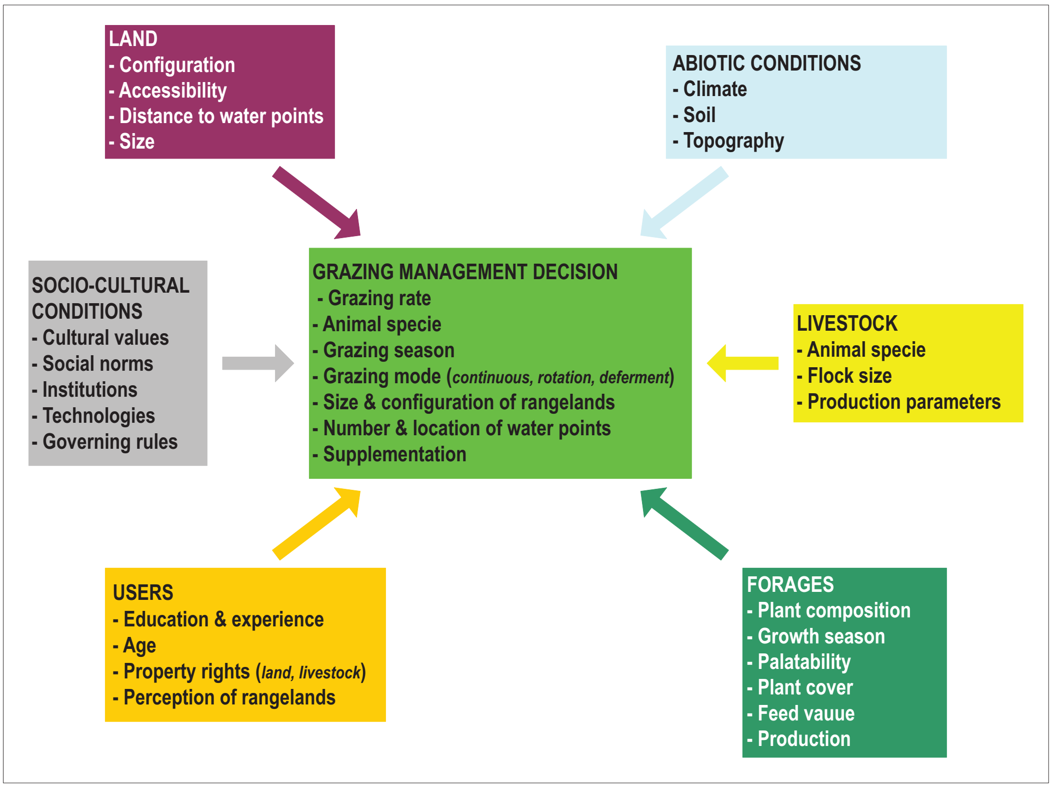

Figure 1 - Factors Affecting Sustainable Rangeland Development

The following are some of the major concerns:

- Grazing pressure: Do we have the means to control animal numbers?
- What are the herders' strategies to cope with feed shortage in the rangelands?
- What is the government role/intervention to face severe droughts?
- How to improve livestock productivity through appropriate feeding management?

It is important to "read" the state of a rangeland through the observation of vegetation and soil. The following guidelines may be used to assess overgrazing or under-utilization of a rangeland (see Table 2 and Figures 2 and 3).

Table 2 - Simple Indicators of Rangeland Use in Arid and Semi-Arid areas of WANA

Signs of Overgrazing	Signs of Undergrazing
Dominance/apparition of invaders like *Peganum harmala*	Apparition, extension and even predominance of palatable or non-palatable woody species
Regression of fodder species in favour of poorly or non-palatable species (*Artemisia campestris, Hammada scoparia, Cistus spp*., ect.)	Increase of the volume of vegetation/plants, plant litter, and dense herbaceous stratum
Tendency toward dominance of annual/seasonal species	Difficult access of livestock because of mattoral for example
Overbrowsing of palatable woody species (*Olea oleaster, Salsola, Juniperus, Quercus, Phyllyrea*, etc.)	Refusals of species, especially palatable ones.
Soil compacting by repeated stamping (slopes, transit routes, and water points)	
Advanced erosion (bare plants, gullies, and runoffs)	

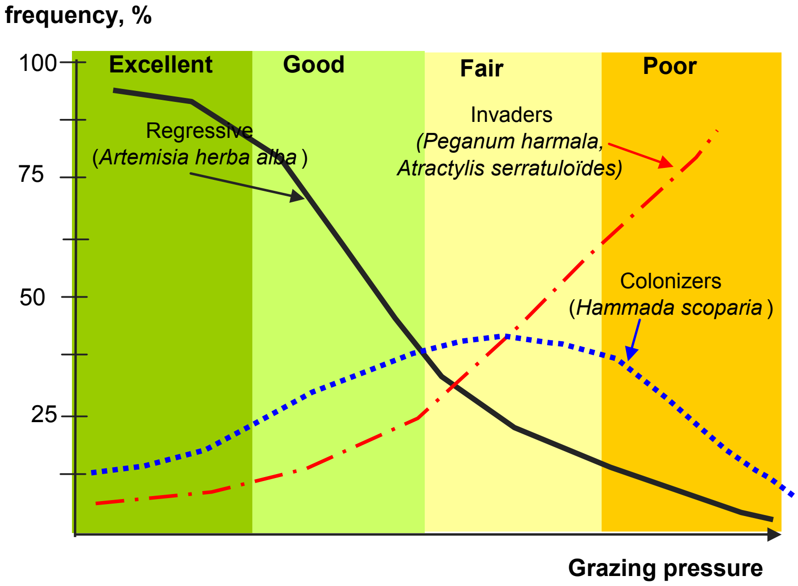

Figure 2 - Relative Variation of Three Steppe Plant Groups (colonizers, invaders and regressive) in a Rangeland Subject to an Increasing Grazing Pressure
(adapted from Bourbouze and Donadieu, 1987)

Figure 3 - Invasion of *Peganum Harmala* in a Degraded Rangeland (*Maatarka-Tendrara, Morocco*)

2.2.3 - Interventions in Factors Affecting the Mode of Rangeland Use by livestock

Management of Stocking Rate (ST)- Basic Definitions:

Stocking rate (ST): The number of animals from a specific type per hectare during a specified duration. Example: *The stocking rate of this rangeland is X ewes per ha in spring season.*

Livestock density (LD): The number of animals per hectare for a short period of time. Example: *The livestock density of this plot is 20 goats per hectare for 6 days of browsing.*

Grazing capacity (GC): Number of days times number of animals per hectare for a specific duration. Example: *6 ewes, spring season, 2 ha, 20 days. The GC is = 20 days x 6 ewes/2 ha=60.*

Grazing pressure (GP): The number of animals from specific type per unit of biomass weight for a specific duration. Example: *The grazing pressure in summer is 1.6 ewes per ton of dry-matter available biomass.*

Available vegetation (AV): Weight of vegetation available in the rangeland per kg of animal live weight. Example: *20 kg dry matter of available feed per kg of animal live weight.*

Animal production per ha: The stocking rate by the production per animal for a specific duration. Example: *The rangeland produces 30 kg of growth per ha.*

What is the optimal stocking rate?

In theory, it is possible to calculate the optimal grazing rate. Indeed, beyond the grazing rate x1 (see Figure 4), the growth per animal (y) decreases and reach zero at x2 grazing rate, corresponding to the maintenance. The animal production per ha (P) is equal to the growth per animal (y) times the grazing rate (x). P follows a curve that reaches its maximum at xm (see Figure 5) which represents the optimal grazing rate. It is clear that is not possible to have animals at their maximum of productivity and the highest animal productivity per ha.

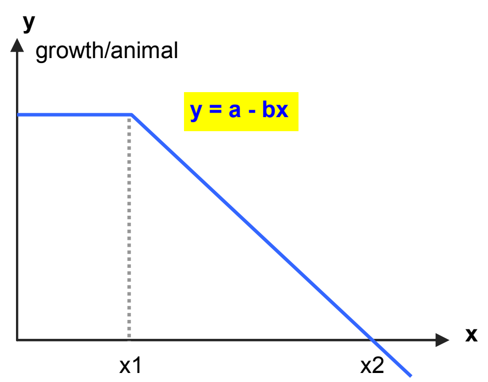

Figure 4 - Theoretical Model of Animal Growth Variation according to Grazing Rate

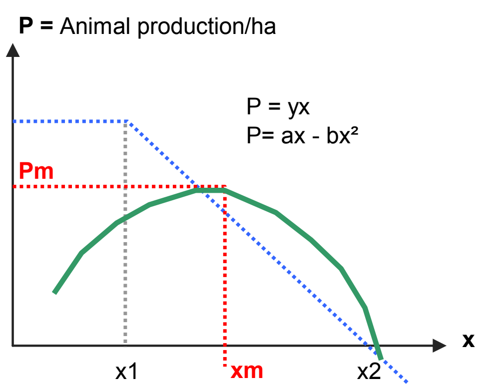

Figure 5 - Theoretical Model to Estimate the Optimal Grazing Rate

How to calculate xm?

In theory, **xm** is equal to the half of **x2**. However, in practice, the situation is more complicated.

What is the optimum we are targeting? Herders try to maximise production per ha when the rangeland area is limited. In collective rangelands, herders will use very high grazing rates; otherwise the neighbour will.

If economic parameters are considered, the optimal grazing rate is lower than the one for optimal production per ha which can also be calculated using the following formula:

$$P = ax - bx^2$$

If **S** is the selling price of 1 kg growth, the gross profit (**GP**) is equal to:

$$GP = Sax - Sbx^2$$

If **C** represents the financial charges per animal, the net profit (**NP**) is equal to:

$$NP = Sax - Sbx^2 - Cx$$

The maximum net profit (**NPm**) is equal to:

$$NPm = (Sa - C) / 2Sb$$

If ecological aspects are considered, the optimal grazing rate will depend on the planned objectives toward vegetation that can be summarized as follows:

- Maintain the current state of the rangeland via a balanced grazing rate;
- Favour the regeneration of the herbaceous stratum using a lower grazing rate or rehabilitative grazing rate;
- Achieve maximum take-off using very high grazing rate in order to renovate abandoned grazing area.

Therefore, it is difficult to define the optimal grazing rate without sufficient clarity concerning the objectives related to animals and vegetation.

Moreover, the situation is further complicated because we need to readjust the grazing rate according to seasons. Generally speaking, the grazing rate should be reduced with the advance of the season.

How to reduce the grazing rate? There are two main options. The first one is to increase the grazing area, and the second is through reducing the number of animals (sell, culling, association or *khlata*, etc.).

3. Rangeland Improvement

Several techniques for increasing the productivity of the rangeland were investigated including deferring grazing, shrubs planting, reseeding, fertilizer application, scarification, etc. Some of these techniques show significant results under favourable conditions. However, under arid environments most of these techniques failed and meagre results are reported in different locations. Table 3 summarizes the conditions and the assumptions for positive results of the main techniques available at this stage.

Deferring grazing for 2 to 3 years and even sometimes for one grazing season only might give good results if there is sufficient soil moisture and sufficient seed bank. This technique is not efficient if the range is highly degraded. At the moment, this is probably the most used technique for rangelands in arid zones but it must be synchronized with rainy season.

Impressive results are obtained with fast growing shrubs planting (*Acacia cyanophylla, Atriplex nummularia, Opuntia ficus indica*) in Central Tunisia where average rainfall is 200-300 mm per year (see Table 3). The water requirement of these species cannot allow them to be used to improve rangelands in the South, since average rainfall is around 100 mm or even less. However, in certain "niches" and in association with water harvesting techniques, planting Opuntia and Atriplex may be recommended. Still in this case it is recommended to use native shrubs, as *Rhus tripartitum, Periploca leavigata, Retama retam*, etc. which are better adapted to harsh climates. These native species are slow growing and their productivity is much lower than the introduced ones, which represent a real constraint for adoption by rangeland users. In both cases, serious investigation is needed to assess the technical, social and economic efficiency of both alternatives (see Table 4 and Figures 6 and 7).

Results of reseeding, whether in association with scarification or not, are quite low and remain dependent on soil moisture and availability of seeds. Good results are obtained under favourable conditions but this technique is rarely successful in harsh environments.

Fertilizer, mainly phosphorus, is appropriate only when average rainfall is higher than 300 to 400 mm depending on soil type.

Table 3 - Main Techniques For Rangeland Improvement in WANA
(Nefzaoui, 2004)

	Level of degradation			
Techniques of rangeland improvement	Low	Moderate	High	**Biological requisites for positive results**
Deferment grazing (*rest*)	X	XX	0	Availability of seed bank in the soil
Shrub planting	0	XX	XX	- Availability of water for irrigation during the first 2 years (*option: to be associated with water harvesting facilities*) - Availability of adapted species/ecotypes
Overseeding (*re-seeding*)	0	X	X	- Sufficient soil moisture - Availability of appropriate seeds
Fertilisation application	X	X	0	Sufficient soil moisture
Scarification (*crusting*)	0	X	X	- Availability of seed bank in the soil - Crust soils

Table 4 - Average Productivity of Natural Rangelands and Improved Rangelands in Tunisia
(Nefzaoui, 2002)

Rangelands	Technique Used for Improvement	Productivity (FU)
Private (Bir Amama, Sidi Bouzid)	Spineless cactus	700
Submitted to the Forest Regime (Ouled Farhane, Sidi Bouzid)	Spineless cactus ***and*** *Acacia cyanophylla*	800 – 1000
Submitted to the Forest Regime (El Khima, Sidi Bouzid)	*Rhus tripartitum, Periploca leavigata*	300
Cooperative (Guettis, Gafsa)	Spineless cactus ***and*** *Acacia ligulata*	400 – 500
Tribal non-improved (Dahar, Tataouine)	None	35 - 50
Tribal improved (Dahar, Beni Khedache)	None	35 - 50

FU: forage unit (1 forage unit is equal to the energy content of 1 kg barley grain)

Figure 6 - Degraded Rangeland on Shallow Soil (Algeria)

Figure 7 - Halophytes are well Appreciated by Camels in Pre-Saharan Rangeland (Tataouine, Tunisia)

3.1 - Resting and Deferring Grazing

3.1.1 - Resting

Resting is an efficient tool to regenerate degraded rangelands in arid and semi-arid areas. Better results are achieved with deep, permeable and fertile soil, and under less harsh climatic environments. The duration of resting depends on the degree of degradation and the rainfall, and varies from one season to ten years (see Figures 8 and 9).

Advantages

- Easy to implement, low cost.

Constraints

- Inefficient if livestock number is not controlled;
- Increased grazing pressure on other pastures (especially open pastures);
- Need to control the grazing capacity to maintain sustainable production.

Recommendations

- The duration of resting is usually less than 6 years. 2-3 years of resting is generally sufficient to allow good recovery of the rangeland and an increase in biomass production by 2.5.
- The resting period should start with a rainy year because it is more acceptable for people and increases the chances of success.
- It is better to start the resting period in the spring (April) rather than Autumn (November).
- The opening of a protected rangeland should take place after a rainy year to avoid overgrazing and loss of the benefits of resting.
- The area to put under rest should be of a sufficient size (1,000 to 5,000 ha).

3.1.2 - Under-grazing

The idea behind under-grazing is to reduce the grazing capacity in order to maintain it below the balanced grazing rate.

Advantages

- Avoids wastage of feed resources.

Constraints

- More difficult to implement compared to resting, because it requires full control of livestock number authorized to graze as well as duration of grazing. The management tool here is rotational grazing which is difficult to implement, especially in collective/common rangelands.

3.1.3 - Rotational Grazing and Deferring Grazing

The main idea here is to admit high grazing rates during short periods in order to allow "good" forage species to complete their biological cycle between two successive grazing periods. This will allow the regeneration of the pasture and avoid selectivity of low palatable species.

Advantages

- Efficient management tool.

Constraints

- It is difficult to implement this technique because it requires (i) an absolute control of flocks and high discipline from shepherds; and (ii) costly fences that is why it applied in state or private rangelands.

Figure 8 - Communal Rangeland Resting Managed by the Community via Their Community-based Organization (GDA), South Tunisia

Figure 9 - Effect of Resting on Rangeland Recovery
The right side of the fence (enclosure) has more vegetative cover than the left side (open to grazing), Jabal Al Akhdar (Libya). Fencing is an expensive way of protection and should be avoided whenever is possible.

3.2 – Shrubs and Cactus Planting

Advantages

- Some shrub and tree fodder species are highly tolerant to drought.
- Fodder reserves are useful in situations of fodder scarcity and drought periods;
- High productivity;
- Ability to valorise out of season rains;
- Ability to use underground water, varying according to species from 2 to 20 meters,
- Ability to valorise marginal soils (sand dunes, salty soils, slop land),
- Ability to valorise marginal waters not usable for conventional crops,
- Easy to implement with high success rates,
- Helps in soil and water conservation and desertification control,
- Helps in protecting flora and fauna,
- Improves the landscape, as well as ornamental, and territorial management,
- Possible integration in agro-pastoral systems.

Constraints

- The need to control the flocks,
- The need for improved management techniques,
- For management constraints, only one specie can be installed,
- The need for specific multiplication techniques and nurseries.

Choice of Appropriate Species

The choice of specie depends on annual rainfall rate, tolerance to cold, topography, runoff, water harvesting potential, and rangeland development objective such as fodder production, wood production, dunes fixation, erosion control, etc. (see Table 5 and Figures 10 to 17).

Figure 10 - Atriplex Plantation to Improve Algerian steppe (Lahmad)

Figure 11 - A Successful Technique is to Combine Shrub Planting with Water Harvesting Structures

Figure 12 - Pitting Allows Rainwater to Accumulate and Enhances Soil Miniaturization and Germination of Pastoral Seeds

Figure 13 - Valerani Machine designed to Treat Large Areas. *It follows the same technique as pitting, allows to harvest water and reinforces the development of natural vegetation shrub, and other man-made plantations.*

Figure 15 – Using Spineless Cactus and *Acacia cyanophylla* Improves Rangeland Productivity in Arid Areas of Sidi Bouzid, Tunisia, with an Average Rainfall of 250 mm. *Productivity increases from 150 to 800 FU per ha.*

Figure 16 - Rangeland Improved in Sidi Bouzid, Tunisia, Using *Acacia cyanophylla* Plantation Implemented By the Forestry Department and Visibly Underutilized.

Figure 17 - Degraded Rangeland on Shallow soil Being Improved by Spineless Cactus Planting

Figure 18 - *Stipa Tenacissima*-based Steppe Improved by Spineless Cactus Planting in Kasserine, Tunisia

Table 5 - Recommended Shrub Species According to Agroecological Attributes and Soil Types
(adapted from Le Houérou, 2002)

Annual average rainfall	Moving sand dunes	Fixed sand dunes, sandy deep soils	Sand on crust soils	Crust soils	Silt soils no irrigation availability	Silt soils with irrigation availability (*CE < 10 ms/cm*)	Saline soils (*CE <= 40ms/cm*)
50 -100 mm	• *Calligonum arich* • *Calligonum azel* • *Haloxylon persicum* • *Genita sahara*	• *Calligonum arich* • *Calligonum azel* • *Haloxylon persicum*	• *Helianthemum confertum*	-	-	• *Haloxylon aphyllum*	• *Atriplex mollis* • *Atriplex halimus*
100-200 mm	• *Calligonum arich* • *Calligonum azel* • *Haloxylon persicum* • *Atriplex canescens linearis*	• *Parkinsonia aculeata* • *Prosopis spp.* • *Atriplex canescens linearis*	• *Calligonum comosum* • *Prosopis spp.* • *Atriplex canescens linearis* • *Olea europea*	• *Periploca loevigata* • *Atriplex glauca* • *Artemisia herba alba* • *Atriplex halimus* • *Olea europea*	• *Haloxylon aphyllum* • *Atriplex halimus* • *Artemisia herba alba*	• *Atriplex nummularia* • *Atriplex amnicola* • *Myoporum serratum* • *Prosopis spp.* • *Opuntia ficus indica*	• *Atriplex nummularia* • *Atriplex halimus* • *Atriplex amnicola* • *Myoporrum serratum* (CE<=20 ms) • *Eleagnus angustifolia*
200-400 mm	• *Acacia cyanophylla* • *Opuntia ficus indica*	• *Acacia cyanophylla* • *Opuntia ficus indica*	• *Atriplex canescens linearis* • *Prosopis spp.* • *Olea europea*	• *Artemisia herba alba* • *Periploca loevigata* • *Atriplex glauca* • *Atriplex halimus* • *Atriplex nummularia* • *Prosopis sp.* • *Olea europea*	• *Atriplex nummularia* • *Atrilex halimus* • *Gassia spp.* • *Acacia cyanophylla* • *Opuntia ficus indica*	• *Atriplex nummularia* • *Myoporum serratum* • *Prosopis spp.* • *Opuntia ficus indica*	• *Atriplex nummularia* • *Myoporum serratum* (CE<=20 ms) • *Eleagnus angustifolia*

3.3 - Overseeding (re-seeding)

Reseeding techniques may have positive result if enough moisture is available in the soil (reseeding is recommended for areas where average annual rainfall is superior to 350 mm). It is appropriate for moderate to highly-degraded rangelands. Nevertheless, good results were obtained in Southern Tunisia on sandy soils by using *Stipa lagascae* under low rainfall conditions (150 mm per year). Generally, good results are achieved when reseeding is followed by a rainy season. One of the main constraint to this technique is the availability of appropriate seeds. It is recommended to use seeds collected from the area using appropriate machinery (sweepers). The seeds collected are a composite of several species of grasses and legumes (medics). Under favourable conditions, reseeding may be associated with fertilizers, mainly phosphates.

To treat large areas, aerial reseeding is needed. Unfortunately, economically and technically aerial seeding is not completely mastered.

3.4 - Crushing and Other Agronomic Practices

Crust soils and shallow soils do not allow the establishment of good pastures. In order to avoid runoffs and to create "niches" where plant species can develop, it is necessary to break the upper layer of the soil through the use of appropriate machinery. Good results are obtained by combining crusting and reseeding, because often the seed bank is very poor under this environment.

The use of fertilizers, especially phosphate application, has been tried in many countries under relative favourable conditions (300 – 400 mm rainfall). Indeed, phosphate application increases the biomass production and the quality of the fodder by improving the development of legume species. With poor soils and rainfall below 300 mm per year, fertilizers fail to achieve significant improvement.

3.5 - Mobility, Watering, and Shading

Mobility is a common feature of pastoralism, but its practice varies not only in range and seasonality, but also in the relationship between people and livestock. Analyzing the rationale for mobility in different systems, and understanding the causes of reduced mobility in semi-sedentary systems, are essential prerequisites for designing effective interventions in pastoral systems.

Flocks and rangeland management depend on water availability, especially during dry season. Rangelands without permanent water resources cannot be used outside the rainy season in which temporary ponds, cisterns, and/or water contained in forage replace the free-water requirements. In a recent study in Southern Tunisia, the cost of livestock watering is estimated to 40 % of the cost of feed supplements. Rangelands without water points are underused, and eventually become degraded. Indeed, both overgrazing and undergrazing lead to degradation. Traditionally, pastors resort to transhumance to cope with water shortage. There are other techniques followed in most of the WANA countries including efficient use of water ponds, cisterns, and small dikes. The other option is to use tanks to transport water to livestock.

In extensive systems, sheep raised on rangeland walk 6-8 km per day, goats 10-12 km, and camels 50-100 km. Therefore herders' camps are traditionally placed surrounding water points at these distances. The introduction of mechanization (trucks, pickups) increased this distance up to 20 to 40 km. It is well established that rangeland surrounding water points are heavily degraded, and the introduction of mechanization resulted in an increase in degraded areas (see Figure 19). Therefore, in rangeland development projects, it is crucial to pay special attention to the distribution of water points because it will strongly influence the distribution of flocks and hence the impact of grazing (see Figures 22 to 24).

Mechanization profoundly modified the management of the rangeland in the steppes of the WANA (see Figure 20). Water, supplements and other services are brought by trucks to flocks. As a result, the family is settled close to cities to have access to education and health, and only sheep herders move to transhume the herd. Only poor herders remain full transhumant like what was happening in the past (see Figure 21).

Vegetation in steppe rangelands is not high and do not provide sufficient shade to protect flocks from summer heat or the winter's cold winds. Certain facilities need to be built. Development projects using local materials construct shaded yards near water points. According to some observations made, these shaded areas allow 20 to 30 % improvement in livestock productivity and reduce lamb mortality in winter.

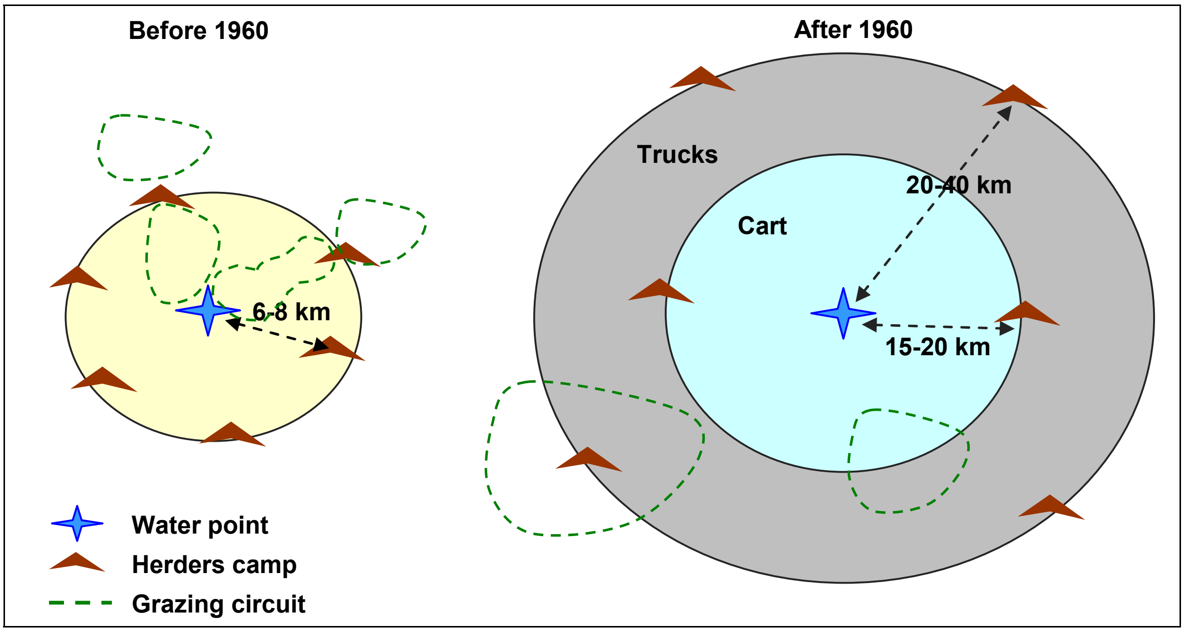

Figure 19 – Changes in Rangeland Use during Summer Because of Mechanization

(adapted from Bourbouze, 2006)

Figure 20 - Mechanization (transport of livestock and inputs) changed the face of rangelands in WANA

Figure 21 - Tent and Feed Troughs in the Steppe of the Oriental, Morocco

Barley grain supplementation becoming a common practice.

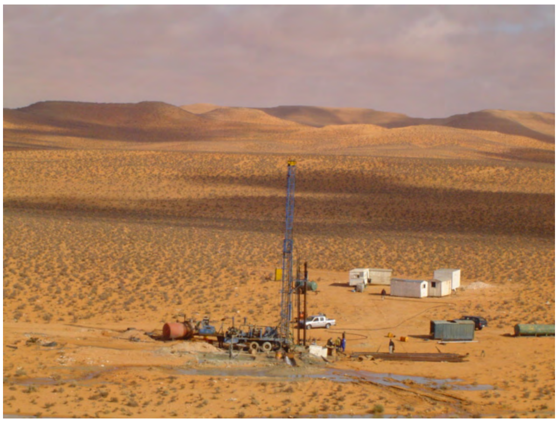

Figure 22 - Establishment of a New Water Point by the Agro-pastoral Development Project in Tataouine, Tunisia. *The distribution of water points is an efficient tool for rangeland management and should be carefully designed to avoid overgrazing.*

Figure 23 - Roman cisterns are widely used for livestock watering and require continuous maintenance such as removing sand accumulation out of the cistern (Tataouine, South Tunisia).

Figure 24 - Surface water collection in ponds proved to be efficient in solving livestock watering problem and improving the landscape management in Zoghmar community (Sidi Bouzid, Tunisia).

4. Land Tenure and the Role of Local Institutions in Rangeland Management

Decision-makers as well as research and development parties are increasingly aware that "the heart of the rangeland sustainable management" is linked to institutional issues. In the past, the state of rangelands was relatively better not only because population pressure and demand for meat were lower, but also because the management of rangelands was more strictly controlled by traditional institutions (*Jemaa* in Morocco, *Myaad* in Tunisia) that enjoyed effective power. The size of stocks and access to pastures with clearly defined boundaries were rigorously regulated. Transhumance was a routine practice which favored complementarities between grazing areas. The disempowerment of traditional institutions has led to the spread of chaotic management of rangelands. Transhumance has practically disappeared as settlement within rangelands has become the rule. Cultivation of parts of the rangelands is expanding. Privatization of these or other parts of the rangelands is progressing; and, last but not least, what remains from the original rangelands is exposed to fierce overexploitation.

Broadly speaking, three main types of land tenure are common in the WANA region, namely collective, state-owned and private. The prevalence of one system on the other is different among countries (see Figure 25).

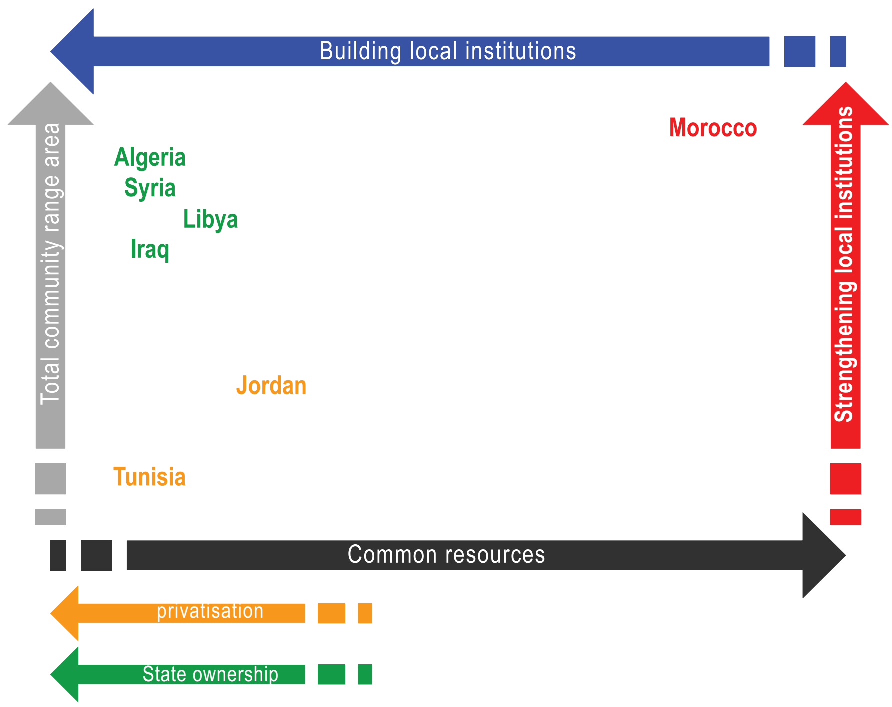

Figure 25 - Rangeland Land Tenure Status in WANA Countries
(adapted from the work done within Mashreq-Maghreb Project II)

Numerous policy and institutional reforms have been carried out in several countries of the WANA. In most cases, policy and institutional reforms weakened pastoral institutions. These institutional reforms can be classified into three main types: state appropriation of rangeland resources, strengthening customary tribal claims, and land titling (Ngaido and McCarthy, 2004).

The first approach consisted of state appropriation of rangeland resources. It was used by the majority of the M&M countries, as governments assumed that they were better equipped to manage rangeland resources. Along with tenure reforms, traditional tribal communities were reorganized into cooperatives. However, traditional institutions informally continued to manage range resources, although they did not have any legal rights over these resources. Such situation led to conflicts and disputes. Recently, more emphasis is being placed on encouraging the participation and involvement of communities in the management of their resources, but a legal framework to support such efforts is lacking.

The second policy option consisted of strengthening customary tribal claims. Under this option, pastoral communities have full control over their resources and continue to use traditional mechanisms and rules to define access and resource use for all community members. This framework, however, does not address inter-community access options and reduces actual mobility by confining livestock grazing on tribal resources.

The third option is land titling which is a form of privatization that has been tried mainly in Morocco and Tunisia. Tribal land titling is mainly found in Morocco. Privatization at the tribal level often results in tribes organizing into development associations to undertake different development efforts. Privatization and titling at the individual level results in the individualization of tribal collective land, which destroys traditional access-options that serve as a safety net for herders during dry seasons and drought years.

Most WANA governments view pastoral resources as state property, while the pastoral communities consider them their own. Poorly defined tenure rights often lead to conflicts and equity issues. Those who advocate devolution policies suggest that the success of range management depends on the extent to which pastoral communities are granted full control over access and use of the resources, and on the assurance of benefiting from improvements (Ngaido and McCArthy, 2004).

The recent experience of communal rangeland management by Agricultural Development Grouping (GDA) in South Tunisia is quite promising. These GDA are built upon socio-territorial units that correspond to traditional tribe boundaries. These tribes fully participate in the design and implementation of the rangeland's integrated development. The future will tell us how successful they are!

References

Abdelguerfi, A. & Marrakchi, M., 2000. Les ressources phytogénétiques fourragères et pastorales: de l'érosion a la conservation. Options méditerranéennes, 45, 15-27.

Bourbouze, A. & Donadieu, S., 1987. L'élevage sur parcours en régions méditerranéennes. CIHEAM-IAM, Montpellier, 1987, 104 p.

Bourbouze, A., 2006. Systèmes d'élevage et production animale dans les steppes du nord de l'Afrique : une relecture de la société pastorale du Maghreb. Sécheresse Volume 17, Numéro 1, pages : 31-39 Janvier-Juin 2006

Le Houérou, H.N., 2002. Multipurpose germplasm of fodder shrubs and trees for the rehabilitation of arid and semi-arid land in the Mediterranean isoclimatic zone. A New Policy Directions to Mainstream Desertification Policies. Options Méditerranéennes Série B. Etudes et Recherches, 37.

Le Houérou, H.N., 2006. Environmental constraints and limits to livestock husbandry in arid lands. Sécheresse 2006 ; 17 (1-2) : 10-8

Nedjraoui, D., 2004. Evaluation des ressources pastorales des régions steppiques algériennes et définition des indicateurs de dégradation. In Ferchichi A. (comp.). Réhabilitation des pâturages et des parcours en milieux méditerranéens. Rangeland and pasture rehabilitation in Mediterranean areas. CIHEAM-IAMZ, 2004. Cahiers Options Méditerranéennes ; v. 62. p. 239-243.

Nefzaoui, A. & Ben Salem, H., 1999. Pastoral systems dominated by cereal-fallow combination in North Africa and West Asia. In Etienne M. (ed.). Dynamics and sustainability of Mediterranean pastoral systems. Dynamique et durabilité des systèmes pastoraux méditerranéens . Zaragoza : CIHEAM-IAMZ, 1999. Cahiers Options Méditerranéennes ; v. 39, p. 199-212.

Nefzaoui, A., 2002. Rangeland management options and individual and community strategies of agropastoralists in Central and Southern Tunisia. International conference on policy and institutional options For the management of rangelands in dry areas. CAPRI Working paper N° 23; pp.14-16.

Nefzaoui, A., 2004. Rangeland improvement and management options in the arid environment of Central and South Tunisia . In Ben Salem H. (ed.), Nefzaoui A. (ed.), Morand-Fehr P. (ed.) . Nutrition and feeding strategies of sheep and goats under harsh climates = Stratégies de nutrition et d'alimentation des ovins et caprins en climats rigoureux . Zaragoza : CIHEAM-IAMZ, 2004. Options Méditerranéennes : Série A. Séminaires Méditerranéens ; n. 59, p. 15-25.

Nefzaoui, A., 2004. Rangeland improvement and management options in arid environment of Central and South Tunisia . In Ferchichi A. (comp.). Réhabilitation des pâturages et des parcours en milieux méditerranéens = Rangeland and pasture rehabilitation in Mediterranean areas . Zaragoza (Spain) CIHEAM-IAMZ, 2004. Cahiers Options Méditerranéennes ; v. 62, p. 17-26.

Ngaido, T. & McCarthy, N., 2004. Collective action and property rights for sustainable development. Institutional Options for Managing Rangelands. Vision 2020 for Food, Agriculture, and Environment. Focus 11, February, 2004.

Thomas, R.J., El Mourid, M., Ngaido, T., Halila, H., Bailey, E., Shideed, K., Malki, M., Nefzaoui, A., Chriyaa, A., Awawdeh, F., Hassan, S.H., Sweiden, Y. & Sbeita, A., 2003. The development of Integrated crop-livestock production systems in the low rainfall areas of Mashreq and Maghreb. In. Research towards integrated natural resources management: examples of research problems, approaches and partnerships in action in the CGIAR. p. 97-110.

This publication was prepared and printed with the financial support of the International Fund for Agricultural Development (IFAD) and the International Development Research Centre (IDRC).

Do you need further information?

Please contact KariaNet at:

++20-2-37627729 or ++20-2-33367051
++20-2-33367056

8 Ahmed Nessim Street, 8th floor, Dokki, Giza, Egypt
PO Box 14, Orrman, Dokki, Giza, Egypt

Dr. Mustapha Malki, Regional Coordinator mmalki@idrc.org.eg
Mrs. Hala Rafik, Project Administrator hrafik@idrc.org.eg

http://www.karianet.org
http://www.ifad.org
http://www.idrc.ca