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R4D Initiatives

Project Briefs

ICARDA
Science for Better Livelihoods in Dry Areas

Sustainable Development of Lowlands in Agro-Pastoral Ecosystems

Strengthening the resilience of lowlands in the Near East and North Africa

BACKGROUND

The lowlands and its populations — often rural and poor farmers on the margins — are facing less rainfall and increased desertification and soil erosion. An already hardscrabble livelihood for the regions' agro-pastoralists has been made increasingly difficult by climate change. The depleted resources they now contend with, including less fodder for their livestock, increasing water scarcity, and an increased demand for food have further threatened their food security.

The lowlands of the Near East and North Africa (NENA) provide an agricultural oasis of sorts for agro-pastoral communities in the rangelands, particularly during the driest parts of the year. ICARDA targets the sustainable management of these precious resources. The Center's efforts include water-harvesting, controlled grazing, effective soil preparation and the planting of well-adapted native shrubs.

The Importance of the Lowlands

The lowlands are a valuable socio-economic, cultural and ecological resource for its inhabitants. Native plants are used as medicine, fuel, and feed and serve as a cultural tie to the heritage and identities of pastoralists. Thriving lowlands also reduce migration to urban areas, where earning a livelihood might prove even more difficult, and provide an opportunity for women to generate additional income.

Ecologically, the accumulation of seeds and nutrients provides a ready-made reservoir of plant life, creating a basis for vegetation cover, native flora resilient to the dry climate, and a bulwark against invasive species. The propagation of native seeds and plant life then encourages the growth of high-value crops and palatable feed for ruminants. The latter reduces the necessity for importing feed by agro-pastoralists as well as reducing the need and cost of traveling great distances to provide feeding areas for livestock. Additionally, a healthy lowlands area extends the growing season and sequesters carbon, another ecological benefit.

The lowlands face several challenges that threaten their long-term sustainability and the livelihoods of their inhabitants.

Current Challenges: Threatened by Mismanagement

Overgrazing, poor land management, unsustainable crop practices, soil salinity, water logging, and soil and water erosion, however, have led to the degradation and desertification of the lowlands, effects only exacerbated by climate change. Currently, the lowlands face several issues that threaten their long-term sustainability and the livelihood of their inhabitants, which include farmers, as well as flora and fauna.

- **Rill erosion:** When rills erode, top soil loss ensues and leads to eventual vegetation and nutrient loss. For crop lots located near rill walls, the resulting loss of soil moisture leads to less productive crop yields. Rill erosion also leads to poor surface drainage which can cause waterlogging and a rise in the salinity of the soil.
- **Poor land management leads to overgrazing, and poor cultivation practices lead to further land degradation.**
  - **Overgrazing.** Without a sustainable management system that allows for herb recovery and regrowth, overgrazing by ruminants damages the lowlands landscape and the livelihoods of agro-pastoralists dependent on the land. Canopy cover is lost and with little to no leaf area left after severe stubble grazing, the remaining vegetation is unable to meet energy demands for growth and respiration via photosynthesis. This also leaves no residual leaf mass, which negatively affects the rate of re-growth. Soil erosion susceptibility also increases, which means a loss of nutrients, an increase in sediment, and the eventual loss of native species and biodiversity. The latter then allows invasive — and less palatable —species to infiltrate the area.
  - **Poor cultivation practices.** Land that cannot recuperate via planned crop rotation faces erosion, loss of top soil and nutrients, and ultimately leads to a decrease in crop yields. Additionally, poor soil preparation practices, like deep tilling, can also lead to nutrient loss and ultimately affect land productivity.
  - **Uprooting of shrubs and woody vegetation.** A significant source of livelihood for marginalized and poor farmers, particularly women, native plants are foraged for fuel or livestock feeding and for medicine. This type of practice also contributes to the loss of soil cover, exposing it to erosion, and reduces growth and the chances of successful re-growth.
- **Land Conflict.** Land productivity loss leads to increasing pressure on the land and potentially greater conflict over increasingly scarce arable lands and water points.

Recommended Sustainable Lowland Management Practices

Throughout the NENA region, ICARDA has spearheaded zone-specific sustainability programs aimed at addressing the challenges described above with the end goal of providing long-term sustainability for the lowlands and their inhabitants. Sustainable land management practices for the lowlands include: water-harvesting techniques; effective soil preparation, including minimum tillage methods; controlled grazing; and shrub planting and direct seeding of hardy and well-adapted native species.

Water-Harvesting Techniques

Water harvesting maximizes water productivity enabling better use of the scarce resource and avoiding waterlogging, particularly the water spreading technique.

Waterlogging erodes soil nutrients and wastes an already-scarce resource

Jessour permeable rock dams are one type of water-harvesting technique which can be used throughout the lowlands. Long low structures are built across valley floors which control gulley erosion and create silt deposits while spreading and retaining run-off for improved plant growth. Organic matter content is higher closer to the Jessour, increasing soil fertility. The improvement of water availability also ensures an increased plant canopy, thereby ensuring better ground cover.

The Jessour microcatchment systems are easy to design and install, as any slope can be used to enhance water run-off. The runoff is then stored, either in surface or subsurface cisterns, or in the soil profile itself. In some areas of Tunisia, for example, olive trees are being used as part of this crucial system, and this type of planting scheme can harvest some 2000 m^3 of additional water during the rainy season. In addition to erosion control, this technique also improves soil fertility and can supply drinking water for animals.

Jesssour permeable dams can be built across valley floors to improve water availability and water productivity

Semi-circle constructions are another technique that can be used for water-harvesting, though the landscape surface must be such that runoff is easily generated by rainfall.

The semi-circle serves both as the storage facility and the target area for the water; as such, it allows the farmer easy access to both. Additionally, because it's inexpensive and quickly installed, it can be easily adapted to suitable areas.

Contour and intermittent contour bunds also allow for effective water use, creating catchments where water can accumulate and plants can be grown; the constructions also allow for excess water to be sluiced off. The bunds, or embankments, are built along contour lines and spaced 5-20 meters apart and built in semi-circle, crescent or trapezoidal shapes facing upslope so that the run-off water is effectively captured.

Rotational Grazing

Allowing an area to recuperate before grazing reduces soil erosion and nutrient depletion, and increases consistent soil fertility levels. Recuperation requires that land managers remove the grazers that would otherwise stop the rehabilitation of a specific site. In Tunisia, for example, the land is managed so that grazing frequency and intensity is regulated and specific conservation goals are created and met (e.g., bird-nesting success, effective seed dispersal, plant re-establishment or reproduction).

In the Al Wafra region of Kuwait, fenced-off areas promote rotational grazing. Fencing off a parcel of land protects it from trampling, aids natural growth regeneration, and the ensuing growth cover promotes healthy soil structure. In fact, fencing-off areas is considered a leading tool in efforts to slow global species loss; additionally, the labor involved in the process creates employment opportunities for local communities.

Fencing off specific sections of rangeland prevents overgrazing, protects top soil, and allows an area to recover naturally. Here, Rhanterium epapposum blooms early in the winter season in Kuwait

Alley cropping. In **Algeria, Tunisia and Syria**, alley cropping is used strategically to improve forage production, mitigate drought, serve as a windbreak, capture windblown sediments, and reduce the need for fertilizer. It is an important practice as it provides many benefits, such as: crops can be grown over the long term while maintaining soil fertility.

In pre-conflict **Syria**, three sustainable rangeland management practices were recommended to enhance the long-term restoration of the land: creating protected areas so that natural vegetation could recover; direct seeding or broadcasting of hardy shrubs with zero-tillage methods; and shrub transplantation to promote faster growth in a shorter amount of time.

Integrated cultivation systems have also contributed to sustainable techniques in **Yemen**. Sorghum and sesame plants are broadcasted densely to avoid weeding, which also allows for water collection. Animals feed on plant residue after harvesting, and the fields are consequently fertilized with animal manure. Ziziphys trees are also grown beside wadis, wrapped with vine debris, branches and other twigs. The subsequent "leaf litter" then further restores soil fertility.

Direct seeding combined with scarification is another way to ensure healthy soil seeding and ensuing soil fertility. It contributes to seed survival, particularly when a mixture of two or more seeds is implemented, giving one species a greater chance of survival where predation of the other is high. In Syria, ICARDA worked with partners to rehabilitate the lowlands by direct seeding and scarification methods. The techniques saved costs and time compared to shrub transplantation as a means of restoring species to the badia. Direct seeding, for example, considerably reduced the establishment cost of shrub species (at 1/10 the cost of shrub seedlings transplantation).[1] The success of the latter depends on rainfall and whether grazing is limited for enough time to allow for land restoration; however, the method yielded 550 kg DM/ha in the autumn, 65 kg DM/ha in the spring, and an interspace vegetation mass of 2344 kg DM/ha, all during the period noted in Louhaichi et al (2016). The direct seeding yields were comparable to those produced during periodic resting, which resulted in 2944 kg DM/ha.[2]

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Summary

Sustainable management of the lowlands requires comprehensive and multi-faceted approaches to land management. These include scientifically-grounded integrated practices that combine ecologically-oriented approaches which benefit the land, its natural resources, and the indigenous people that depend on it. Partnerships between local stakeholders, politicians, government and non-governmental agencies, and those working the land, are required to successfully implement the crop-planting, water-harvesting, and range-land management techniques described in this brief guideline.

Citations

[1] Louhaichi, M., Y. Yigezu, J. Werner, L. Dashtseren, T. El-Shater, and M. Ahmed. (2016). Financial incentives: Possible options for sustainable rangeland management? Journal of Environmental Management. 180, 493-503.

[2] Louhaichi, M., Ghassali, F., Salkini, A. K., and Petersen, S. L. (2012). Effect of sheep grazing on rangeland plant communities: Case study of landscape depressions within Syrian arid steppes. Journal of Arid Environments. 79, 101-106

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