Nurturing communities and ecosystems: the power of community engagement and silvopastoralism in drylands

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Abstract

This paper examines two case studies of ecosystem restoration in arid and semi-arid regions of the Near East and North Africa (NENA). The first study evaluates the economic benefits of rangeland restoration in Jordan using the traditional "Al-Hima" system, a community-based approach to sustainable grazing management. A cost-benefit analysis revealed that Al-Hima restoration increased forage production, groundwater infiltration, and carbon sequestration, resulting in a positive benefit-cost ratio of 2:1. The second study analyzes a silvopastoral restoration project in Tunisia, where the integration of trees and shrubs with livestock grazing led to increased biomass production, improved ground cover, and enhanced water use efficiency. This project also demonstrated socioeconomic benefits through reduced livestock feeding costs. Both case studies emphasize the importance of community engagement, sustainable land management practices, and the integration of ecological and socioeconomic considerations in successful ecosystem restoration initiatives.

Introduction

Drylands encompass a significant portion of the world's land area, supporting diverse ecosystems and communities such as rangelands and pastoralist communities. The Near East and North Africa (NENA) region is the world's driest area with Mediterranean zones, large swaths of arid and hyper-arid deserts, and a diverse array of ecosystems and barren deserts with almost no vegetation (UNCCD, 2024). Rangelands are a vital ecosystem, essential for the livelihoods of millions of people in the NENA region. They provide critical ecosystem services like livestock grazing, water regulation, and carbon sequestration. This region, however, faces substantial environmental challenges, including desertification and soil degradation, primarily driven by unsustainable land management practices and climate change. Rangelands are important socioeconomic drivers, e.g., Morocco's rangelands deliver 1.5 foraging units/year (FAO, 2022). This paper examines two case studies of ecosystem restoration in arid and semi-arid regions, highlighting the potential for ecological and socioeconomic benefits. The first explores rangeland restoration in Jordan using the traditional "Al-Hima" system, while the second analyses a silvopastoral restoration project in Tunisia.

1. Jordan

Methods
An ex-ante cost-benefit analysis was conducted to demonstrate the value of large-scale restoration through the Al-Hima[12] system implemented by the Ministry of Agriculture and IUCN in the Zarqa River of Jordan (Myint and Westerberg, 2014). The project involved establishing a community-managed Hima area, where sustainable grazing practices were implemented, and access to grazing resources was regulated.

The economic valuation study by Myint and Westerberg (2014) used a combination of valuation methods (stated preference, avoided cost, replacement cost, and market price), the study compared a baseline scenario (no change in land-use management) with a Hima restoration scenario (large-scale adoption of the Hima system). High-resolution remote sensing, GIS, and biophysical soil and water assessment tools were used to calibrate the impact of land-use changes on ecosystem services. The study compared two scenarios:

- Baseline Scenario: This scenario assumes no change in current land-use management schemes.
- Hima Restoration Scenario: This scenario assumes large-scale adoption of the Hima system where each plot of land was divided into four units, with three under the Hima system and one kept as open access. A rotational grazing system was adopted where one of the Hima units would be open for grazing in any given year and closed the year after.

Results
The study revealed significant economic benefits from Hima restoration. Firstly, by substantially increasing forage production and reducing the reliance on livestock feed purchases, the Hima system ***enhanced rangeland productivity***. Over a 25-year period, the total discounted value of avoided fodder costs was estimated at 23 million USD. The study concluded that in rangeland units with open-access (unrestricted grazing), productivity decreased by 2 kg of dry biomass per year. Another key benefit of Hima restoration was ***increased groundwater infiltration.*** GIS modelling showed that large-scale restoration through the Hima model led to an annual increase of 14% in the yield of the Zarqa River Basin and valued at approximately 19 million USD per year. Additionally, there was a notable ***reduction in sedimentation.*** The avoided cost of replacing lost storage capacity due to sedimentation and maintenance was estimated at 3.4 USD/m3. Finally, the value of ***sequestered carbon*** over 25 years in the restored rangeland was estimated at 30.5 USD/ha. The study also identified costs associated with Hima restoration, including implementation (community engagement, equipment purchase, surveillance infrastructure), management, and opportunity (forgone benefits of current grazing practices). Despite these costs, the net present value of Hima restoration was calculated at 17 million USD with a benefit-cost ratio of 2.1; meaning for every 1 USD invested in Hima restoration, pastoral communities would receive 2 USD in benefits.

2. Tunisia

A pilot project implemented by the FAO, the International Center for Agricultural Research in the Dry Areas,, and the Tunisian Forestry Directorate in the Sbaihia community, Tunisia, showcased the benefits of silvopastoralism (FAO and ICARDA, 2020) in enhancing community resilience to drought, increasing income, and restoring rangelands.

Methods
The project adopted a participatory/multidisciplinary approach, engaging the local community, national institutions, and researchers. A series of activities were implemented to demonstrate the feasibility of silvopastoralism and grazing with trees. One of the main interventions was the ***restoration using native species.***

[12] Traditional communal rangeland management practice in the Levant and the Arabian Peninsula dating back to ancient times that governs resource allocation through a community-based decision mechanism .

Drought-tolerant and palatable shrub and tree species (e.g., Opuntia ficus-indica), along with the native forage legume Hedysarum coronarium (sulla), were planted on slopes to reduce erosion and increase biomass and fodder availability. Another main intervention was the ***reseeding of degraded lands with sulla***, a native and highly palatable shrub, to evaluate its performance under different treatments. These treatments included assessing the adaptation of sulla to tillage under three conditions: sulla with soil scarification, scarification alone, and an untreated control. The primary field measurements for this evaluation were dry matter yield (DMY), rain use efficiency (RUE), and pastoral value (PV). Additionally, the effects of the interventions on biodiversity, biomass, and vegetation cover were examined using three treatment types: plots reseeded with sulla, plots protected from grazing for two years, and plots subjected to grazing. Finally, rotational grazing schemes were established to prevent overgrazing.

Results

The restoration activities were highly successful as illustrated in Table 1, with all species demonstrating good survival rates. *Ceratonia siliqua* had the lowest survival rate at 78 percent, while *Opuntia* had a 100 percent survival rate. The selected species provided local communities with increased fodder biomass for their livestock.

Table1: Focus on key results (the project had several experiments; in the paper we focused on the main ones listed below).

Experiment One	Scarified Sulla Plots	Scarified Only	Control
Biomass Production (tDM/ha)	7	2.5	3
Rain Use Efficiency (DM/ha/m³)	0.8	0.38	0.5
Pastoral Value (%)	42.5	20	20
Experiment Two	**Reseeded**	**Protected**	**Grazing**
Ground Cover (%)	100	100	59
Species Composition (No. of Species)	30	77	20
Biomass production (tDM/ha)	10	2.2	1

Figure 1 shows that the biomass production was significantly higher in the scarified sulla plots (>7 tDM/ha) than in the scarified (around 2.5 tDM/ha) and control plots (3 t DM/ha). RUE was also highest in the scarified sulla plots (0.8 DM/ha/m3), followed by control (0.5 DM/ha/m3) and scarified plots without sulla (0.38 DM/ha/m3). PV was 42.5 percent in the sulla plots and less than 20 percent for the other two. Reseeding with sulla and protecting the land from grazing both resulted in complete (100 percent) ground cover, primarily consisting of protective plant litter. In contrast as illustrated in Figure 2, land open to grazing had much sparser plant cover (only 59 percent), with most of the ground consisting of bare earth (69 percent). Protected rangelands had the richest species composition (77), followed by sulla reseeded plots (30) and grazed plots (20). In terms of biomass production, reseeded plots achieved the highest yield (10 tDM/ha), compared to protected plots (2.2 tDM/ha) and control plots (1 tDM/ha). The socioeconomic benefits of reseeding integrated with rotational grazing were also evident, as managed grazing reduced the cost of livestock feeding by about $0.13/day/head.

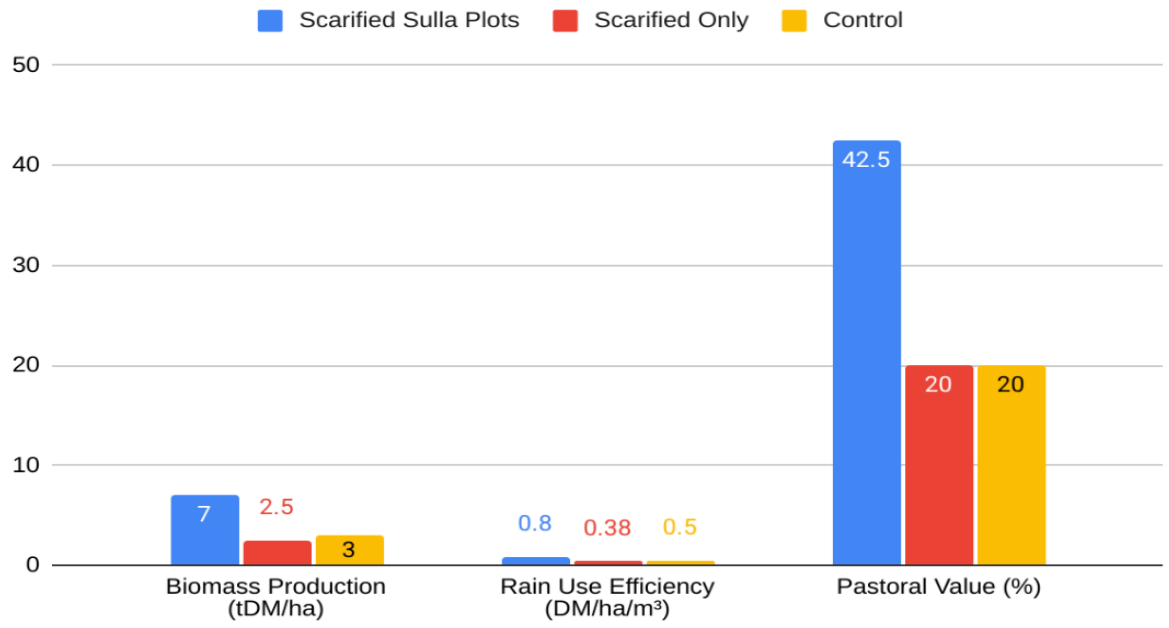

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Figure 1 illustrate the findings from experiment 1 on restoration using native species

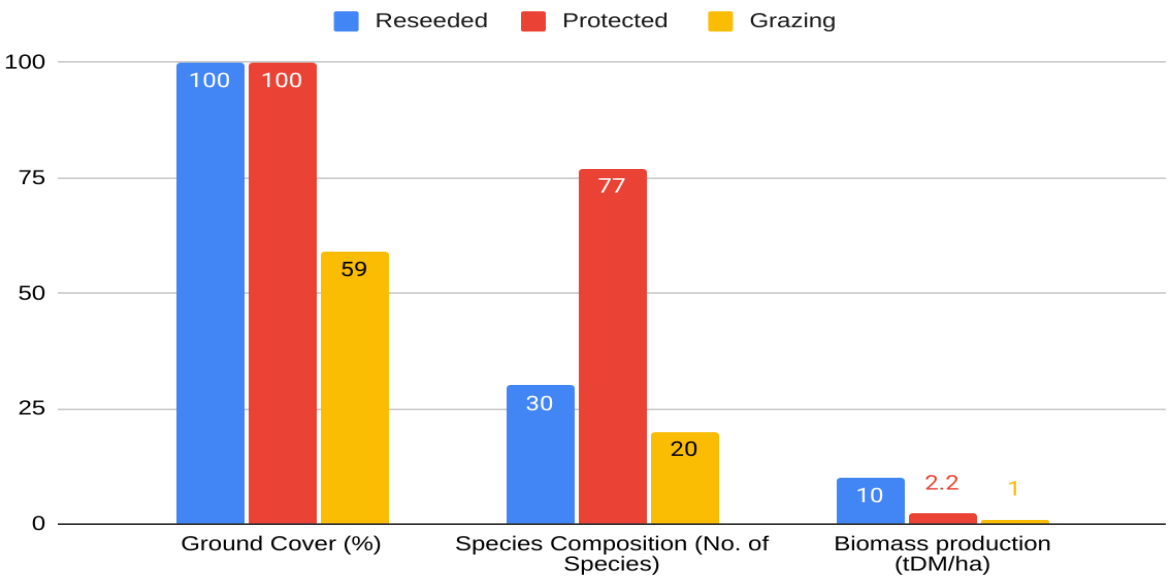

Figure 2 illustrate the findings from experiment 1 on reseeding of degraded lands with sulla

Discussion

Both the Jordanian and Tunisian projects highlight the importance of enhanced rangeland management and restoration through better community engagement and rangeland enrichment via reseeding and planting native species. These results highlight the critical role of reseeding with native species such as sulla in enhancing biomass production, protecting soil from erosion, and enhancing water infiltration and use efficiency. However, it is also

important to consider potential drawbacks related to biodiversity. The importance of community involvement for the successful restoration of rangelands is gaining traction globally. For instance, in Kenya, the inclusion of Maasai tribes in rangeland management proved beneficial (Nyongesa et al., 2023). Similarly, research in Mongolia demonstrated the benefits of community inclusion in restoration and management (Ulambayar and Fernandez-Gimenez, 2019). Adopting a silvopastoral approach within the broader framework of landscape restoration can lead to more effective outcomes, delivering enhanced socioeconomic and environmental benefits (Vetter, 2020). The promising results from Tunisia reflect this paradigm shift, advocating for the integration of silvopastoralism in restoring both forests and rangelands.

Conclusion

The case studies from Jordan and Tunisia demonstrate the effectiveness of integrated approaches in combating land degradation and promoting sustainable land management. By combining ecological restoration with socioeconomic considerations and community engagement, these projects successfully enhanced ecosystem services, improved livelihoods, and built local capacity. Their success highlights the potential for replicating and scaling up similar initiatives in other regions facing desertification and land degradation.

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