

BIO-INDICATORS

FOR MONITORING

RANGELAND ECOSYSTEMS HEALTH

In Garissa County

Why Bio-indicators

Bio-indicators are useful where certain environmental factors are difficult to measure such as rangeland health or where the environmental factor are difficult to interpret such as effects of climatic change.

Introduction

Bio-indicators are tools for gauging ecosystem health conditions. They include plants and animals that are sensitive to environmental stressors. The attributes measured include species richness, diversity, abundance and vegetation cover. Bio-indicators are useful where certain environmental factors are difficult to measure and interpret such as rangeland health and effects of climatic change.

HOW HEALTHY Are Our Rangelands?

Assessment of bio-indicators along a grazing gradient has been used to infer rangeland health. Grazing gradient analysis shows decrease in plant and animal diversity and increase in bare soil near cattle watering points. Plant diversity is a key indirect measure of grazing disturbance. Thus, increased bareness in rangelands implies pasture scarcity which leads to livestock deaths during drought.

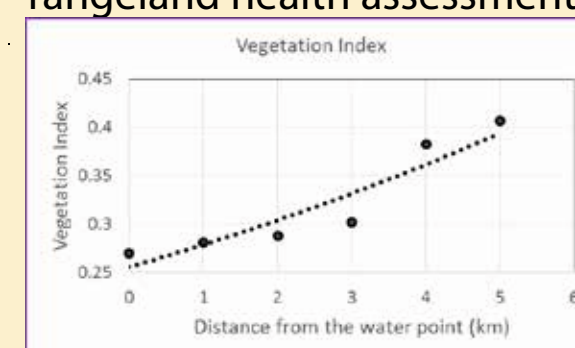
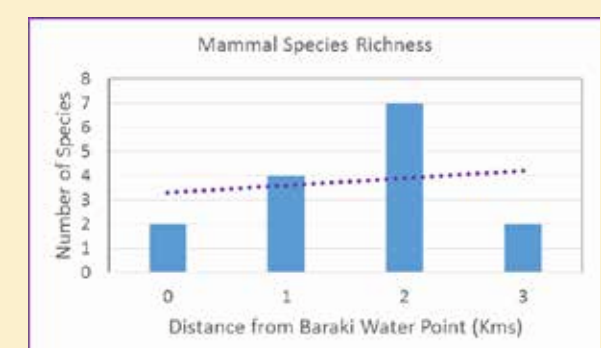
Choice of Bio-indicators

Bio-indicators are selected based on:-

- Ease of identification
- Wide occurrence
- Cost-effectiveness in assesment
- Expert and Indigenous
- Purpose and policies

Findings

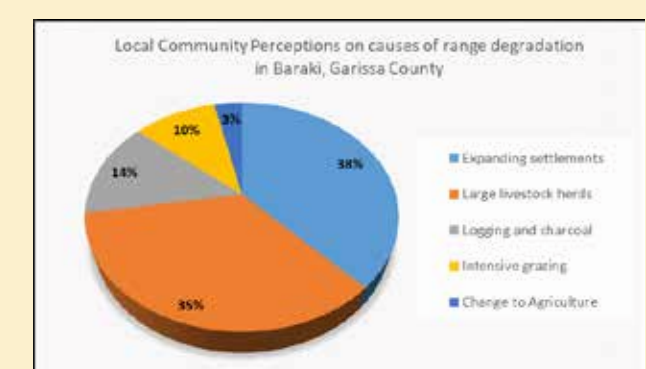
Recent data from Garissa indicates a positive relationship between plant and animal species diversity with increasing distance from the water point in Baraki. This confirms the theory and empirical evidence of use of bio-indicators in rangeland health assessment.



Variation of vegetation index and mammal species richness with distance from Baraki Water point

Recommendations

- Validated bio-indicators are useful for monitoring rangeland health to inform management decisions
- Bio-indicators can be integrated with geo-spatial tools and grazing gradient protocol to measure rangeland health
- Integration of Indigenous and local knowledge on bio indicators in rangeland monitoring is imperative.



Project: Rangeland Management for improved Pastoral Livelihoods in Kajiado, Marsabit, Isiolo and Garissa Counties

Funding: Kenya Climate Smart Agriculture Project (KCSAP)

By: Mulwa, R.Malaki,P.,Wasonga,V.,Lusweti, A.,Madindou,I., Ogeto,M.,Meroka, B. and Golicha, D. Published 2023

INVASIVE SPECIES CONTROL AND MANAGEMENT IN RANGELANDS

KAJIADO COUNTY CASE STUDY

What is an 'invasive species'?

A non-indigenous species introduced, accidentally or intentionally, to a place outside its natural geographic range and which dominates the indigenous species or takes over the habitat becoming destructive to the environment or human interests.

Invasive species cause degradation of pasture in rangelands. This negatively affects pastoral livelihoods since it reduces livestock productivity. *Ipomoea hildebrandtii*, *rosopis juliflora*, *Opuntia ficus indica*, *Senna occidentalis*, *Lantana camara*, *Acacia eficiens* and *Parthenium hysterophorus* comprise the top invasive plant species affecting Kenya's ASALs. In managing invasive species, physical, chemical, mechanical or biological methods have been tested, either singly or in combination.

Gaps and challenges in managing invasive species in Kenya

- Limited capacity and taxonomic knowledge for recognition and monitoring of invasive species
- Poor predictive capacity - since the ongoing limited control measures are based on biological studies conducted elsewhere
- Control measures are haphazard and inconsistent, generally being underfunded and dependent on political goodwill
- Lack of sufficient synergy among relevant national and county government ministries; and expert agencies
- Limited studies quantifying the costs associated with invasive plant species
- The policy environment does not fully enhance capacity to respond to and manage invasions

Consideration for Management and control of invasive plant species

Management and control of invasive species that have become established requires substantial resources and manpower. However, initiating control during early invasion stages and using a multi-pronged and well thought out approach is the best strategy. Strategic measures would include;

- Restore and rehabilitate areas where invasive species have been removed through re-seeding with suitable species
- Provide incentives to promote control of invasions by local communities and landowners
- Local communities need to be empowered to exploit the positive attributes of invasive plant species e.g building and fencing poles, furniture making
- County government should explore technologies for exploitation and commercialization of invasive species and their products including animal feeds and bio-fuels.

The key invasive species for kajiado were *Prosopis juliflora* and *Ipomoea hildebrandtii*.



Ipomoea hildebrandtii



Prosopis juliflora pods



Extracting the woody part from felled *Prosopis juliflora*



Burning of *Ipomoea* after Physical removal

Adaptive Utilization of Invasive Plant Species



Bio- Energy: Traditional Charcoal kiln in progress from a cleared bush of *Prosopis*, Kajiado



Drum fabricated into a kiln for Charcoal production



Bio-Energy: Bags of charcoal from *Prosopis* trees in Kamukuru, Kajiado West



Fencing & Building Materials
A fence in Wadhajir Farm in Garissa constructed using *Prosopis* poles



Production of Animal Feed

Lessons Learnt

- Ensure that transferred technology is sustained
- Invasive species have potential economic benefits that can complement local livelihoods
- Upscale utilization options associated with positive attributes of invasive plant species
- Identify and sustain post removal alternative land use to avoid re-invasion
- There are conflicting views on effects and management of *Prosopis juliflora*.
- Removal of invasive species is a continuous process

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GARISSA COUNTY CASE STUDY

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Invasive species cause degradation of pasture in rangelands. This negatively affects pastoral livelihoods since it reduces livestock productivity. *Prosopis juliflora*, *Ipomoea hildebrandtii*, *Opuntia ficus indica*, *Senna occidentalis*, *Lantana camara*, *Acacia reficiens* and *Parthenium hysterophorus* comprise the top invasive plant species affecting Kenya's ASALs. In managing invasive species, physical, chemical, mechanical or biological methods have been tested, either singly or in combination.

Gaps and challenges in managing invasive species in Kenya

- Limited capacity and taxonomic knowledge for recognition and monitoring of invasive species
- Lack of capacity to predict the spread of invasive species
- Lack of synergy and coordinated control measures by expert agencies, national and county governments
- Limited studies quantifying the costs and benefits associated with invasive plant species
- The policy environment does not fully enhance capacity to respond to and manage invasive species

Considerations for management and control of invasive plant species

Management and control of invasive species that have become established requires substantial resources and manpower. However, initiating control during early invasion stages and using a multi-pronged and well thought out approach is the best strategy. Strategic measures would include;

- Providing incentives to promote control of invasions by local communities and landowners
- Empowering local communities to exploit the positive attributes of invasive plant species e.g building and fencing poles, furniture making from *P. juliflora*
- Restore and rehabilitate areas where invasive species have been removed through re-seeding with suitable species
- County government should explore technologies for exploitation and commercialization of invasive species and their products including animal feeds and bio-fuels.

LESSONS LEARNT

- Invasive species have potential economic benefits that can complement local livelihoods
- Upscale utilization options associated with positive attributes of invasive plant species
- Removal of invasive species is a continuous process
- Identify and sustain post removal alternative land use to avoid re-invasion
- Ensure that transferred technology is self-sustaining.
- There are conflicting views on effects and management of *Prosopis juliflora*.

Prosopis juliflora, is the main invasive species for Garissa county rangelands

Land cleared of *Prosopis juliflora* in Garissa

Fencing & Building Materials from *Prosopis juliflora* in Wadhajir Farm in Garissa

Bio-Energy: Bags of charcoal from *Prosopis* trees Garissa

Drum fabricated into a kiln for Charcoal production

Fodder, *Sorghum drummondii* (Sudan grass) grown on land cleared of *Prosopis juliflora* in Garissa

Production of Animal Feed production in Garissa

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RANGELAND RESEEDING IN GARISSA COUNTY

Introduction

Rangeland reseedling is a sustainable management option of restoring degraded land to enhance livestock forage and productivity (see Box 1). Forage plants including grasses and other species, that are adapted to the soil and climatic conditions; and provide nutritional needs of livestock can be used for re-seeding. Such plants also promote soil health and improve water infiltration. Additionally, they reduce soil erosion by wind or water and enhance carbon sequestration. *Cenchrus ciliaris* and *Eragrostis superba* were used for reseedling in Baraki, Dujis and Aqar-al, Garissa County (see Fig. 1).

Basic guideline for reseedling degraded areas

- Identify degraded sites for range re-seeding
- Identify suitable grass species based on expert and local knowledge
- Test soil to assess carbon stock and chemical/physical properties.
- Engage stakeholders and common interest groups in technology transfer.
- Secure and reseed degraded areas

IMAGES SHOWING PROCESS OF RESEEDING IN GARISSA



Box 1: Importance of reseedling

- Rehabilitation of degraded rangelands
- Improve livestock productivity through forage availability
- Management of invasive plant species
- Improved ecosystem health, function and resilience in a changing climate
- Enhances carbon sequestration
- Enhance pastoral community adaptation mechanisms in the ASAL Counties

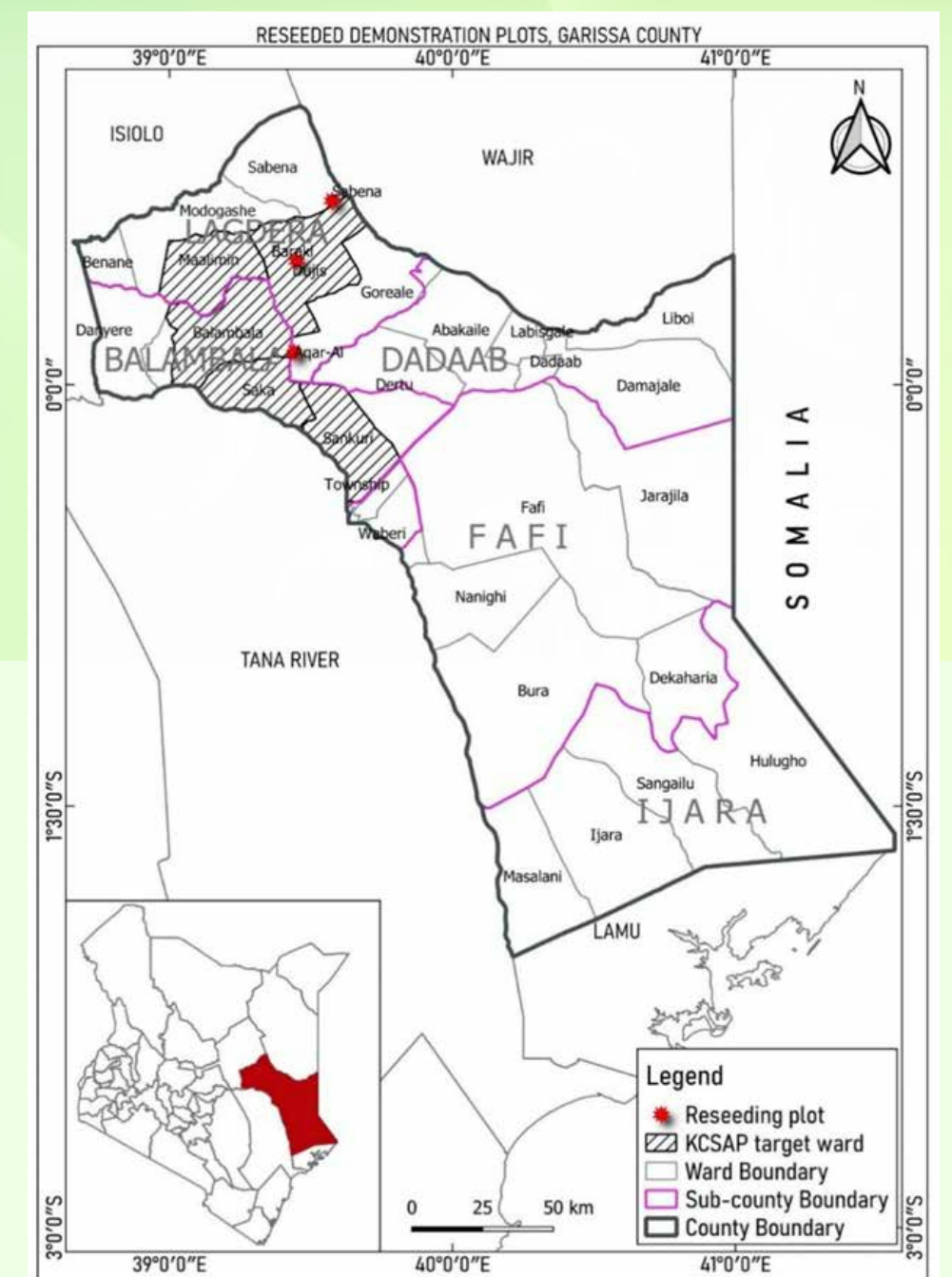


Figure 1. Map of Garissa County showing locations of reseedling demonstration plots

LESSONS LEARNT

- There are prospects for developing fodder value chain for counties in rangelands including Hay and Seeds
- Encourage up-scaling of reseedling by engaging local CBOs and individual farmers.
- The prevailing weather condition is critical to the success of reseedling activity.

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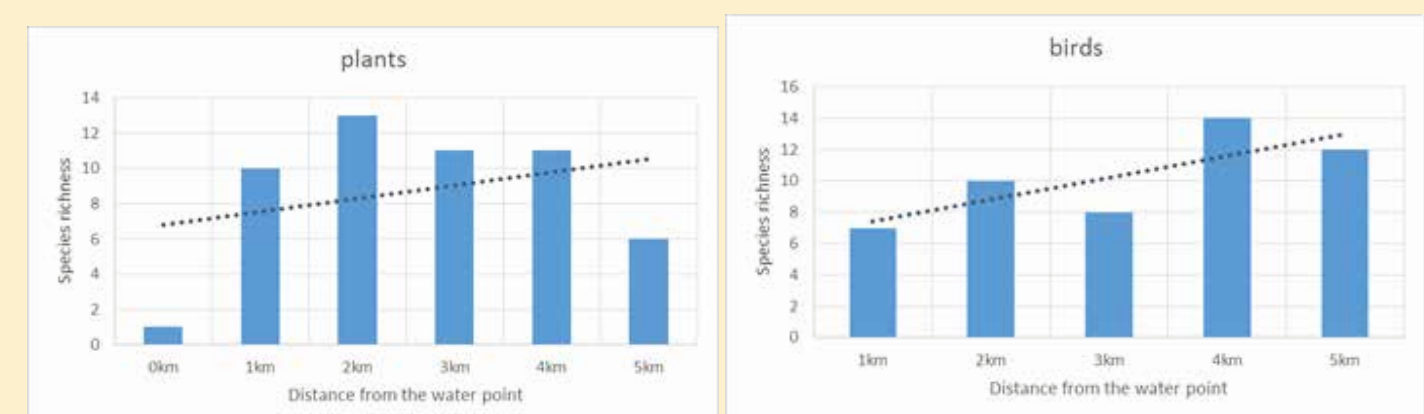
Water point at duka moja



Water trough at Marandagwa, Kajiado

Findings

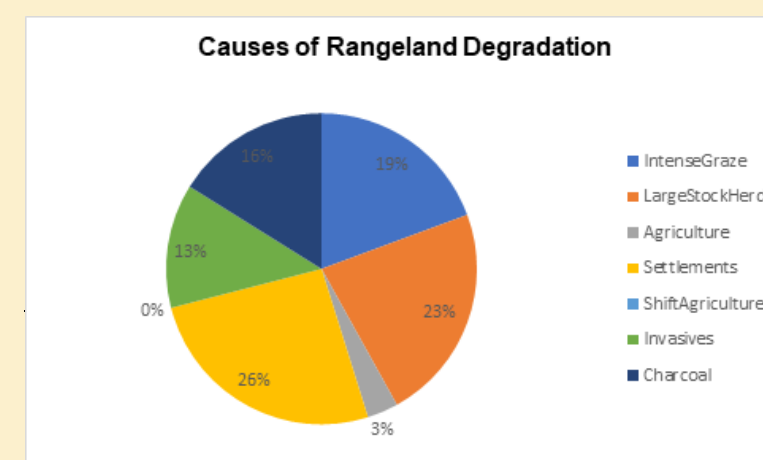
Recent data from Kajiado indicates a positive relationship between plant and animal species diversity with increasing distance from the water point in Duka Moja. This confirms the theory and empirical evidence of the use of bio-indicators in rangeland health assessment.



Variation of plant and bird species richness with increasing distance from Duka Moja water point (Kajiado)



Degraded Rangeland



Variation of vegetation index and mammal species richness with distance from Baraki Water point

Recommendations

- Validated bio-indicators are useful for monitoring rangeland health to inform management decisions
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Reseeding Process



Identification of degraded area



Land preparation



Broadcasting seeds



Securing reseeded plot

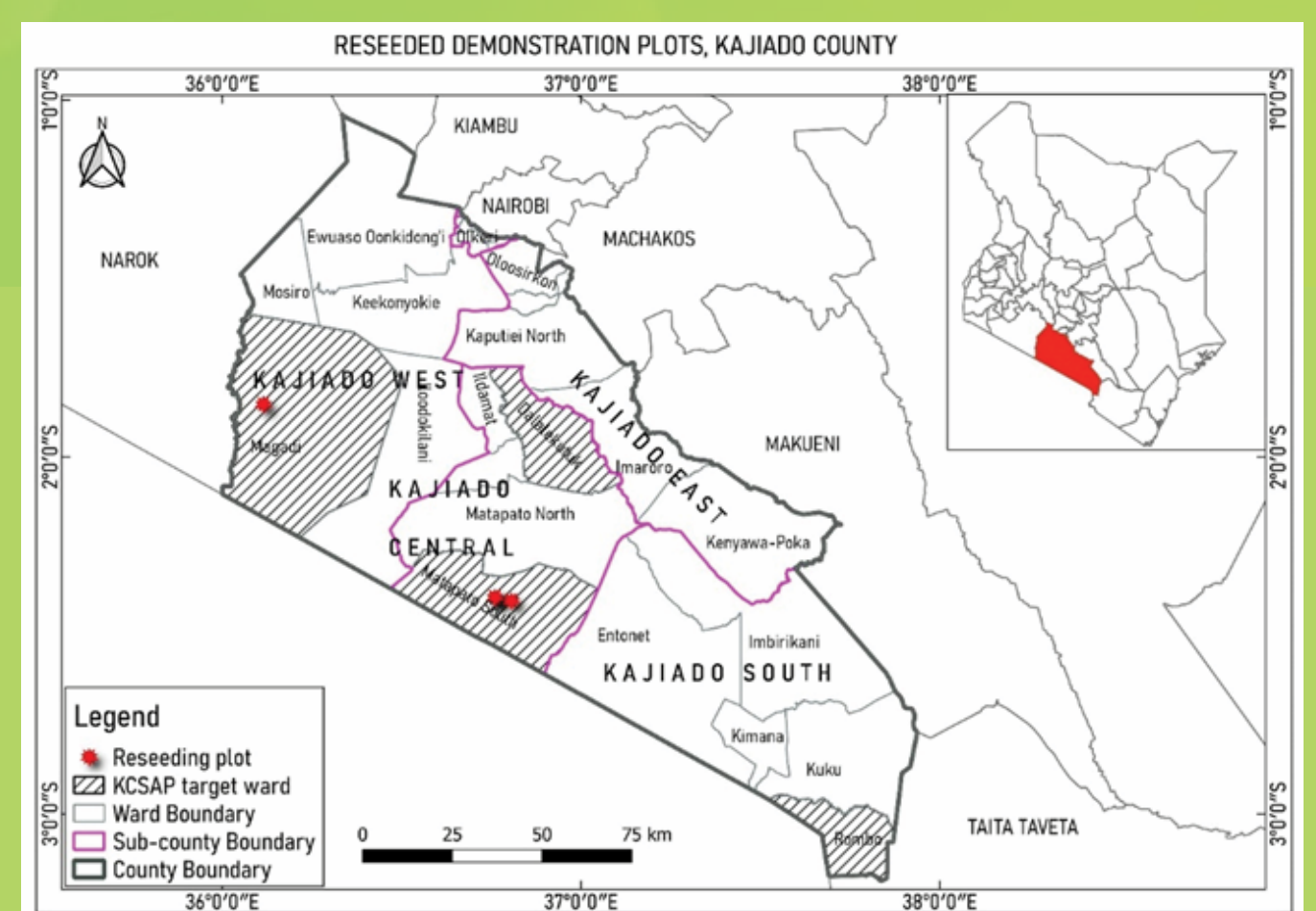


Fig 1. Map of Kajiado County showing locations of reseeding demonstration plots

LESSONS LEARNT

- There are prospects for developing fodder value chain for counties in rangelands including Hay and Seeds
- Encourage up-scaling of reseeding by engaging local CBOs and individual farmers.
- The prevailing weather condition is critical to the success of reseeding activity.



Improvised hay barn in Duka Moja, Kajiado County

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