Land degradation is one of the central challenges facing sustainable development in the world today. The ability of the land to support life and sustain development is central to reducing poverty (SDG1), achieving food security (Big 4 Agenda and SDG2), and supporting life on land (SDG 15). Across Kenya and in the drylands in particular, land degradation has widespread economic impacts, reducing the viability of livestock production and pastoral livelihoods, increasing vulnerability to drought, and exacerbating conflict. In Isiolo and Garissa counties, the interaction of land degradation and climate change continues to erode resilience and undermine development.
HIGHLIGHTS

Key Drivers of Land Degradation
- Livestock numbers and distribution, infrastructure, and water distribution and management.

Definitions of land degradation
- Degradation is multi-faceted and depends on management objectives.
- Standard definitions are limited and often exclude locally important elements of degradation, including invasive species, changes in species composition, and disease.
- Time is an important component of definitions of land degradation and restoration targets - e.g. areas that are degrading may be declining relative to a healthy baseline, while areas that are improving may have already been degraded.
- Land potential is important for understanding restoration options and priorities.

Priority Interventions
- Planning = Integrated multi-scale cross-sectoral planning.
- Governance = Harmonize and strengthen natural resource governance.
- Monitoring = regular and robust participatory monitoring.

However, there is hope. Innovative research and monitoring approaches, which integrate innovative science with local knowledge, are improving our understanding of the drivers and hotspots of land degradation in drylands, and highlighting opportunities for impactful sustainable land management interventions. This brief summarizes the land degradation status of Isiolo and Garissa counties in August 2019 and highlights potential interventions and next steps to enhance sustainable land management in the drylands.
LAND DEGRADATION

Land degradation is a complex phenomenon with drivers and impacts operating at different spatial and temporal scales. Often defined as the “temporary or permanent lowering of the productive capacity of land”\(^1\), land degradation has widespread implications for ecosystem services, climate change, livelihoods, and economic development. In the rangelands of northern Kenya, land degradation encompasses a number of factors including soil erosion and fertility loss, encroachment of woody species, declines in ground cover, changes in plant species composition, and the loss of biodiversity.

Halting land degradation and restoring rangelands is a central development objective for Kenya\(^2\) and an important component of the County Integrated Development Plans (CIDPs) for both Garissa and Isiolo counties.

Effective restoration and rehabilitation initiatives depend on a clear understanding of the state and extent of degradation, the drivers and pressures causing degradation, and the potential impacts of degradation on livelihoods and economic development. Targeted research and monitoring are needed to inform decision-making, support implementation, highlight investment opportunities, and identify challenges and opportunities. This is particularly true for County Governments as the focal points for natural resource management and participatory community based development.

BACKGROUND- ISIOLO AND GARRISA COUNTIES

Isiolo and Garissa counties (Figure 1 and Table 1) are ASAL areas (arid and semi-arid lands) with large pastoral populations. Both of these counties have high poverty rates (59.1% and 65.5%, respectively\(^3\)), and depend on natural resources for a large proportion of their economic productivity. Degradation of these natural resources has an important impact on poverty, but evidence on the extent and the causes of land degradation is largely absent. Evidence based decision making is essential for enhancing resilience, reducing poverty, and ensuring equitable and sustainable development for all.

This brief provides a foundation for informing policy and decision making for sustainable land management at the county level.

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\(^3\)KNBS(2015) Kenya Integrated Household Budget Survey
Table 1. Background statistics for Isiolo and Garissa counties.

<table>
<thead>
<tr>
<th></th>
<th>Isiolo</th>
<th>Garissa</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area (square km)</td>
<td>25,336.10</td>
<td>45,720.20</td>
</tr>
<tr>
<td>Population (2009 Census)</td>
<td>143,294</td>
<td>623,060</td>
</tr>
<tr>
<td>Cattle (2016)</td>
<td>213,665</td>
<td>1,270,554</td>
</tr>
<tr>
<td>Sheep (2016)</td>
<td>397,527</td>
<td>1,958,435</td>
</tr>
<tr>
<td>Goats (2016)</td>
<td>425,877</td>
<td>2,246,345</td>
</tr>
<tr>
<td>Camels (2016)</td>
<td>65,916</td>
<td>463,578</td>
</tr>
</tbody>
</table>

Figure 1. Map of Isiolo and Garissa Counties.
ASSESSING LAND DEGRADATION - THE PRAGA APPROACH

PRAGA means Participatory Rangeland and Grassland Assessment. A participatory tool for rangeland restoration and rehabilitation that combines cutting edge remote sensing and scientific methods with local knowledge and experience. PRAGA is a nine step participatory process designed to provide evidence and insights on land degradation and restoration opportunities for sustainable development (Figure 2).

This report highlights the key findings from the pilot implementation of the PRAGA process in Isiolo and Garissa counties – it identifies areas of degradation and sustainable land management, highlighting potential drivers of degradation, and providing recommendations of potential interventions and priority next steps.

The PRAGA methodology uses the DPSIR conceptual framework to integrate local and scientific knowledge to explore potential drivers and pressures affecting rangeland health, and provide preliminary insights on potential impacts and appropriate responses and interventions (Figure 3). DPSIR\(^4\) is a causal framework designed to support evidence-based decision making through an improved understanding of socio-ecological systems, including

- exploring the DRIVERS and PRESSURES and their impacts
- monitoring the STATE of the system (e.g. land degradation, biodiversity, etc)
- highlighting the socio-economic IMPACTS of changes in system state
- exploring potential societal RESPONSES and interventions.
LAND DEGRADATION - HOTSPOTS
As part of its contribution to achieving land degradation neutrality (LDN), Kenya has committed to restoring 5.1 million acres of forests and rangelands by 2030⁵. To achieve this ambitious target, we must reduce and reverse the drivers of degradation, identify priority degradation hotspots in need of restoration, and scale up effective approaches to sustainable land management. Robust, accessible, and applicable data are key to each of these components, and central to targeting interventions for maximum efficiency and impact.

DRIVERS and PRESSURES
Land degradation is a complex process driven by a mix of drivers and pressures acting at different spatial and temporal scales. To be effective and sustainable, restoration and rehabilitation interventions must be responsive to chronic drivers and emerging and dynamic pressures. Through the integration of local knowledge and scientific approaches, the PRAGA process highlighted three (3) key variables as drivers of human induced land degradation in in Isiolo and Garissa:

01 Livestock populations
02 Infrastructure (e.g. roads and settlements)
03 Water distribution and management


⁵AFR100 - https://afr100.org/content/kenya
To illustrate how these factors may interact to influence land degradation, the PRAGA team developed a “human footprint” (HF or presence) index for Isiolo and Garissa counties (Figure 4).

Figure 4. Human footprint index for Isiolo and Garissa counties.

The HF index is a composite of two key variables 1) distance to infrastructure (in this case distance to settlement and distance to road), and 2) average livestock density between 2000 and 2010 (TLUs per km2). By overlaying these variables, the HF index suggests areas which may be experiencing high (3), intermediate (2), or low (1) levels of human induced pressure on rangeland resources (Figure 4 and Table 2).

<table>
<thead>
<tr>
<th>Garissa</th>
<th>Isiolo</th>
</tr>
</thead>
<tbody>
<tr>
<td>HF</td>
<td>sqkm</td>
</tr>
<tr>
<td>1</td>
<td>6,340</td>
</tr>
<tr>
<td>2</td>
<td>31,674</td>
</tr>
<tr>
<td>3</td>
<td>5,823</td>
</tr>
</tbody>
</table>

Table 2. Coverage of Human footprint index categories in Garissa and Isiolo counties.
STATE
To identify priority areas for investment in rangeland rehabilitation and restoration, and examples of sustainable land management, which could be scaled up, the pilot application of the PRAGA methodology, developed a land degradation map for Garissa and Isiolo counties. The map was produced using the trends. Earth tool⁸ and incorporates the three key indicators of land degradation used to monitor the state of life on land (SG 15.3) - land cover, land productivity, and soil carbon. By combining these three sub-indicators and assessing their change over time (2001 to 2015) the map highlights areas of the landscape, which are degraded (red), stable (beige), and improved (green)⁹.

Table 3. Area and percent cover of land that is degraded, stable and improved by county (results are based on the analysis of data for the past 15 years -2001 to 2015 - from trends. Earth).

<table>
<thead>
<tr>
<th>Count</th>
<th>Degraded</th>
<th>Stable</th>
<th>Improved</th>
</tr>
</thead>
<tbody>
<tr>
<td>Garissa</td>
<td>19,941</td>
<td>23,060</td>
<td>835</td>
</tr>
<tr>
<td>Isiolo</td>
<td>15,771</td>
<td>9,098</td>
<td>546</td>
</tr>
</tbody>
</table>

⁸This land degradation map was developed using the trends. earth online tool (http://trends.earth/docs/en/)

⁹Note the time frame for this analysis. These methods highlight changes since 2001 and must be complemented with local knowledge and other methods to identify and address patterns and processes of degradation that occurred prior to the assessment period.
The map of land degradation in Garissa and Isiolo counties (Figure 5) provides a quantitative index of changes in land health as a foundation for identifying hotspots and priority areas for restoration investments, scaling up sustainable land management, and further research. Examples of hotspots of degradation (yellow ellipses) and improvement (blue ellipses) are highlighted in Figure 6 and Table 4. As the table shows, apparent land improvement does not necessarily imply a revival of the natural habitat, but may be a sign of expansion of irrigation or encroachment by invasive species, as discussed below.
### Table 4

Areas of potential land degradation and improvement with potential drivers and possible interventions to be validated with field visits and local knowledge.

<table>
<thead>
<tr>
<th>ID</th>
<th>Area</th>
<th>State</th>
<th>Potential Drivers</th>
<th>Priority Interventions</th>
</tr>
</thead>
<tbody>
<tr>
<td>D1</td>
<td>Isiolo and Archers Post</td>
<td>Degraded</td>
<td>Proximity to urban areas and major roads</td>
<td>Land Use Planning</td>
</tr>
<tr>
<td>D2</td>
<td>Kittermasters and Garba Tula</td>
<td>Degraded</td>
<td>Proximity to Isiolo, access to permanent water, conflict in other areas</td>
<td>Land Use Planning and Governance</td>
</tr>
<tr>
<td>D3</td>
<td>Dadaab</td>
<td>Degraded</td>
<td>Proximity to Dadaab camp</td>
<td>Governance, Regional Peace initiatives</td>
</tr>
<tr>
<td>I1</td>
<td>Sericho</td>
<td>Stable/Improved</td>
<td>Agricultural expansion, invasive species (?)</td>
<td>Monitoring</td>
</tr>
<tr>
<td>I2</td>
<td>Goreafe</td>
<td>Stable/Improved</td>
<td>Distance to water, Conflict</td>
<td>Land Use Planning, Governance</td>
</tr>
<tr>
<td>I3</td>
<td>Eskot</td>
<td>Stable/Improved</td>
<td>Conflict</td>
<td>Governance</td>
</tr>
<tr>
<td>I4</td>
<td>Mbalambala</td>
<td>Stable/Improved</td>
<td>Agricultural expansion, invasive species</td>
<td>Land Use Planning, Governance, Invasive Species Control</td>
</tr>
</tbody>
</table>

However, what is this map really telling us, and how can we know what interventions are likely to be most effective where? The PRAGA approach brings together these scientific data with local knowledge as part of a participatory assessment to enhance our understanding of land degradation and potential responses.

For example, if we explore this index of land degradation in relation to the human presence index developed during the participatory assessment we see that these drivers, while not explaining all of the degradation across the landscape, appear to be reasonably good predictors of degradation at these scales (Figure 7)
Figure 7. Relationship between remote sensing based degradation index and the locally derived human footprint index.

Micro and Macro Landscapes
The PRAGA methodology is designed to enhance our understanding of land degradation and potential interventions by linking scientific data and local knowledge. To illustrate the power of this approach, and to test and refine the methodology, the PRAGA team piloted the approach in two landscapes of Isiolo and Garissa counties (7,253 km²).

During the assessment, local pastoralists described the degradation status (high, medium and low) of the landscape using their own local micro-landscape classification system (Figure 8). While there is a general correspondence between the remote sensing based degradation index and the local perceptions of degradation (Figure 9), there are a number of areas of divergence, including area 1.3 and 1.4 in Figure 6, where local knowledge proved particularly important for interpreting the results and informing potential interventions.

For example, the relatively stable and slightly improving areas in I.3 (Fig 6) are likely the result of underutilization of the area due to the risk of conflict, while the similar patterns of stability and improvement in area I.4 are misleading as this area is heavily degraded due to the invasion of Prosopis juliflora.
Both instances highlight the power, and necessity, of integrating scientific and local knowledge and the importance of participatory assessments for validating results and informing interventions.
KEY LESSONS AND RECOMMENDATIONS - Opportunities for Investment (RESPONSES)

Knowledge about the status and drivers of degradation is essential for prioritizing investments, designing, and implementing restoration interventions. However, successful and scalable approaches must be based on locally relevant definitions of degradation and be responsive to local needs and priorities.

This assessment provides insights into potential degradation hotspots and possible priority intervention areas in Isiolo and Garissa Counties. Highlights and lessons learned include:

**Monitoring Degradation**
- The PRAGA methodology provides a framework for integrating scientific and local knowledge to inform decision-making. The approach should be scaled up to provide a detailed assessment of the entire county, and expanded to include data collection on water points, settlements, county level map of management units and status of governance.
- Hotspots and drivers of degradation
  - Isiolo and Garissa counties have distinct patterns of land degradation and improvement that are best addressed by locally derived solutions based on global best practice.
- Remote sensing indices suggest that 62.1% and 45.5% of Isiolo and Garissa counties are degraded.

**Key challenges**
- Peace and development - Ironically, peace and a reduction in conflict present opportunities for infrastructure development (e.g. roads, centres, boreholes, etc.) which, if poorly planned and managed, can negatively impact local livelihoods and overall rangeland health.
- Erosion of local governance systems - The erosion of traditional governance systems, and the lack of coordination of governance structures across scales (e.g. local, county, national), often results in unsustainable changes in patterns of resource use in space and time.
- Intensification - Sedentarization, changes in herd and breed structures, and intensification of pastoral and agro-pastoral systems are threatening the health of dryland systems.

**Key responses**
 Governance - Recognition and support for local and traditional governance structures essential to sustainable development in drylands. Local systems should be strengthened and integrated with formal governance structures to promote ownership and sustainability.

 Planning - To be effective, planning must be integrated across sectors and scales. Sector specific planning is often inefficient, undermines rangeland health, exacerbates degradation (e.g. unplanned water point development), and is detrimental to long term development objectives. Integrated planning should be participatory and evidence based, with mechanisms for linking local knowledge and formal planning structures.

 Knowledge and Information management - Rangeland management decisions should be based on evidence. Developing a robust rangeland-monitoring program, such as PRAGA, should be a priority for ASAL counties. Effective monitoring programs are essential for prioritizing interventions and catalysing impact. Monitoring data must support and strengthen existing decision making process at local, county (e.g. CIDP and Spatial Plans), and national levels.

 East African rangelands, while resilient and restorable, are increasingly under threat from a lack of integrated planning and weak governance. Investments in monitoring and knowledge management are essential to identifying priority needs, defining possible interventions, and implementing restoration programmes to reduce degradation, restore ecosystems, and promote sustainable development across the drylands.
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https://www.iucn.org/drylands