A Web-Based Decision Support Tool For Monitoring Kenya's Rangelands

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November 23, 2022

Abstract

The Kenyan ASALs (Arid and Semi-Arid Lands) through livestock production, contribute to over 12% of the 40% Agricultural GDP with further contribution through the tourism sector. They cover over 70% of the country and are home to both wildlife and pastoral communities. With dependence on rain-fed pastures, better management of the ASALs require near real time information on available resources. While information on vegetation conditions is important, other critical resources such as location of water, extent of unpalatable invasive species and other ancillary information is required for a comprehensive understanding of the condition of the ASALs. The Rangelands Decision Support tool was developed to address lack timely information for decision making in the ASALs which influences management of available pastures in dry and wet seasons, development of proper grazing plans, livestock movement, conflicts and implementation of conservation measures meant to rehabilitate degraded lands, management of scarce water resources and mitigation of the spread of invasive species. The tool automates data processing from acquisition to development of final products that consist of dekadal NDVI and monthly products (NDVI Z score, absolute anomalies and VCI (Vegetation Condition Index)). Users are able to select suitable products for specific assessment and produce maps at their monitoring units in PDF format. This research present a fully operational processing chain for the data incorporated in the tool and case studies demonstrating application of the different indicators for monitoring at different monitoring units.

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Background

✓ SERVIR Eastern and Southern Africa (SERVIR E&SA) project is a joint initiative of National Aeronautical Space Agency (NASA) and USAID; with the Regional Centre for Mapping of Resources for Development (RCMRD) as the implementing organization.

✓ SERVIR E&SA's overarching goal focuses on assisting developing countries to improve environmental management and resilience to climate change by strengthening the capacity of governments and other key stakeholders to integrate Earth Observation information and geospatial technologies into development decision-making.

✓ The service was developed and structured based on consultative needs assessment to identify users priorities and needs in rangeland monitoring and management

Problem Specification

Rangelands comprise 80% of Kenya's land mass which are classified as arid and semi-arid, and contain 70% of the country's livestock population while also generating 90% of tourism revenue . The rangelands are under continuous threat due to climate variability, coupled with a rapidly growing livestock and human populations. Extreme events are also increasing in intensity and frequency, resulting in notable declines in productivity in the rangelands due to shorter recovery time. With dependence on rain-fed pastures, better management of the rangelands require near real time information on vegetation conditions and availability of water.

Goal

Development of a dynamic web based tool for assessment of vegetation conditions and availability of water to provide timely information for decision making in the rangelands. The tool seeks to inform decisions on management of available pastures in dry and wet seasons, development of proper grazing plans, informing livestock movement in planned grazing areas, implementation of conservation measures meant to rehabilitate degraded lands, management of scarce water resources and mitigation of the spread of invasive species.
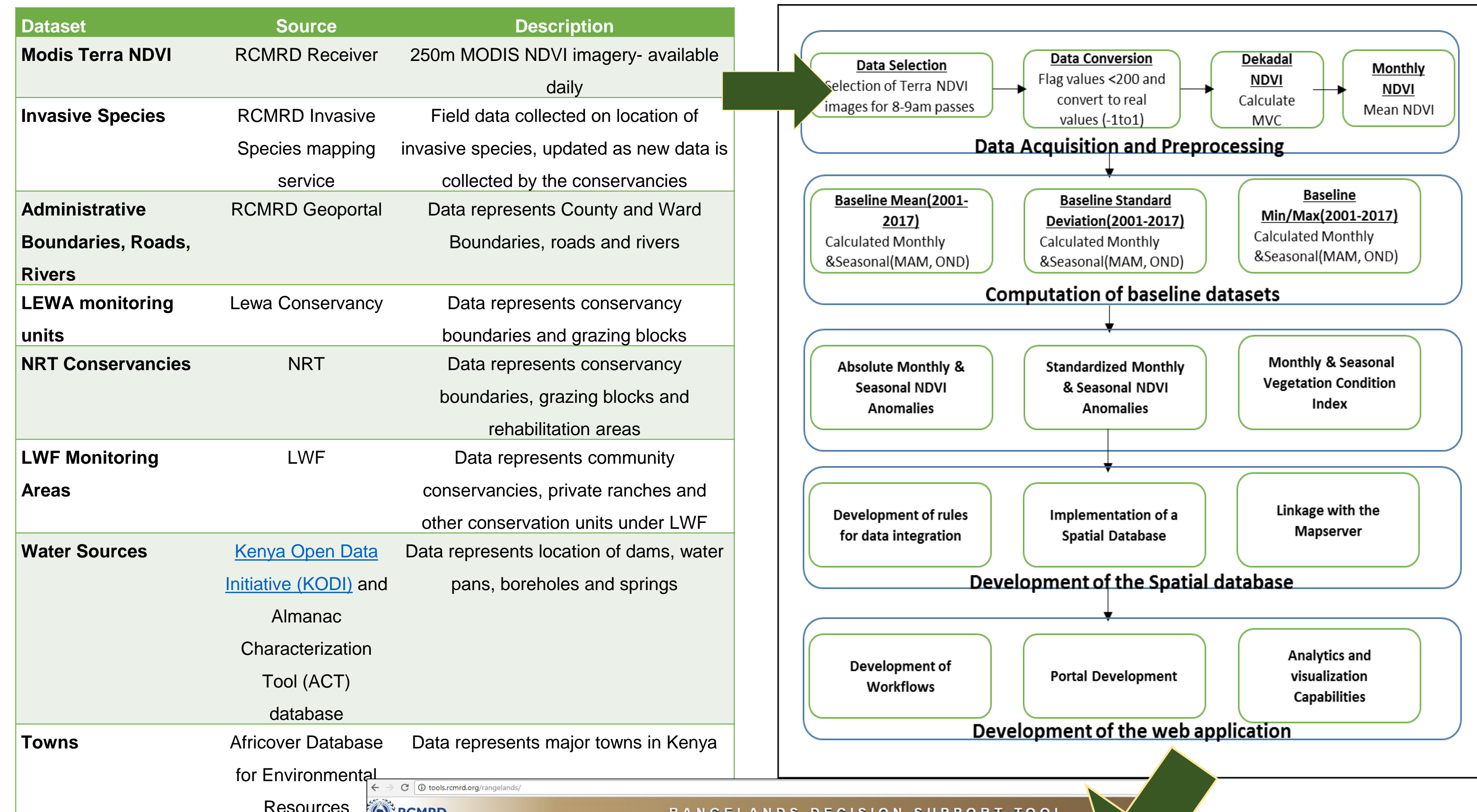
Key Stakeholders

Decision makers: Northern rangelands Trust (NRT) and Laikipia Wildlife Forum (LWF) – conservancy owners/managers, Kenya Rapid, National Drought Management Authority (NDMA), County governments, rangelands management committees
Users: Northern Rangelands Trust (NRT), Laikipia Wildlife Forum (LWF), National Drought Management Authority (NDMA), FEWSNET, Kenya Wildlife Service, Centre for Training and Integrated Research in ASAL Development (CETRAD), Kenya RAPID (under Partnerships for Resilience and Economic Growth (PREG))
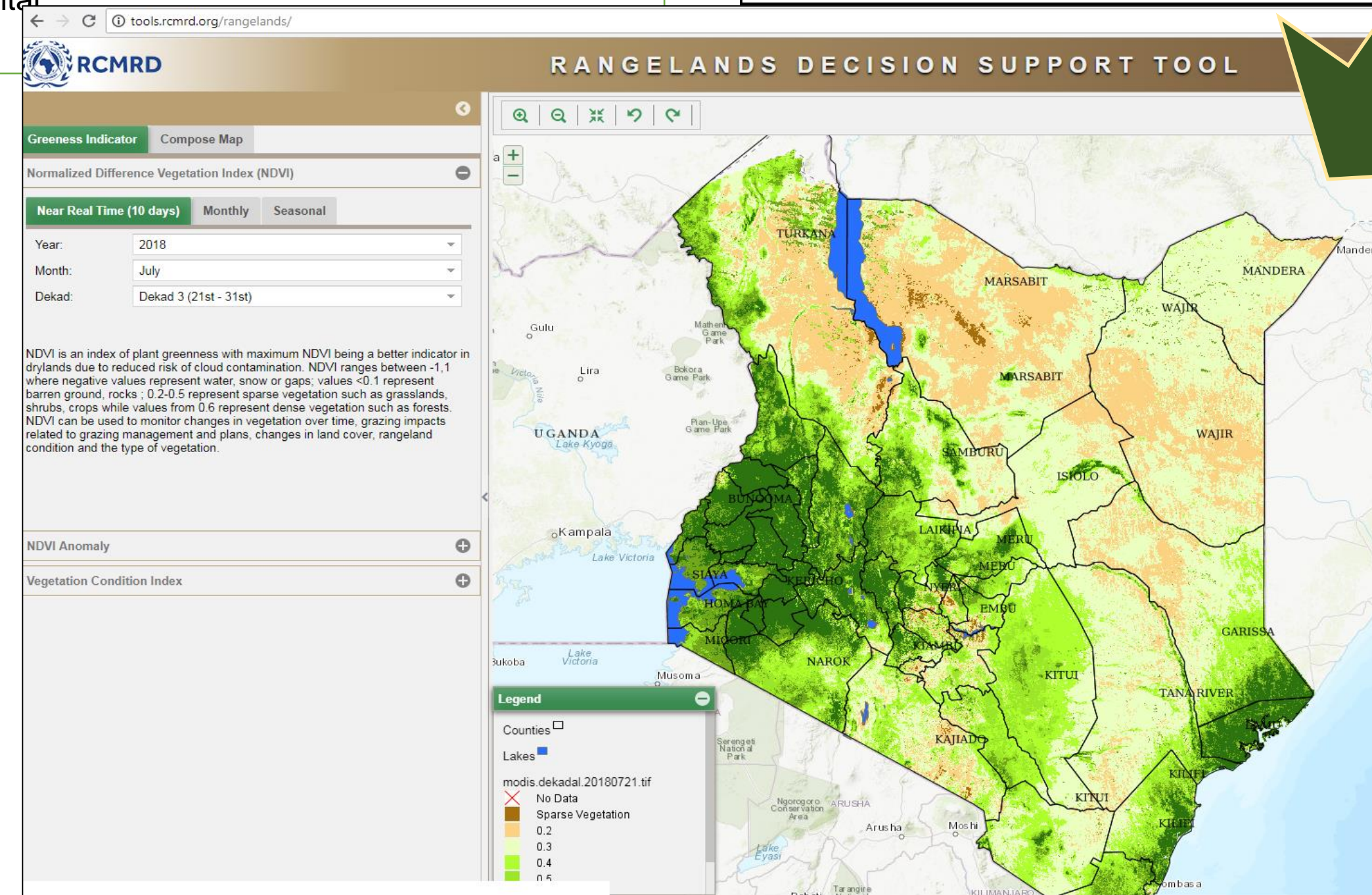**Beneficiaries:** NDMA county officers, Local communities, Grazing coordinators, Conservancy managers, local conservation groups, Ranch owners and managers
Service integration: Inputs from invasive species modelling

Rangelands Decision Support Tool Workflow

Dataset	Source	Description
Modis Terra NDVI	RCMRD Receiver	250m MODIS NDVI imagery- available daily
Invasive Species	RCMRD Invasive Species mapping service	Field data collected on location of invasive species, updated as new data is collected by the conservancies
Administrative Boundaries, Roads, Rivers	RCMRD Geoportal	Data represents County and Ward Boundaries, roads and rivers
LEWA monitoring units	Lewa Conservancy	Data represents conservancy boundaries and grazing blocks
NRT Conservancies	NRT	Data represents conservancy boundaries, grazing blocks and rehabilitation areas
LWF Monitoring Areas	LWF	Data represents community conservancies, private ranches and other conservation units under LWF
Water Sources	Kenya Open Data Initiative (KODI) and Almanac Characterization Tool (ACT) database	Data represents location of dams, water pans, boreholes and springs
Towns	Africover Database for Environmental Resources	Data represents major towns in Kenya

Data Acquisition and Preprocessing

Data Selection → Data Conversion → Dekadal NDVI → Monthly NDVI

Computation of baseline datasets

Baseline Mean(2001-2017) | Baseline Standard Deviation(2001-2017) | Baseline Min/Max(2001-2017)

Absolute Monthly & Seasonal NDVI Anomalies | Standardized Monthly & Seasonal NDVI Anomalies | Monthly & Seasonal Vegetation Condition Index

Development of rules for data integration | Implementation of a Spatial Database | Linkage with the Mapserver

Development of the Spatial database

Development of Workflows | Portal Development | Analytics and visualization Capabilities

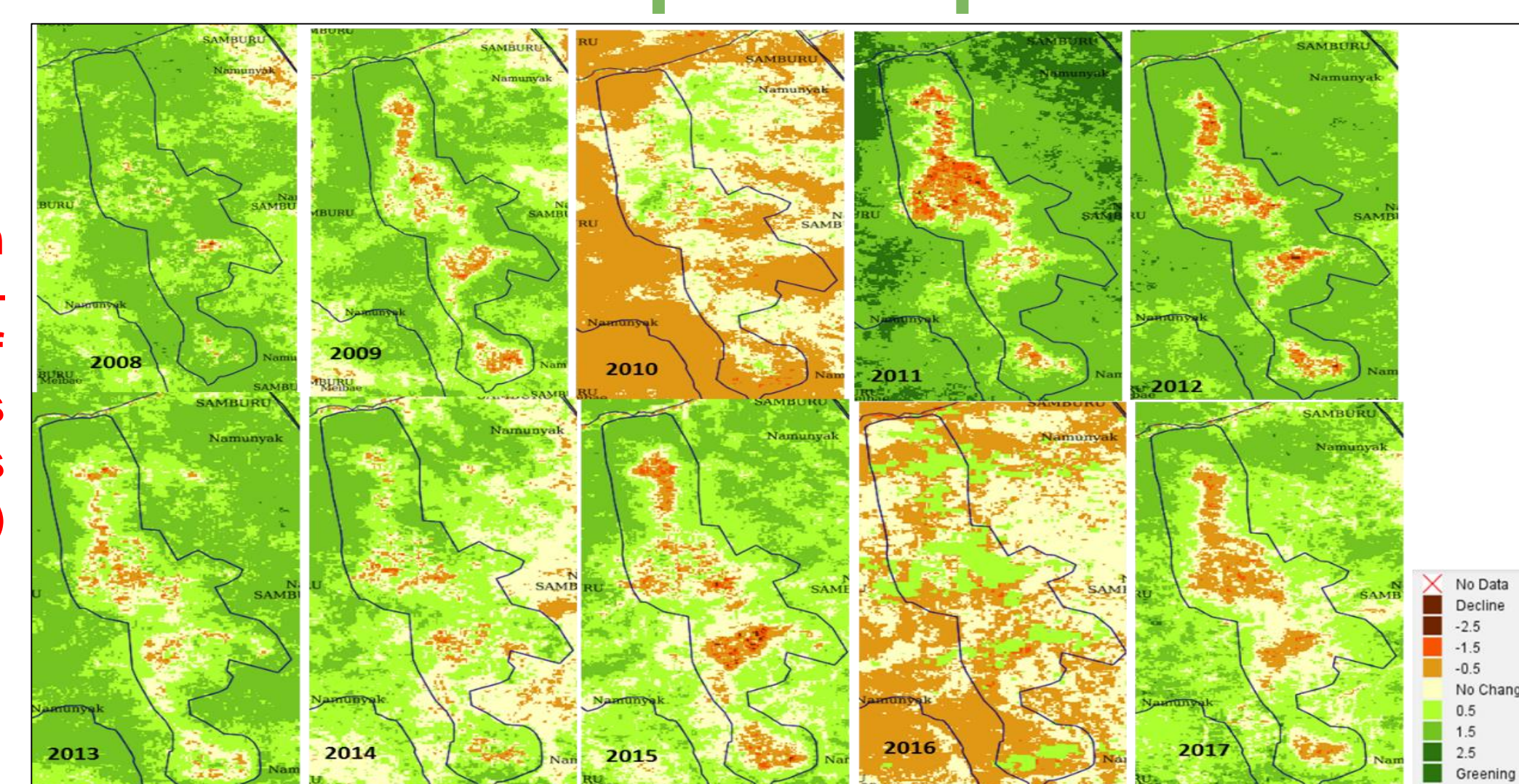**Development of the web application**
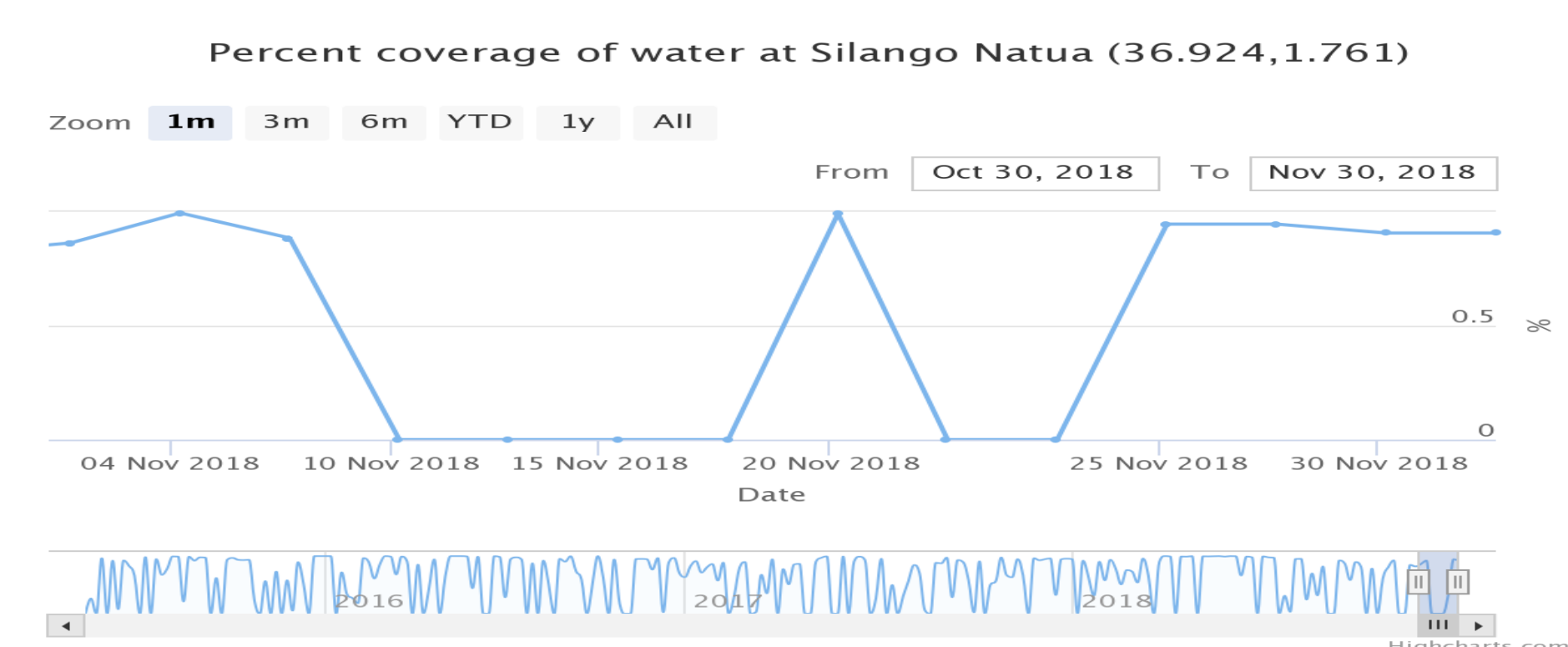
Fully Automated Web based platform
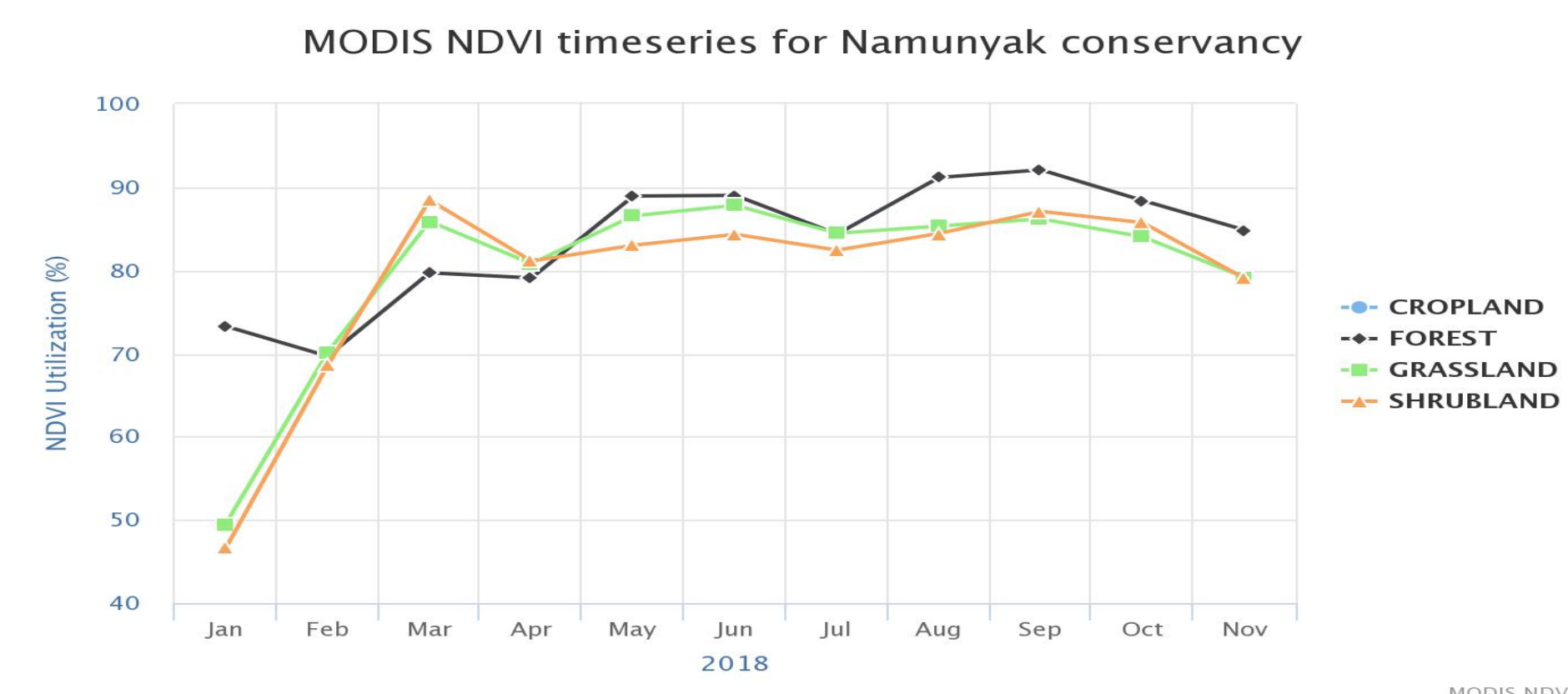

Example Outputs

Multi-temporal vegetation conditions monitoring – Monitoring implication of prolonged drought events on protected resources (Mathews Range)
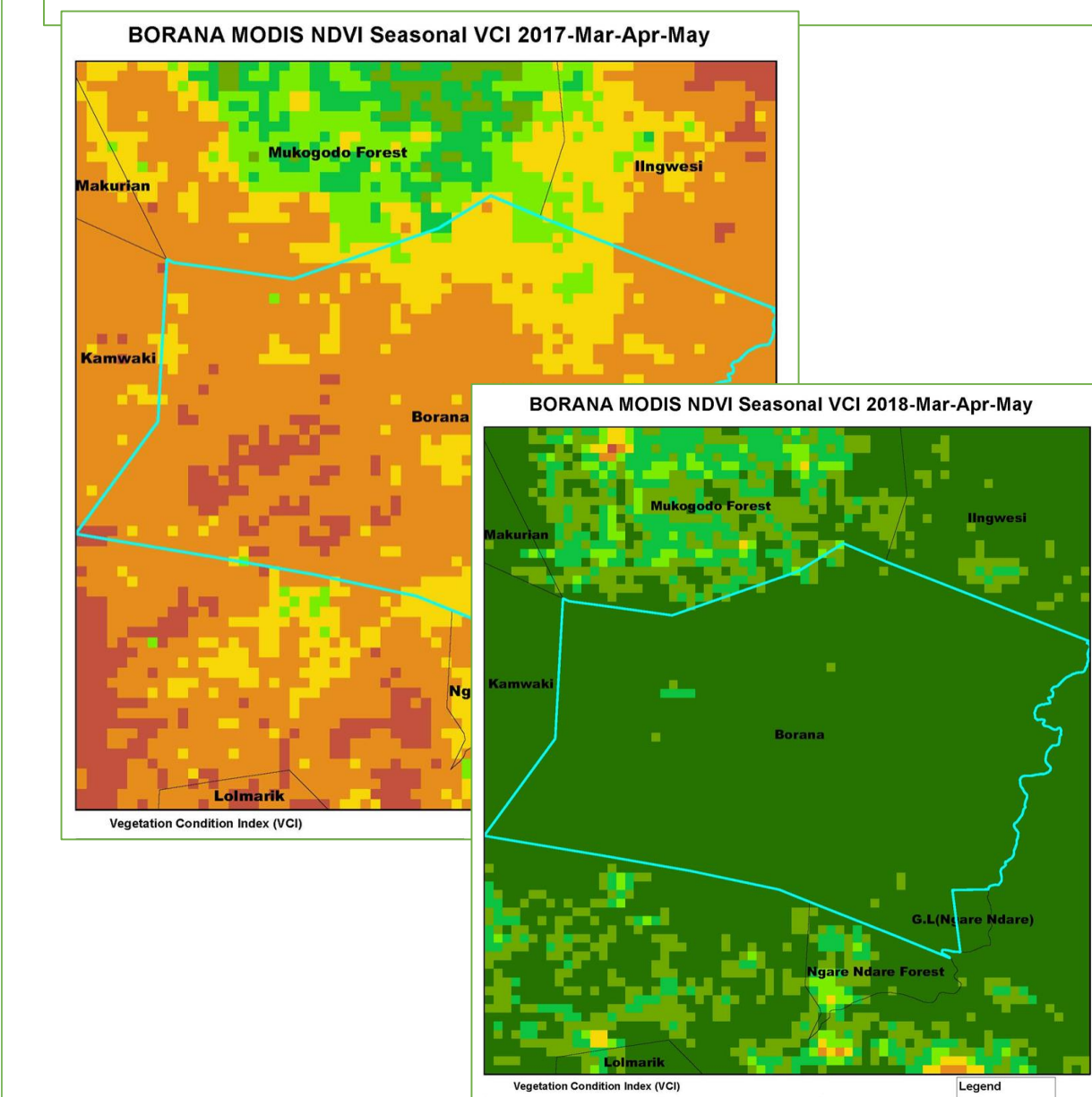
Multi temporal Surface Water Monitoring

Percent coverage of water at Silango Natua (36.924,1.761)

NDVI Utilization by land cover

MODIS NDVI timeseries for Namunyak conservancy

Use Cases

"Don't panic! The tool will allow me to reassure management on the resilience of the Lewa Ecosystem. From the maps I can clearly show what they had assumed to be degradation, was actually vegetation loss from the drought (2017) and the vegetation recovered fully when the rains came(2018)" **David Kimiti- Head of Research and Monitoring, Lewa**

"Our current grazing plans, due to frequent droughts had resulted in in poor vegetation conditions especially in Leparua area. Using the maps, we have been able to confirm the areas which are degraded and developed a new plan which we will present to management for review" **Sammy Tema- NRT Grazing Coordinator for Il-Ngwesi Conservancy**

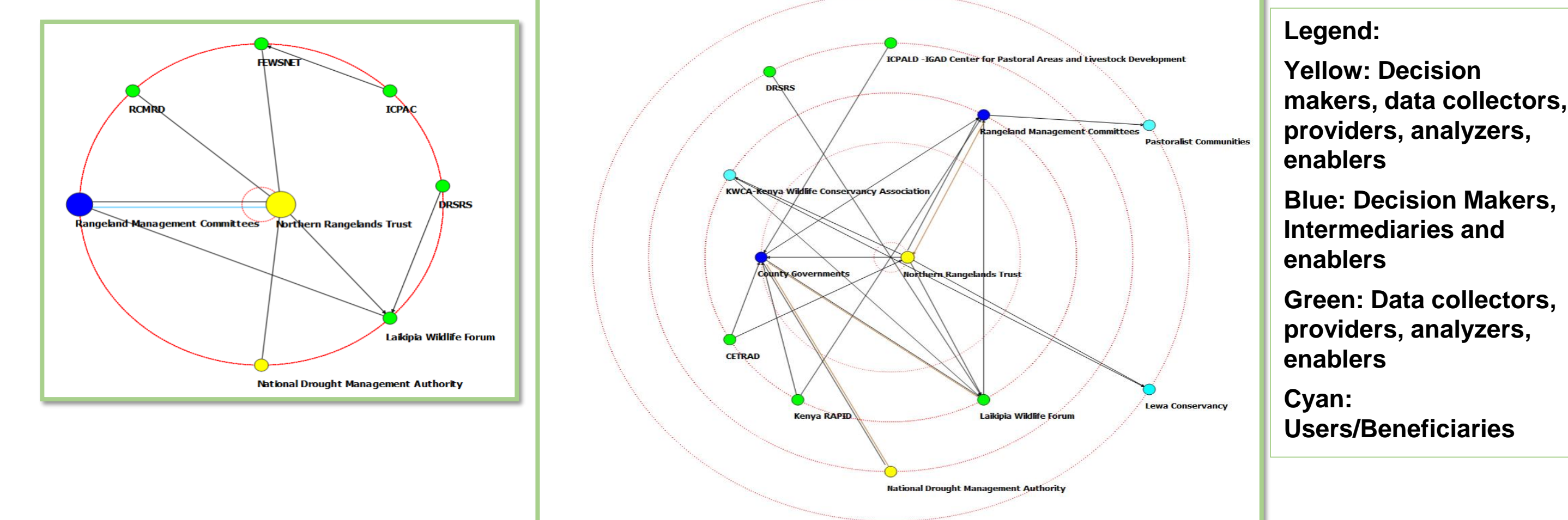Maps generated to array panic and reassure management of the resilience of conservancy
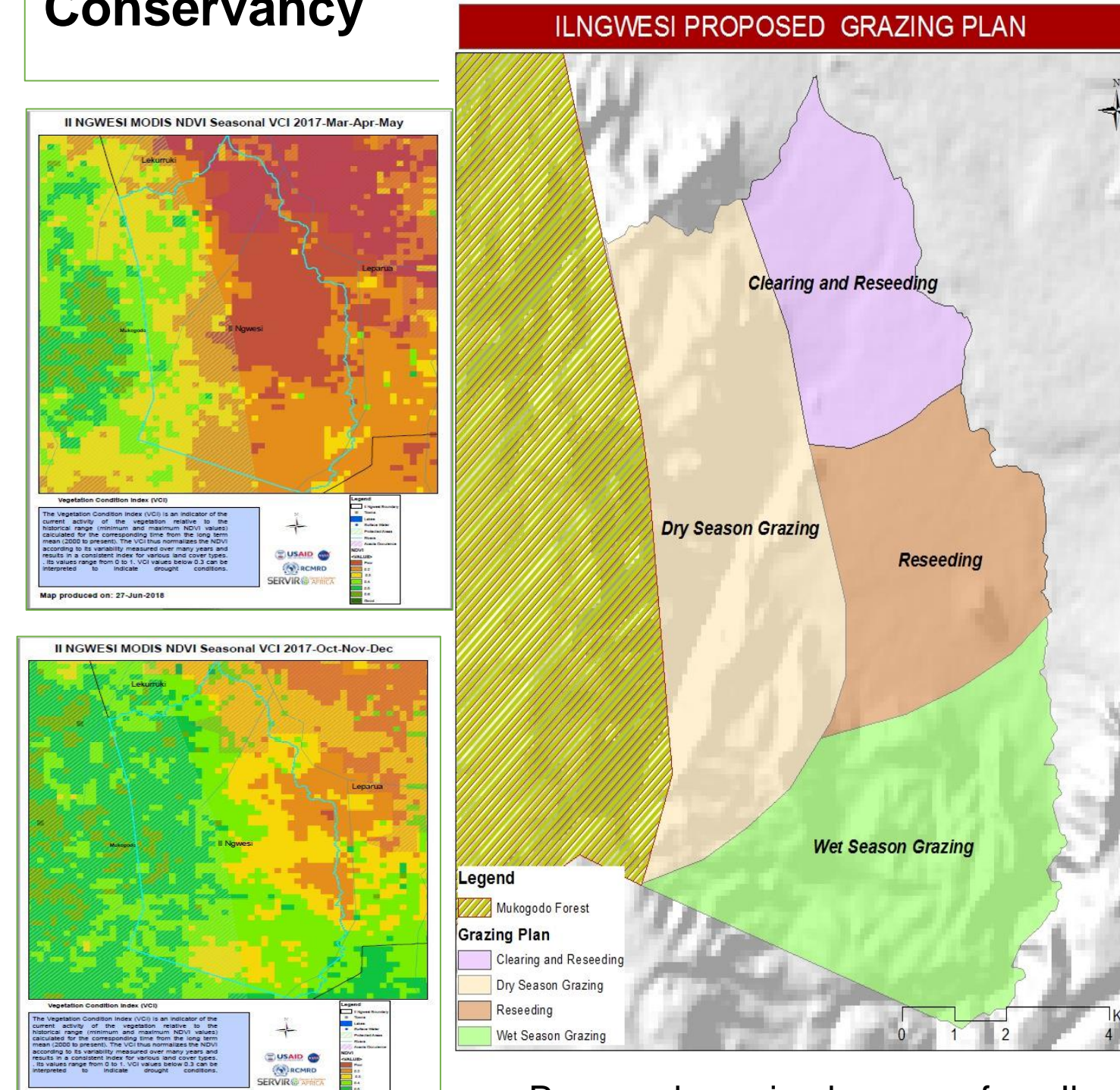
Maps generated to make the assessment for IlNgwesi Conservancy

Proposed revised map for Il-Ngwesi Conservancy developed during the training by the NRT team

Milestones

Growth in Stakeholders Network following stakeholder consultations, needs assessments

Legend:
Yellow: Decision makers, data collectors, providers, analyzers, enablers
Blue: Decision Makers, Intermediaries and enablers
Green: Data collectors, providers, analyzers, enablers
Cyan: Users/Beneficiaries

Growing investments by counties for capacity building in application of the tool for decision making

Support for partners such as Kenya RAPIDS and MERCY CORPS in rangeland management & monitoring
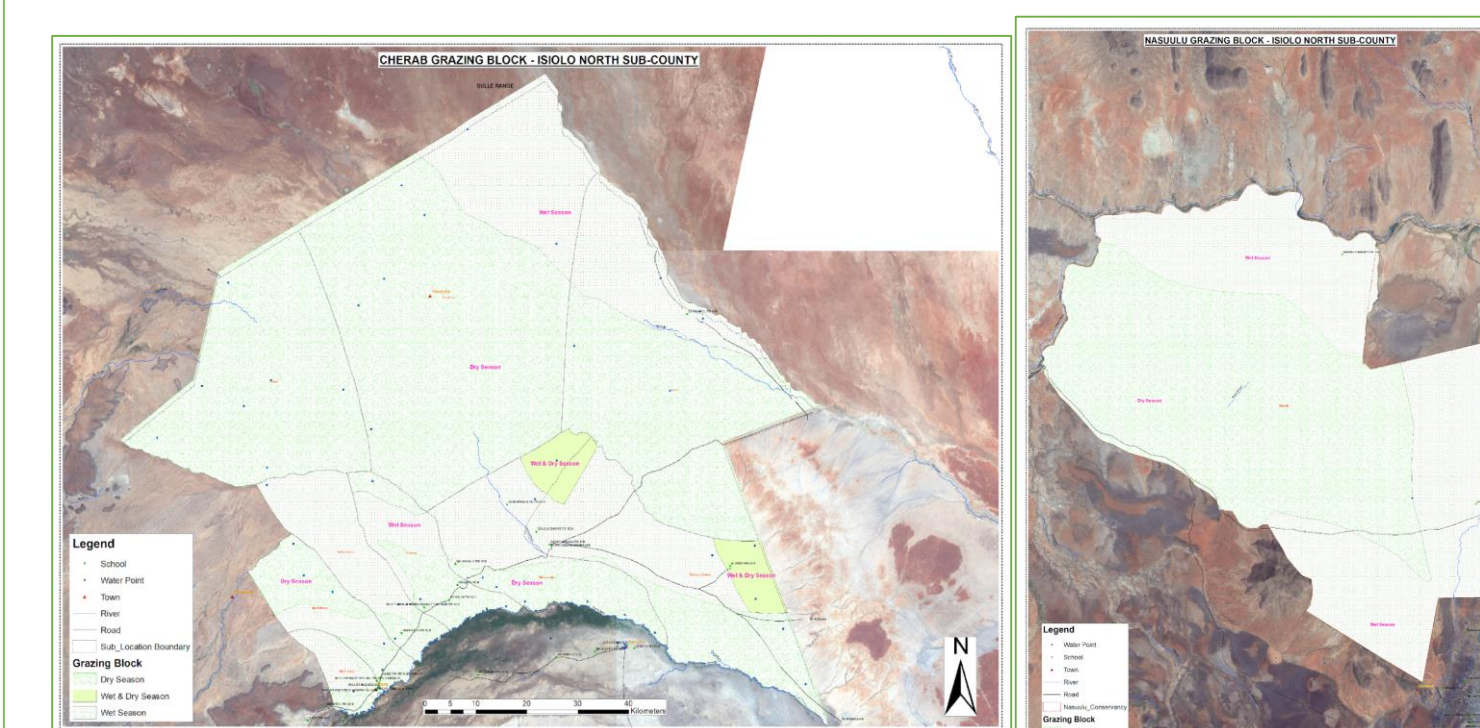
Digitized wet and dry grazing area maps for parts of Isiolo County

Sensitization and digitization of grazing areas in Turkana