Application of Land Degradation Index Map (LDIMs) in identifying degraded areas for National Tree Planting

BACKGROUND:

Land degradation denotes a decline in land productivity including agricultural production and is a serious problem in Africa, affecting every facet of the economy. Land degradation arises from mismanagement of soil, vegetation and water resources at both low and large scale. At RCMRD, the GMES and Africa project focuses on a range of services, including Land Degradation monitoring and assessment. This service entails the development of land degradation index maps, aimed at equipping policymakers with localized insights to guide intervention strategies within their respective countries. RCMRD's efforts have resulted in the development and dissemination of these products to key stakeholders involved in policy formulation and decision-making processes. Recipients include institutions such as the Directorate of Resource Survey and Remote Sensing (DRSRS) in Kenya, the Ethiopian Biodiversity Institute, the Ministry of Agriculture of Uganda, the Ministry of Environment of Eritrea, among others, tailored to their specific requirements. This particular case study highlights the utilization of these services by DRSRS in Kenya.

END-USER'S PROFILE (BENEFICIARY ORGANIZATION):

The Directorate of Resource Surveys and Remote Sensing (DRSRS), is a Kenya government agency established in 1975 as a response to answering environmental concerns that were raised in the 1972 Stockholm Conference which created the United Nations Environmental Programme (UNEP). The Directorate is domiciled at the Executive office of the President under the purview of the Chief of Staff and Head of the Public Service (COS&HOPS). It offers services in applied remote sensing and Geographical Information Systems (GIS), It's mandate is on the collection, storage, analysis, updating and dissemination of geo-spatial data and information on natural resources and the environment for sustainable development.

DRSRS is one of the Partners in the **GMES & Africa** Project, and directly supports key Ministries and Agencies in Kenya, with spatial data and information on land degradation that is integral in formulation of strategic policies on land reclamation and afforestation, through the National tree planting program. The Directorate is the focal point agency that advices the Government of Kenya on matters to do with GIS and Remote Sensing towards supporting economic transformation and development agenda.

END-USER'S NEEDS & CAPACITY BUILDING:

The Government of Kenya relies heavily on the spatial data and information generated by the Directorate, that is critical in monitoring the success of the tree planting program. The Directorate through the GMES and Africa Program, has continued to map all the degraded landscapes across the forty-seven (47) Counties in Kenya and now guides using Land degradation maps which priority areas are in dire need of rehabilitation. The maps are part of the Remote sensing and GIS solutions that are being deployed by multi-agency teams in Kenya, during the national tree planting days. Besides mapping the degraded areas using this service, **DRSRS** also offers support to Counties in Kenya in the formulation of land use policies and generation of crop suitability maps towards addressing food security. The land degradation data is also overlaid with other thematic layers, and accurately provide basis for planning and resource allocation for projects such as, water resource connectivity in degraded ASAL areas through irrigation and other initiatives to support the marginalized groups.

The **LDIMs** is also critical in the formulation of strategies for land reclamation in an effort to expand agricultural production. As a repository to this data, the DRSRS is obligated to coordinate and build synergy and capacity, for other Government agencies in utilization of

the services for enhanced service delivery and accurate reporting for intervention. To achieve this, the Directorate requires tailored training from **RCMRD** on analysis and interpretation of **LDIMs**, timely dissemination of generated data, and support for field validation to identify drivers of land degradation.

INFORMATION PROVIDED:

The Land Degradation Index map is developed using the Revised Universal Soil Loss Equation (RUSLE) model, which estimates bi-annual soil loss due to erosion through a factor-based approach. This model uses input variables such as rainfall, vegetation cover and condition, slope, soils, and livestock density. The resulting product is produced both in TIFF and JPEG formats on a bi-annual basis via . The mapping and analysis are conducted using QGIS and ArcGIS software, with recent developments incorporating the use of the Impact Toolbox by the Joint Research Centre (JRC). The users acces at products via this link https://geoportal.rcmrd.org/catalogue/#/detail/dataset/481?filter%7Bkeywords.slug.in%7D=gmes.

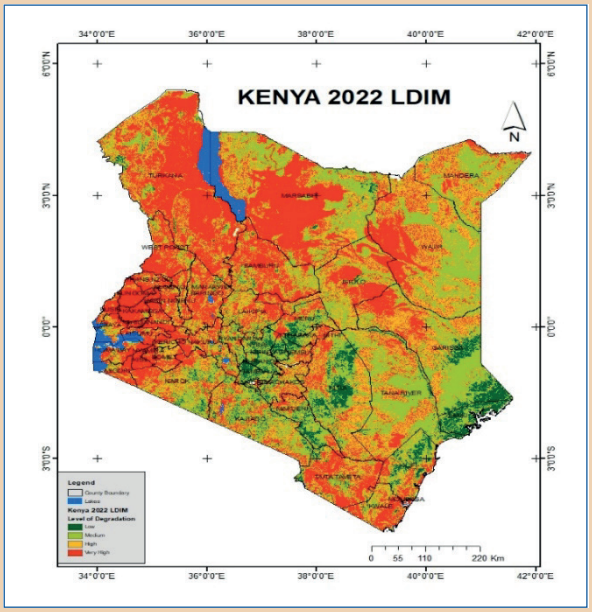


Figure 1: Map showing the status of Land Degrada-on in Kenya in 2022

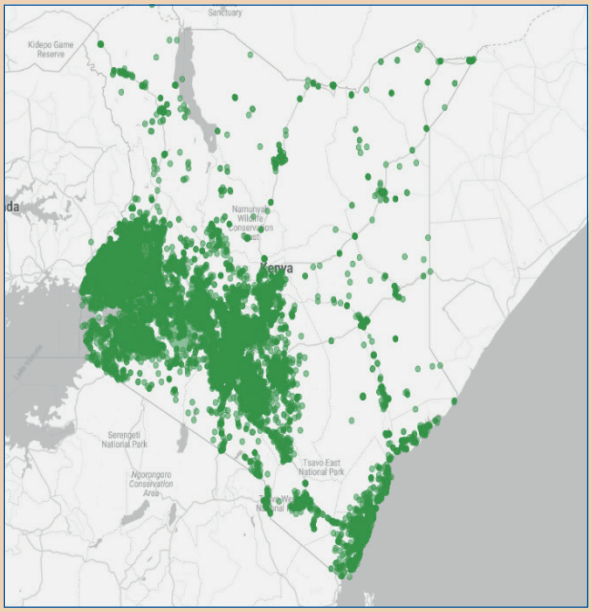


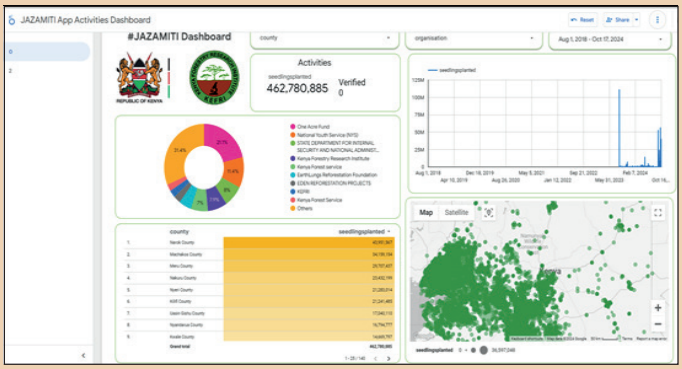
Figure 2: Spa-al distribu-on of Na-onal tree plan-ng in Kenya generated by the JAZAAMITI applica-on

USAGE:

The land degradation index maps are made available through multiple channels, including the GMES geoportal, email, and physical delivery. These products provide valuable information that **DRSRS** uses to identify the areas that are in dire need of tree planting and land reclamation efforts. Through webinars, hands-on trainings, and self-paced tutorials on e-learning platforms, **DRSRS** staff have been equipped with the necessary skills to produce and interpret these maps adequately. Lately, through utilization of these products, the Directorate has

continued to publish impactful technical reports, on the status of Land degradation in Kenya, that are accompanied by GIS maps that are easily visualized and interpreted by the decision makers. The **DRSRS** has a fully-fledged website (https://www.drsrs.go.ke) through which this data and information can easily be accessed by the public.

With the integration of land degradation data, the Directorate has enhanced its capacity in monitoring of the tree planting in Kenya. Recently, DRSRS has been at the forefront in advising the Government of Kenya, on how earth observation (EO) data could be utilized in monitoring its National tree growing program through a protype application dubbed, the ***Jaza Miti*** app. (https://lookerstudio.google.com/reporting/82e7201b-94b2-4aad-927d-3e7edb9d572a/page/p_xrs7dzg5bd).The program is one of the key presidential delivery projects that was launched by His Excellence the President, with a goal of planting 15 billion trees by the year 2032. This is towards reclaiming degraded areas across the country in a bid to expand agricultural productivity and address climate changes impacts.



In order to evaluate the achievements and monitor the progress of growing 15 B tree target, the JazaMiti Mobile application is considered as one stop shop by the Government to document and monitor the trees grown under the initiative. The Mobile Application is an innovation that leverages on ICT to document and report tree growing activities across all the 47 counties in Kenya. Jazamiti App was initiated to solve the gap of Monitoring, Reporting and Verification (MRV) so that the trees grown are monitored to maturity. The mobile app through its species to site matching layer, helps all stakeholders involved in the tree planting initiative, to discover which tree species are suitable in a given agro-ecological zone before planting, therefore enhancing tree survival rates and sustaining the ecosystem across all the forty-seven Counties in Kenya.

IMPACT:

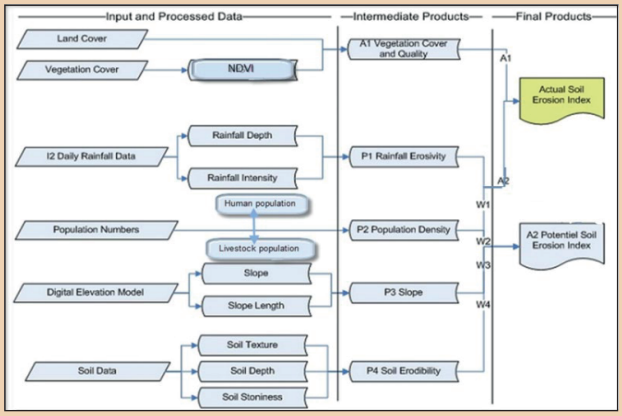
DRSRS's operations have greatly benefited from the GMES' Land Degradation Index maps, in identifying degraded areas. Prior to leveraging on these products, the institution incurred significant expenses, amounting to approximately Eight (8) million Kenya Shillings every financial year, on extensive fieldworks to capture ground data and socio-economic information. With the implementation of this program, the Directorate now efficiently utilizes

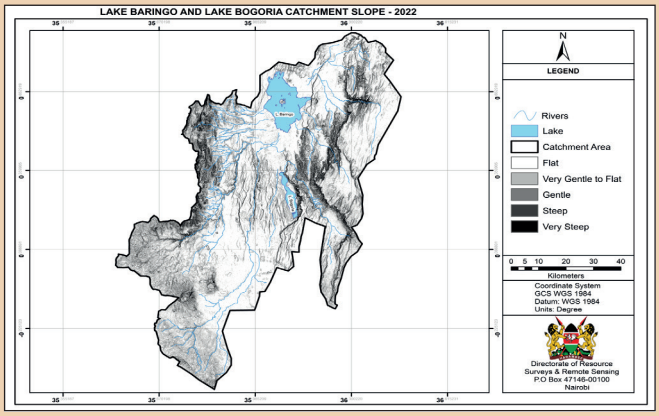
these resources, resulting in substantial cost savings and re-allocation to other needy sectors of the economy. These maps have also demonstrated high accuracy in pin pointing degraded areas, facilitating the planting of approximately 15B trees in the forty-seven Counties in Kenya.

LAND DEGRADATION MAPPING IN LAKE BARINGO & BOGORIA IN KENYA:

Besides the National tree-planting program, the **DRSRS** has been at the forefront in supporting the Government of Kenya, on formulation of policies on rehabilitation of degraded areas in selected catchments. Among the degradation hotspots in Kenya are Lake Baringo and Lake Bogoria catchment areas. Lake Baringo (130 km^2) is a freshwater lake while Lake Bogoria is a saline and alkaline lake. The lakes are important for biodiversity conservation, fishing, research and tourism. Both lakes are important stopover sites for migratory birds and have been designated as Ramsar Sites (wetlands of international importance). Lake Bogoria has the highest concentration of true geysers in Africa and a big population of flamingos making it a major tourist attraction. The Government of Kenya places these two lakes as major tourism sites greatly contributing to the Country's GDP.

Through utilization of the **RCMRD** satellite data supported by the **GMES & Africa** project, the DRSRS has effectively mapped these two catchments, with a view of disseminating information for planning, conservation sustainable management. The objective of the survey is to provide a status report on land degradation in Lake Baringo and Bogoria catchment areas. Both ground surveys methods and remote sensing techniques are used to generate data. Each of the five land degradation assessment inputs is given a weight of influence through Saaty Pair wise comparison. Pair wise comparison offers an objective yet simple way of developing weights for the various inputs of land degradation assessment (RCMRD 2022).





The weights are developed considering the pair-wise comparison of several stakeholders' opinion, or various research sources on land degradation inputs. A soil erosion susceptibility map was generated using the Africa Monitoring of Environment for Sustainable Development land degradation model based on the revised universal soil loss equation (RCMRD 2022). The revised universal soil loss equation model is an empirical model, which has been widely used to estimate potential soil erosion rates because of its easy integration with geospatial technologies and its low data requirements (Watene et al 2021). The model integrates five land degradation inputs; namely, vegetation index expressed as normalized difference vegetation index (NDVI), rainfall erositivity, slope factor (length and angle), soil erodibility and socio-economic factor (human and livestock population). The **DRSRS** has already published a report on this analysis, which acknowledges the support from **RCMRD** through the **GMES & Africa** Project. The report was officially handed over to the County Government of Baringo in Kenya for their planning.

OUTREACH AND SUSTAINABILITY:

The RCMRD has continuously engaged with the users of its products and services on a monthly basis. This involves gathering feedback through various channels, such as surveys, emails, direct consultations, and the RCMRD website help desk.

To further enhance awareness and outreach in the land degradation products, it has undertaken several impactful initiatives including Map competition, hosting the RCMRD International Conference, facilitating Regional Workshops, as well as engaging with the Governing Council and Conference of Ministers, and National Working Groups through seminars. RCMRD has also leveraged social media platforms and produced publicity materials to reach a wider audience.

A heightened level of interest has been witnessed from diverse stakeholders, including high-level decision-makers such as the Governing Council and Conference from the different countries in the RCMRD consortium. This increased engagement and feedback have allowed RCMRD to better understand and cater for evolving needs of its users and strengthen the delivery and impact of its products.

As a focal point agency, the Directorate has anchored the land degradation program in its annual performance contract(PC) for sustainability and continuation of the project. Additionally, through dissemination of geospatial data for sustainable development, the Directorate continues to support other line ministries in the land management and restoration sectors across the Country. The Directorate has developed a geoportal, through which information on land degradation is accessed by stakeholders and key Ministries. Other platforms used for dissemination of the data is through public events, environmental days and workshops conducted by the office of Chief of Staff and Head of the Public Service, that is domiciled at the Executive Office of the President.