

RCMRD NEWS

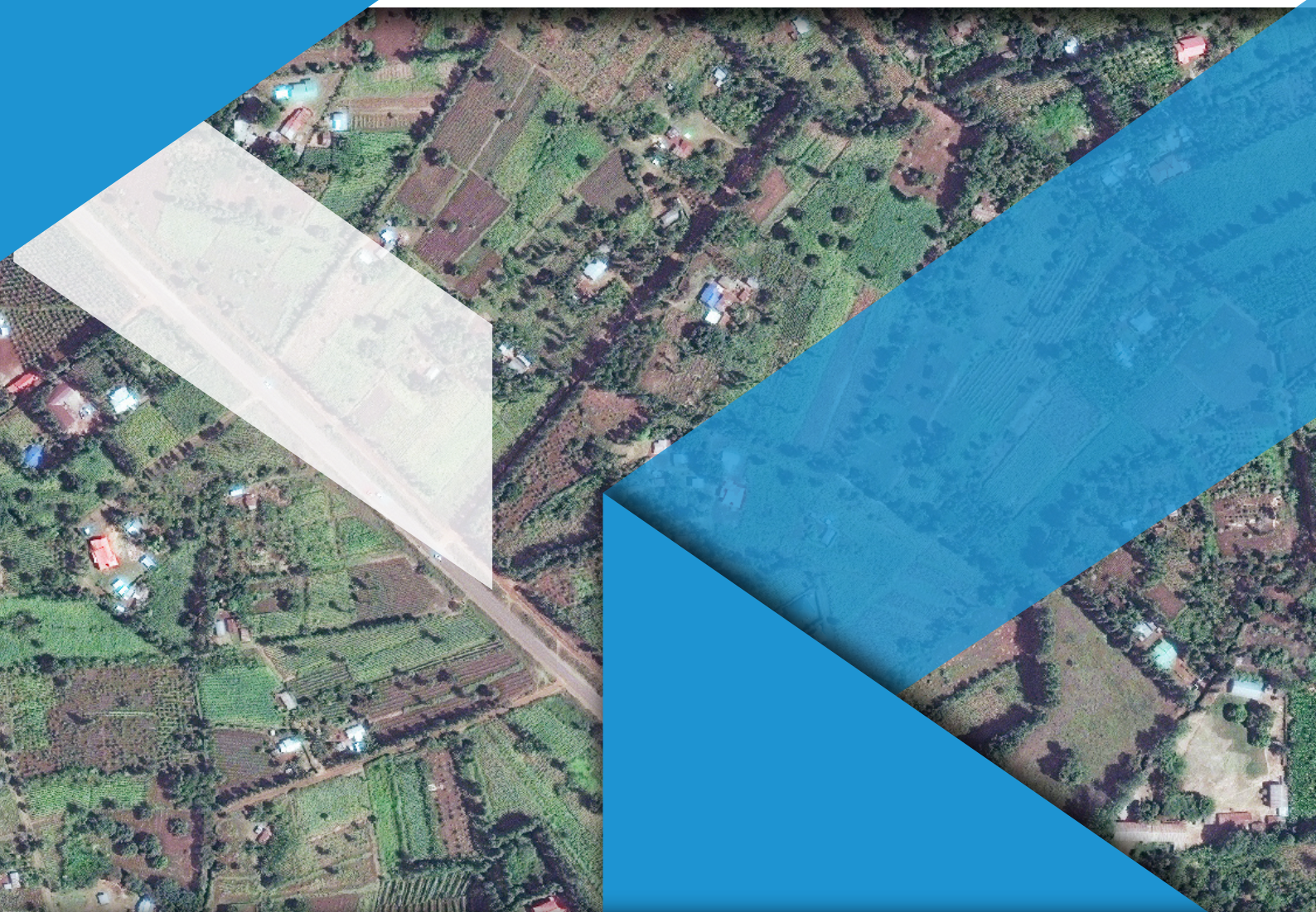
Jan-Oct 2017

Issue No. 17



RCMRD

**Regional Centre for Mapping
of Resources for Development**



>>Inside This Issue



EASTERN AFRICA FOREST OBSERVATORY (OFESA)



**HAZARD RISK ASSESSMENT, PARTICIPATORY
HAZARD ATLASES**



**RANGELAND ASSESSMENT AND
MONITORING IN PUNT LAND, SOMALIA**

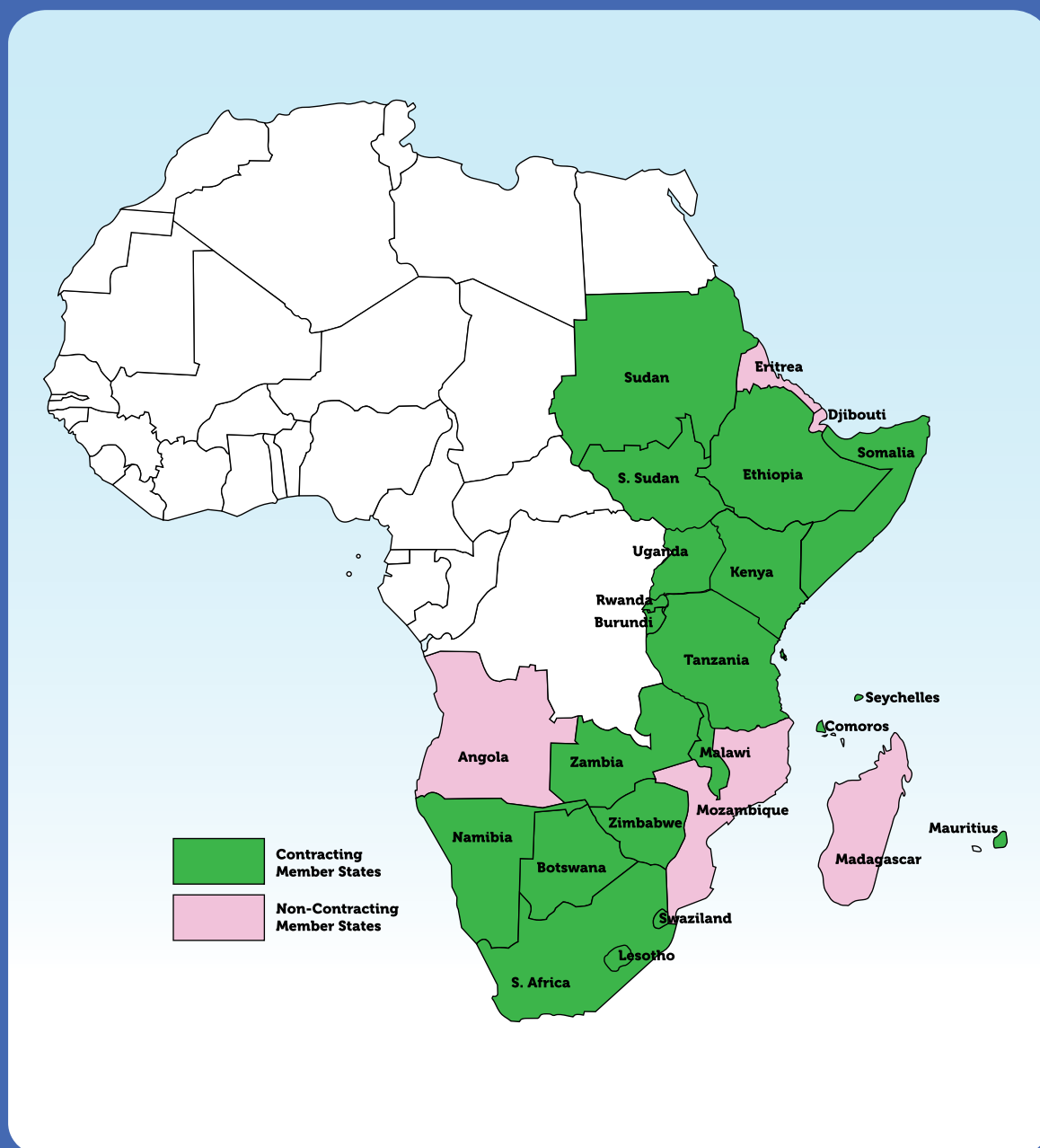


RCMRD

Our Vision

To be a premier Centre of excellence in the provision of geo-information for sustainable development in the member States and beyond.

Member States



DIRECTOR GENERAL'S NOTE



Dr. Emmanuel Nkurunziza
Director General RCMRD

Welcome to our Newsletter issue number 17 which highlights major activities undertaken by the Centre in year 2017. This year is particularly an exciting one for me as it marks the beginning of my tenure as the Director General of the Centre. It was an honour and pleasure that the Centre's Governing Council placed its trust in me to take over the mantle of managing this great institution for the next few years. I am also grateful to my predecessor Dr. Hussein Farah for smoothly handing over a healthy institution

and for his generous facilitation in my integration process.

As ever, we are extremely grateful to our Member States and partners whose support enables us to achieve some of the important things we highlight in this newsletter. 2017 has seen the Centre continue to live up to its vision of being Premier Centre of Excellence in geo-information services. As will be seen in the newsletter highlights, over the year, the Centre continued to be at the forefront of developing geo-information products, applications and services that were delivered to member States and beyond through project implementation, advisory services, training and other forms of capacity building. Please go through the pages of this newsletter to get a taster of what is coming in our 2017 Annual Report that will also be availed to you at the beginning of 2018.

We want to appreciate those of you we crossed paths with during our visits

to the member States in the course of execution of the 2017 work plan and more especially those who visited the Centre either for training, meetings or courtesy calls. This year we received many important visitors from our member states and we want to reiterate that it is always a pleasure and honour to host you at your Centre – you are always welcome. This year we hosted the first ever RCMRD international conference on space science and it was a pleasure seeing many participants and presenters from our member States and partner organisations. We want also to appreciate the hospitality accorded to us whenever we visit our Member states – you always make us feel at home.

Finally I wish to thank all our staff at RCMRD for their commitment and hard work that has enabled us to successfully implement all our activities as set out at the beginning of this year.

EASTERN AFRICA FOREST OBSERVATORY (OFESA)

This project is being implemented by RCMRD and partners; Center for International Forestry Research ("CIFOR") and Centre de coopération internationale en recherche agronomique pour le développement ("CIRAD"). The overall objective of Eastern Africa forest observatory (OFESA) is to strengthen existing institutions and networks in the tropical regions in their capacity to report on their mitigation actions in the forest sector in the context of REDD+ (Reducing Emissions from Deforestation and Degradation in developing countries). At the same time, OFESA will also contribute in the assessment of adaptation/biodiversity benefits of forest coverage and sustainable forest management, for policy makers to use in their policy and strategy development.



Effects of deforestation

This project supports the Eastern Africa forest observatory objective of strengthening regional forest observatories in East Africa and will provide a platform for sharing, exchanging and accessing data and information related to regional forests

and reducing emissions from deforestation and forest degradation (REDD+). The 'regional forest observatory' will comprise two core modules: a regional database containing information relevant for the monitoring of regional forest cover change and for reporting in the context of reducing emissions from REDD+ and a website that will make the database accessible and serve as the main interface of the regional forest observatory. The project is being implemented in Kenya, Uganda, Tanzania and Mozambique with target users being Forest, Environment, Biodiversity and Wildlife Institutions



A man using chainsaw to cut down a tree

The OFESA project is a pilot and will come to an end in April 2018 after running for 15 months. Currently the Centre has implemented 85% of what is required and after the pilot is over there will be plans to scale up the Observatory to have more countries in the Eastern Africa region as well as do a State of Forest report after every two years



HAZARD RISK ASSESSMENT, PARTICIPATORY HAZARD ATLASES

Since 2015, RCMRD has been executing a project on Hazard Risk Assessment and Hazard Atlases preparation for six Counties in Kenya on behalf of the National Drought Management Authority (NDMA) and UNDP. The project had two phases. The first phase covered Turkana, Tana River and Garissa Counties whereas Baringo, Kilifi and Kwale Counties were included in the second phase. The objectives of the Hazard Atlas preparation at county level were to assess the extent and spatial distribution of natural and manmade hazards

presented in the form of maps and Atlases in such a way that the communities and county governments can use them for planning and decision making purpose. More specifically RCMRD will help:

- Develop county multi-hazard and vulnerability maps using GIS techniques
- Preparation of Hazard and Climate Risk Atlas for each country
- Facilitate community participation in hot spots identification and mapping process
- Prepare training manual for the analysis of the output

maps and the Atlas

- Facilitate the training for target technical experts in the select counties on how to apply the information on the map for planning and budgeting.
- Develop Interactive maps for the website

Participatory mapping was one of the approaches where the community participated in the identification of hotspots and ranking of the severity of hazards at sub-county level. All the stakeholders including the community participated in the process and contributed a lot.



Stakeholders during validation workshops



Major hazard types identified in different counties include: drought, land degradation, resources conflict, human and livestock conflict, seismic hazards, human diseases, livestock diseases, crop disease, climate change and vulnerability.

In addition to the identification of the hazards in each county, different

mitigation measures and related activities are also thoroughly discussed. Before final production of the atlas, there were validation workshops to engender ownership of outputs by stakeholders. Further the stakeholders were trained in such a way that they could utilize the Atlases accordingly. The training included issues like

how to interpret the hazard Atlases, how to map the hazards, and how to update the information from time to time. More than 30 trainees in each County participated as well as non-government organization. Some Counties have already started using the products for the County Integrated Development Planning.



Handing over of the Atlases to NDMA officials

RANGELAND ASSESSMENT AND MONITORING IN PUNT LAND, SOMALIA

RCMRD was awarded a project on Rangeland Monitoring Assessment and Mapping using remotely sensed data by Care International. Satellite images of 1988, 2000, 2010 and 2017 were acquired and used to depict the trend of Rangelands in Puntland. The objectives of the project was to: analyse the current situation of the Puntland Grazing valleys and ecosystems, look at the opportunity to maintain rangeland productivity, rehabilitate degraded areas, protection and restoration

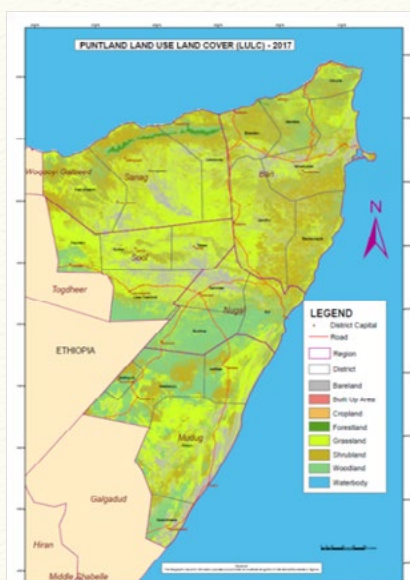
of valuable endangered and distinct species, explore the future role of grazing reserve in provision of feed for livestock based on the carrying capacities through sustainable utilization of the rangelands, strengthen the capacities of the Ministry of Environment, Wildlife and Tourism (MoEWT) and other related institutions to collect, analyse, update and manage the needed information on Rangeland management and develop a database of Puntland Rangeland resources and prepare maps.

The implementation of the project was through a participatory approach involving members of staff from the Puntland, Ministry of Environment, Wildlife and Tourism who were trained on the use of remotely sensed data for rangeland data collection and image interpretation. Further, they gained knowledge on the use of GPS and mobile GIS during ground truthing which was held in Garowe, Puntland. Based on the ground truth data, multi-epoch images processed and interpreted, the trend

of the rangeland indicated decrease in the coverage area and that the croplands, settlements and bare areas are on the increase. The most affected areas are forests and woodland areas. The main causes of these trends are related to human population increase as well as livestock population growth as well as change in climatic conditions.



Participants during the training session



Puntland Land use land cover map

LULC	Area in Hectares			
	1988	2000	2010	2017
Bareland	1,057,707.18	2,619,856.62	2,474,397.18	3,448,116.36
Built Up Area	1,328.40	1,784.43	6,034.23	8,733.69
Cropland	1,312.29	1,342.98	3,545.19	4,349.79
Forestland	524,894.94	465,327.36	226,454.04	118,232.10
Grassland	5,630,563.44	8,099,223.93	6,503,465.52	9,525,064.41
Shrubland	10,198,505.25	8,305,659.18	10,159,748.55	6,587,723.97
Waterbody	37,969.74	40,168.98	40,445.01	41,431.50
Woodland	7,134,676.65	5,053,594.41	5,172,868.17	4,853,306.07
TOTAL	24,586,957.89	24,586,957.89	24,586,957.89	24,586,957.89

Type of Rangeland	Area in Hectares			
	1988	2000	2010	2017
Forestland	524,894.94	465,327.36	226,454.04	118,232.10
Grassland	5,630,563.44	8,099,223.93	6,503,465.52	9,525,064.41
Shrubland	10,198,505.25	8,305,659.18	10,159,748.55	6,587,723.97
Woodland	7,134,676.65	5,053,594.41	5,172,868.17	4,853,306.07
Total Rangeland	23488640.28	21,923,804.88	22,062,536.28	21,084,326.55

2018 MALAWI CENSUS MAPPING PROJECT

The 2018 Malawi Census Mapping project that was being implemented by the Regional Centre for Mapping of Resources (RCMRD) with Survey Malawi Ltd as local partners came to a close at the end of August 2017. The project began in July 2016 and ran for a period of 14 Months. We are happy to report that all the scheduled deliverables were achieved in time. The overall aim of the mapping exercise was to update the geographic frame which the National Statistics Office (NSO) uses for all its data collection activities. However, the main and crucial task was to demarcate the country and come up with up-to-date and accurate Enumeration Area (EA) maps for census enumeration that is due in June 2018.

Specifically, the mapping exercise sought to accomplish the following objectives:

- To acquire high resolution satellite images (50 cm) that would be used as backdrop during the mapping exercise.
- To generate a dwelling frame (DF) database which will be used in census and other surveys to easily identify households.
- To update EA boundaries in time for the 2018 Census enumeration

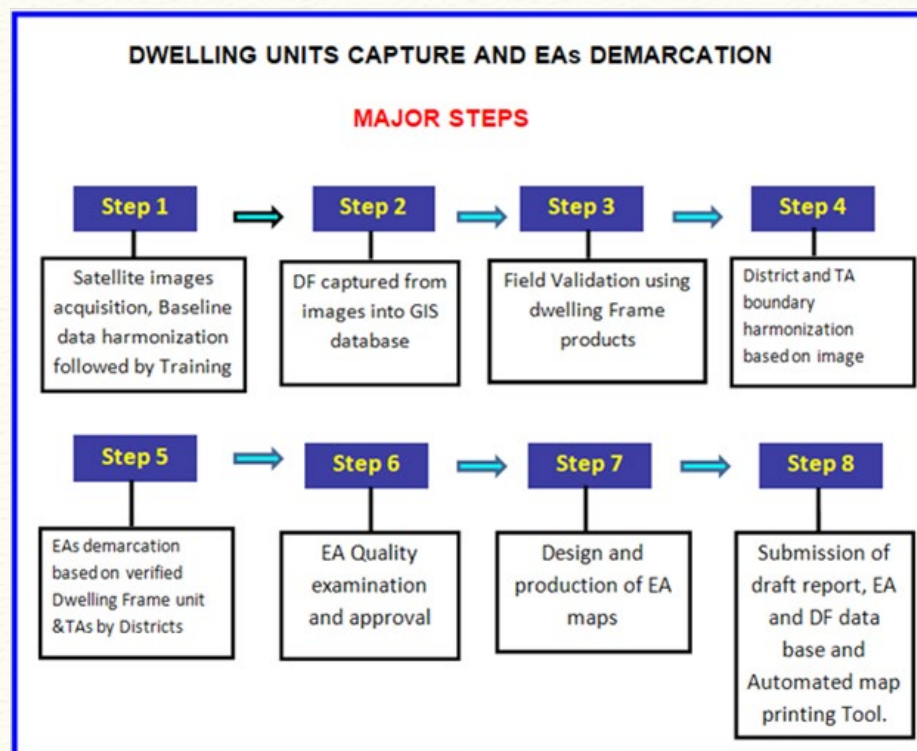
- To produce a range of map products including EA maps which will be used during 2018 Census enumeration and subsequent surveys by the NSO.

- To set up GIS, IT, and human resource infrastructure to be able to support 2018 Census enumeration activities through provision of various geography related services.

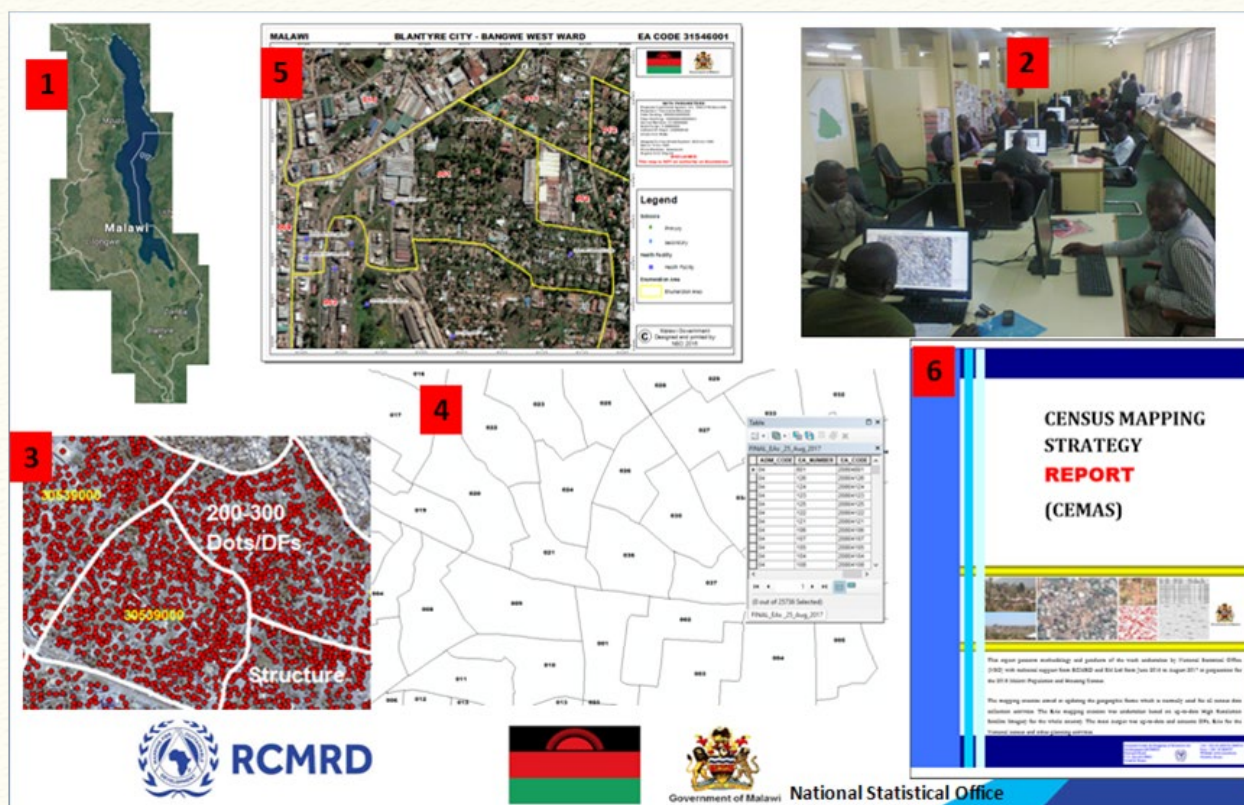
- To Come up with credible Census Mapping strategy (CeMaS) document which will form a basis for future mapping endeavors as reference for various methodologies, terminology and standards pertaining to 2018 Census mapping.

The figure below is a summarized methodology that was applied in order to achieve the above objectives.

Based on the above methodology, the project delivered the following; up-to-date satellite images covering the whole country, updated administrative boundaries (District and Traditional Authority), a Dwelling Frame database for the whole country, a new enumeration Area database for 2018 census; Customized automated map production script that generated over 27,000 EA maps and capacity building of eighteen (18) NSO staff in GIS applications for census mapping using high resolution images. Below are image clips of some of the deliverables as listed above:-



Summarized project methodology



1. satellite images 2. Capacity building of 18 NSO staff 3. A Dwelling Frame database 4. A new enumeration Area database 5. Over 27,800 Printed EA Maps 6. A credible Census Mapping strategy (CeMaS) document.

The final project handover meeting was held in August 2017, where the Draft CEMAS Document was handed over to the Commissioner

of statistics and the final stakeholder meeting was held in October 2017 as a final project deliverable where the final copies of the Census Mapping Strategy Document were handed over to the National Statistical Office.

RCMRD SUPPORT TO TANZANIA'S WATER RESOURCES INTEGRATION DEVELOPMENT INITIATIVE (WARIDI) PROJECT

Climate variability and change in the Wami-Ruvu and Rufiji basins is likely to significantly alter the availability and quality of surface and ground water resources. Both basins are under increasing pressure from a range of climate and non-climate drivers of vulnerability. On the demand side, human consumption, irrigated agriculture, livestock, industry and other uses have

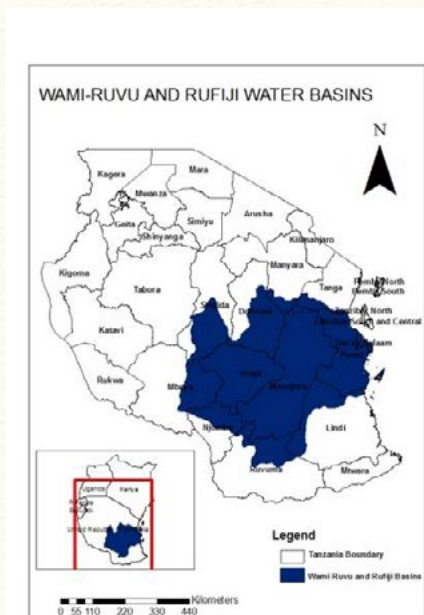
grown significantly in the two basins and are projected to increase well beyond sustainable use in both Wami-Ruvu and Rufiji. On the supply side, several water resources studies conducted in the basins identify increasing uncertainty of rainfall onset, duration, distribution and amount, increasing temperatures, lower recharge/water tables and sea level rise as having negative impacts on water

quality and quantity for environmental, human and productive uses. Altered and decreasing landscape capacity to counterbalance these pressures, largely driven by land cover and land use change, wetland loss and desertification in arid landscapes, is leading to unsustainable water resources – meaning there is insufficient water flows for current levels of use. Water Resources Integration

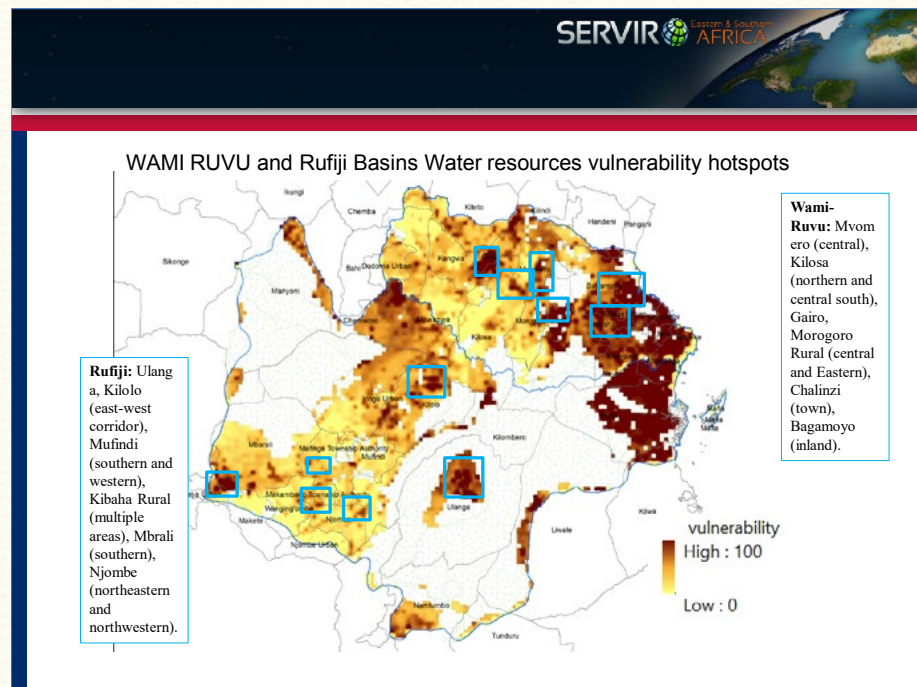
Development Initiative (WARIDI) is supporting Integrated Water Resources Management (IWRM) to improve conservation and

Rufiji and Wami-Ruvu basins. Through this initiative, a comprehensive analysis of climate change vulnerability in the two basins is being

develop spatial vulnerability indices (and constituent indices for exposure, sensitivity, and adaptive capacity). A total of eighteen



A locational map of the project area



A baseline climate vulnerability hotspot map for water resources in Rufiji and Wami-Ruvu basins

sustainable management of water resources and improve human and environmental systems' resilience in the face of these challenges.

RCMRD through the SERVIR ESA project is working with WARIDI; together with key stakeholders; Planning for Resilience in East Africa through Policy, Adaptation, Research and Economic Development (PREPARED), Tanzania Meteorological Agency (TMA), Famine Early Warning Systems Network (FEWSNET) and ICAD ClimatePrediction and Applications Centre (ICPAC) to assess climate change vulnerability and identify adaptation options in the

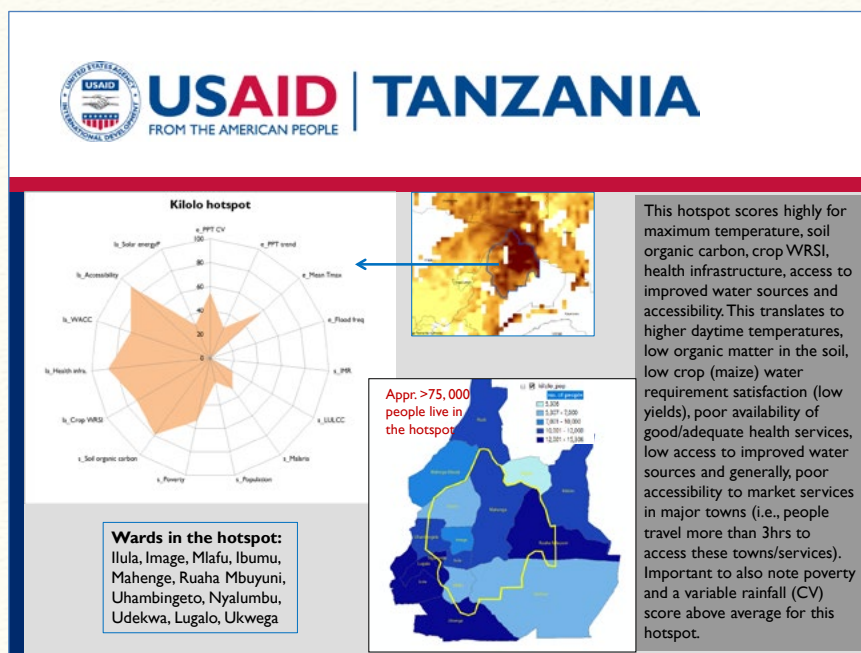
conducted together with the key stakeholders through a series of trainings and co-development of products of climate vulnerability maps. So far, three (3) product co-development workshops have been implemented: The first data management workshop was held on in March 2017 in Dar es Salaam, Tanzania. The objective of this workshop was to provide a comprehensive training on framework, data and methods utilized to develop a spatial climate change vulnerability index utilizing the spatial index approach. Data sets and potential indicators were assembled, processed and transformed in order to

(18) participants drawn from key governmental agencies, non-governmental agencies, research institutions and private agencies successfully completed the training.

The second workshop was held in April 2017 in Morogoro, Tanzania with the objective of developing a series of community climate change vulnerability hotspot maps using data collected by national agencies after the 1st data management training workshop. The preliminary maps produced from the workshop formed part of the deliverables required by WARIDI to target their activities in 20 districts in the 2 basins. Further,

these maps were used in a stakeholder's expert meeting that was held in May 2017 and was intended to come up with possible adaptation interventions for different water user groups in the two basins.

The third workshop was held in Nashera Hotel, Morogoro in June 2017. A total of twenty (20) participants attended from different key governmental agencies, non-governmental agencies, research institutions and private agencies that successfully completed the training. This final workshop was successful in creating maps for the different sectors; Communities, Water, and Agriculture and Food Security.



These images show the contributions of the different indicators to the overall vulnerability and consequently, the locations (wards) in the hotspots with their corresponding population

STRENGTHENING PHOTOGRAMMETRY PROCESSES IN RCMRD'S MEMBER STATES TO MATCH TECHNOLOGICAL ADVANCEMENT IN SPACE SCIENCE AND LINK PLANNING AND INFRASTRUCTURAL DEVELOPMENT

The practice in Photogrammetry today bears very little semblance to that of the formative years of the 20th century. While basic mathematical principals remain wholly unchanged, implementation and applications for production purposes have radically undergone changes to suit the demands of the day. Photogrammetry equations formally in matrix form and embodied in precise analog solutions are now programs within the general purpose

computers with automation options. Image acquisition that formally relied on film camera are now obtainable from a variety of platforms ranging from hand held non-metric cameras to drones and high resolution satellites. The laborious image/photographs orientations and physical measurements of positions (Ground Control Points and Tie Points) in analog instruments and to some extent analytical plotters during the process of Aerial Triangulation have been significantly reduced

by directly importing the Ground Control Points (GDPs), Exterior Orientation Parameters into the system together with the digital images. A provision of performing automatic or interactive tie Points measurements has drastically reduced the operator's time per point and therefore the whole process.

Though Photogrammetry has many applications directly touching human lives, such as in Biomedicines,

Manufacturing, Architecture, Forensic studies, Projectiles and in the entertainment industry, the primary application of photogrammetry and especially on the African continent is mapping. Technological advancement in space science and the computing tools have created two brands of Photogrammetrist; the older experienced lot and the new and upcoming lot with limited experience. The older lot has more experience in analog processes and less experience in digital photogrammetry while the new ones have limited knowledge in both analog and digital. As revealed in the needs assessment survey conducted by RCMRD in 2016 in member States, technology transfer from the older generation to the upcoming Photogrammetrist is not effective leading to data and information seekers reverting to private institutions.

National Mapping Agencies (NMA's) adhere to strict accuracies and standard map specifications which are generally missing in private institutions. Most platforms provide images in digital format. Due to inadequate capacity in the digital photogrammetry, some NMAs utilize images that have not undergone rigorous transformations by orthorectification thus affecting the overall quality of map products, with features extracted from these images

not matching the existing maps making map updating a difficult undertaking. Photogrammetry still remains the most authoritative data acquisition and processing tool for large scale map production and updating. For this reason RCMRD recommits to assist NMAs in member States in technology transfer as well as upgrade their capacity to utilize the latest technology in digital photogrammetry tools and process.

Positive changes in space technology that member states are not utilizing due to the reasons given above include the utilization of High Resolution Stereo Satellites data that covers large extents of the earth with little ground control requirements. High Resolution satellite images nowadays are up to 30cm and rival aerial photography. RCMRD and AIRBUS have a Memorandum of Understanding that allows the former to buy satellite images at a discounted rate for its Member states. Another area not exploited by member States is the use of drones. Drones have the capability of gathering geospatial data quickly and especially along corridor lines. It is the most ideal for small projects or corridor mapping of linear features such as roads, railway lines and canals. They are also useful in gathering data for forest inventories and in 3D city modeling for geo-

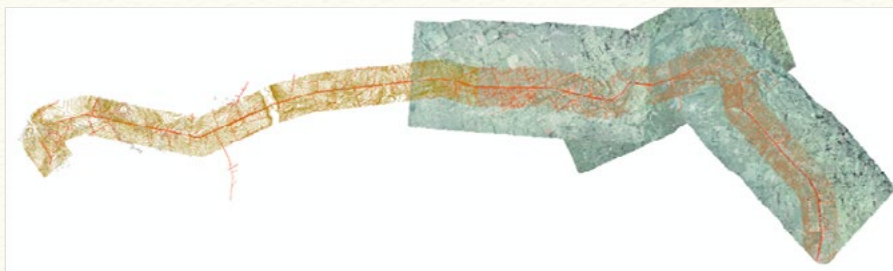
marketing and smart city models. Forensic studies following an accident or crime is an upcoming area of application for the drones or close range photogrammetry. It is in the interest of RCMRD and its member states to vouch for a collaborative partnership that will assist the Member states build capacity in Digital Mapping through training in latest technology and also in implementation of projects. RCMRD has strong in-house Photogrammetry expertise and a network of collaborative partners who can be identified to provide additional services in the area of Photogrammetry should the need arise.

Photogrammetry services currently available at the Centre include, but not limited to Image selection for an area of interest, Identification of suitable GCP locations on the image and on the ground, Aerial Triangulation for satellite and aerial photographs, Generation and correction of DTMs, Orthorectification, Database development and Features extractions. We offer advisory on Photogrammetry systems and we can assist in procurement and installation of such systems, we assist in projects implementation and capacity building in digital Photogrammetry. Between 2012 and 2014, RCMRD with the partnership of Kenya Institute of Survey and Mapping (KISM) and

JICA run an annual course utilizing JAXA satellites images for Topographic map production. A total of 42 personnel from East and South Africa were trained.

RCMRD is interested to know if there are any challenges that are limiting the utilization of the acquired experience. JAXA is no longer providing the PRISM image mode that was used in the training but the principles are largely the same. The 2016 needs assessment was the first step

into formulating a strategy to capacitate Member states in Photogrammetry and digital mapping but member States should also call for help as RCMRD is their Centre



Mapping a road Corridor using aerial photographs

DRONE USE IN AFRICA – EXPERIENCES AND CHALLENGES

An Unmanned Aircraft/ Aerial Systems (UAS), is simply an aircraft without a human pilot onboard rather controlled by an operator on the ground. UAS commonly referred to as a drone is increasingly gaining traction the world over. This is mainly as a result of its wide range of applications ranging from military to civilian applications in videography, situation monitoring and mapping among others. Justification for its wide range of applications derives from benefits that the technology brings with its agility, ease of assembly and use, increased availability at a lower cost compared to manned aircraft systems, flexibility for use of different camera types and the development in processing applications particularly for mapping applications.



Drones in use



In mapping, UAS technology has played a key role either to substitute or complement the traditional aerial photography. Over the years, research in UAS mapping technology has been used to map smart cities, mapping of forest structure and estimation of biomass, cadastral surveys and has even been proposed by the county of Nairobi to manage parking spaces for effective revenue collection among other applications. Around Africa, countries such as Rwanda are using UAVs to deliver health supplies to centers around the country making access fast and affordable; Tanzania have used these unmanned aerial vehicles for animal conservation in preventing human-animal conflicts, and for wetland monitoring and mapping through the GlobE Wetland Project for East Africa; and In South Africa, the Hluhluwe-Imfolozi Park in KwaZulu-Natal in 2014 reported a 90 per cent drop in poaching of rhinos after unmanned aircraft started streaming live videos of the area.

Despite all these interesting applications that the technology can be used to achieve, there has been a setback in relation to laws and regulations meant to govern the use of UAS technology. Most countries around the world have had

a challenge in formulating and implementing these laws. Current civil aviation regulations in most countries do not provide for registration, certification and operation of UAS hence leading to restriction of UAS use and to some extents a complete ban on its application as evidenced in Kenya. However, among those countries in Africa that have drafted drone regulations or are in the process of doing so include; Botswana, Rwanda, Kenya, Zambia, Zimbabwe, South Africa, Nigeria, Madagascar, Namibia and Ivory Coast.

A lack of updated legislation has caused a setback on the progress of development projects set to employ this technology. Such projects had been targeted for environmental conservation and management such as monitoring of wildlife in Tanzanian parks have been thwarted (data shows the country is losing an average 30 elephants a day, or nearly 11,000 a year); the OlPejeta Conservancy in Kenya reported that its anti-poaching UAV project had been delayed by a ban on private sector use of UAVs; while Rwanda in 2008 opposed the use of UAVs by the UN for security surveillance in Eastern Congo due to security concerns. Security concerns have been the major reason

for African Nations restricting use of UAS. However, there are other reasons for such delays which include: the limited certified UAS training for users; protection of radio frequencies from UAV communications interference; and generally the insufficient/ lack of a regulatory framework to govern UAS use.

In light of all these challenges, some African countries are making deliberate efforts to maximize on UAS use. Nonetheless, more efforts are required in order to achieve efficiency through collaboration with relevant stakeholders in drafting legislations governing use of UAVs in the various countries; relevant organizations and stakeholders need to come up with certified training and licensing programs for operation and use of UAVs. With regards to technological advancement, most governments around Africa need to take a step forward to be fully equipped technologically in order to be at the fore front in use of UAVs; and International humanitarian organizations and institutions should help lobby for the use of UAVs in African countries.

LANDSCAPE RESTORATION

Governments have responsibility to measure, monitor and conserve their natural resources. In the case of Rwanda this responsibility is charged to the Rwanda Natural Resources Authority (RNRA) now split into three independent agencies; Rwanda Land Management and Use Authority (RLMUA), Rwanda Water and Forest Authority (RWFA) and Rwanda Mining Board (RMB). With the interlinkage between the mandates of Rwanda Land Management and Use Authority (RLMUA) and Rwanda Water and Forest Authority (RWFA) overlapping, with RMLUA being responsible for Land use Management of the entire country at national and sub-national levels and RWFA managing the forest and water resources in the country.

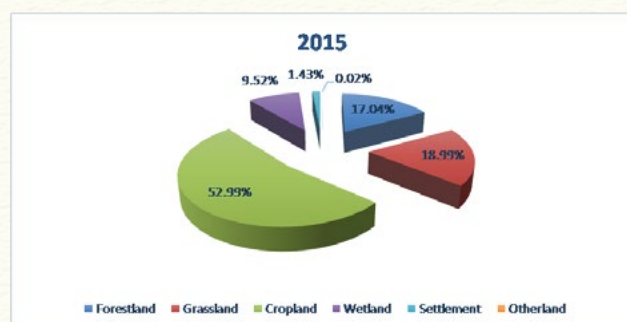
RCMRD's linkage to RNRA has been long lasting

from our initial project of "Land Cover Mapping for Green House Gases (GHG) Inventories" that developed the much useful land cover data for three epochs for the country: 1990, 2000 and 2010 at the same time building capacity for some of the government officials. Through this initial activity and the benefits realized for utility of these datasets in natural capital accounting, RCMRD was funded through World Bank to update the 2015 data for Rwanda. This project was implemented in partnership with the RNRA staff, with their engagement at all phases of the project to its dissemination and official hand over for public use.

The availability of 4 epochs of data brought into light the magnitude of deforestation that has occurred from 1990 to 2015. In earlier times (1990's), the use of remote sensing data in

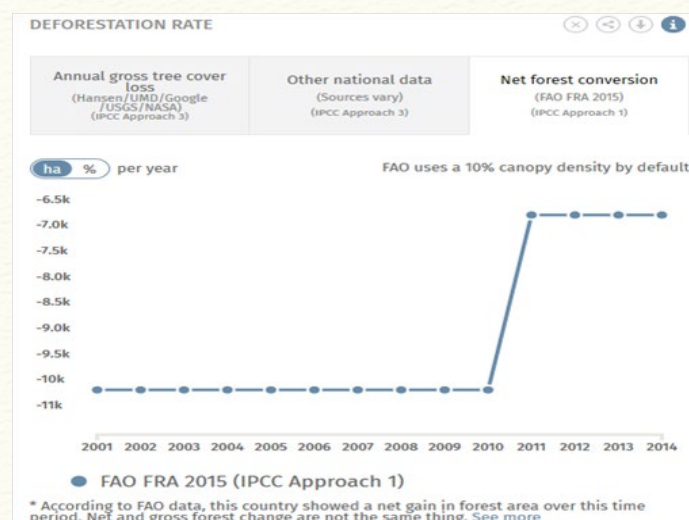
landscape monitoring was not as deeply entrenched in government institutions as it is now. This has become much more realistic now because of open data access to fine resolution data such as Landsat and Sentinel, much more refined classification algorithms for classification of heterogeneous landscape, lower cost for computing infrastructure and software. Advanced education for government officials not just in Rwanda but in the East Africa region as a whole is required.

Looking at the statistics between 1990 and 2015 we noticed that Forest cover has dropped from 43.34 % of the total national area to 17.04% in the year 2015. This was stable for the next 10 years and further deforestation occurred between 2010 and 2015 from 29% to 17%.



Land_Cover	1990	2000	2010	2015
Forestland	43.34%	29.77%	29.15%	17.04%
Grassland	21.07%	15.99%	15.74%	18.99%
Cropland	24.61%	44.40%	44.02%	52.99%
Wetland	10.39%	9.25%	10.17%	9.52%
Settlement	0.46%	0.55%	0.83%	1.43%
Otherland	0.14%	0.05%	0.10%	0.02%
Total	100%	100%	100%	100%

Our findings for this have been corroborated by the data of UN FAO (United Nation Food and Agriculture Organization) FRA (Forest Resource Assessment) for 2015 and GFW (Global Forest Watch) that reported 10% rate of degradation between 2010 and 2015.

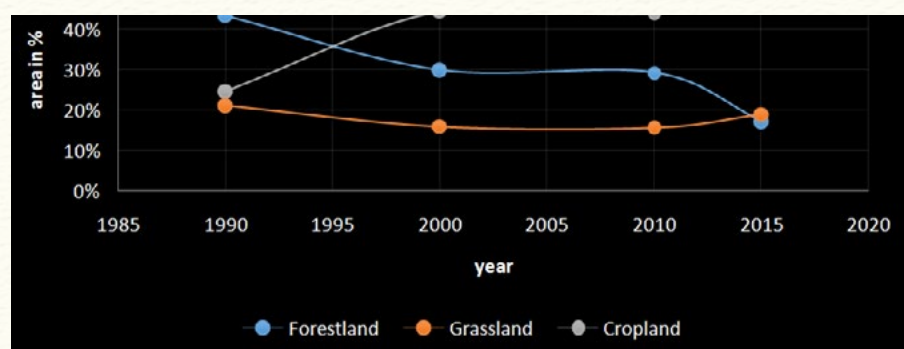


Ref: <http://climate.globalforestwatch.org/countries/RWA>

These land cover changes have mostly been due to anthropogenic causes attributed to increasing population demands for more land resources for urban areas and housing and more agricultural lands to increase food production. This is notable with the 9% increase in cropland area over the same time period.

Population Statistics between 1990 and 2015

Time	Population
1990	7.23M
2000	8.0M
2010	10.2M
2015	11.6M



Source: World Bank

Land use conversions if left uncontrolled can lead to a lot of land and climate-related issues. Given Rwanda's hilly landscape, increased vegetation clearing means that the risks for landslides and potential floods are increased; ground water recharge is reduced; and forest ecosystem services are threatened. This calls upon conservation measures to be

put in place to either protect what is left and maintain it at status quo to avoid further loss or putting restoration measures in areas that are greatly affected.

The land cover data provided so far provides a good basis for this restoration measures to be considered. The spatial nature of this data makes it easier to implement

targeted solutions. The community involvement in making these interventions realistic is quite critical. The community has to be educated in understanding why further deforestation needs to be controlled and in this way they can become champions of restorations measure and even get involved in reforestation and conservation of their own

community forests.

RCMRD has been engaging in consultations with partners on the ground and is looking forward to partner with International Union for Conservation of Nature (IUCN) to see forth the feasibility of developing an integrated decision support system that shall utilize numerous datasets to flag out high land slide potential sites, highly degraded and deforested areas and recommend these to RWFA for reforestation. Partners such as IUCN and WRI (World Resources Institute) have already made some considerable strides to address some of the issues and our efforts shall be complimentary.

This directly responds to the country's commitment to the Bonn Challenge, where the country aspires to undertake forest landscape restoration to 2 million hectares by 2020. Two million may seem like a small number if you compare it to large countries but for a country the size of Rwanda this is almost 100% the country size and by far the largest commitment made by any country. Strategically, agroforestry is an opportune priority in achieving this target because it enables them to continuously provide for the demanding population needs but at the same time restore the landscapes. The Kigali Declaration on "Forest Landscape Restoration in Africa" in 2016 further

affirms this commitment. A commitment that responds to the Sustainable Development Goals (SDG) 15 to combat desertification and improve the natural capital of the country for rural and urban communities alike.

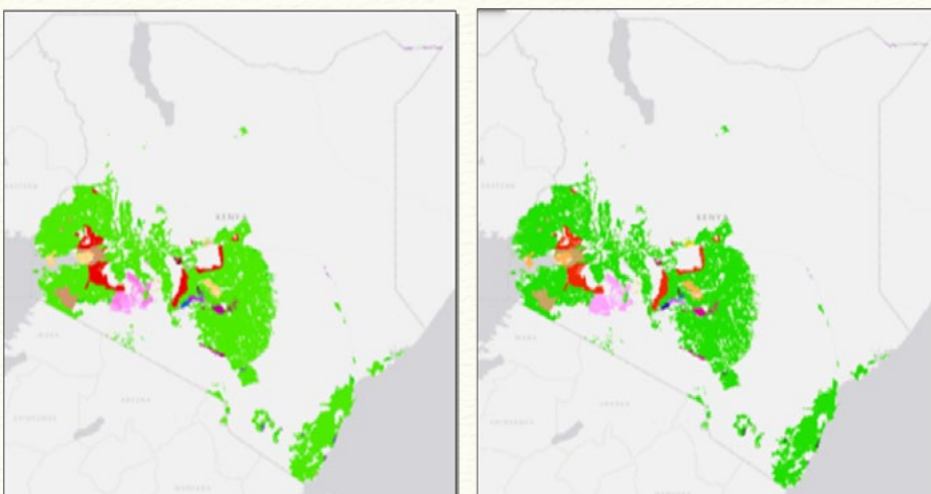
In a bid to strengthen government institutions and more specifically RWFA, we shall additionally be offering more capacity building to bridge gaps noted from the Institute Capacity Assessment for some key stakeholders done mid this year (2017). This shall be done at basic and advanced levels.

AGRICULTURE AND FOOD SECURITY

Climate variability coupled with over-reliance on rain-fed agricultural production on already strained land that is facing degradation and declining soil fertility; highly impacts food security in the Greater Horn of Africa region. Through a series of stakeholder consultations and needs assessments with key partners, RCMRD through SERVIR ESA Project has identified needs and requirements in this thematic area and developed tailor-made solutions to meet these needs. Below is a summary

of the services provided in this area including the key partners engaged:

Mapping of cropland in Kenya



Wall-to-wall cropland maps (2000 and 2015) for Kenya

A consultation carried out in October 2015 in Uganda with key USAID partners Famine Early Warning Network (FEWSNET) revealed the need for an updated crop mask since they were currently using an outdated herbaceous cover map as an input to their food security assessments. RCMRD developed cropland maps for two epochs (2000, 2015) in close consultations with FEWSNET in the period 2016-2017. A technical training was conducted this year to build the capacity of key stakeholders in the agricultural sector with the technical skills for developing cropland and computing change. The completed maps which provide information on major and minor crops being grown and if rain-fed or irrigation system was being used, are freely available to download from RCMRD's geoportal (<http://geoportal.rcmrd.org/>). The maps have been used to compute agricultural statistics on request by request of State Department of Agriculture (SDA), in 2017 to identify the cropland extent in Kenya. These maps will inform food security assessments and support FEWSNET's water balance modelling.

SERVIR ESA is also implementing the Regional Hydrological Extreme Assessment System (RHEAS) with support from NASA Science Coordination



RHEAS viewer. Runoff product

Office (SCO). RHEAS combine a hydrological and a yield model to provide drought indicators and yield estimates that can be assessed at sub regional levels with a provision of confidence levels. Once calibrated, the outputs will inform food security assessments with yield metrics feeding into the crop monitors and other food security assessments.

Support of Crop insurance program

The government of Kenya has implemented a crop insurance program to shield farmers from the unpredictable climate by providing payouts during incidences of crop failure. However, the implementation of the program is facing various challenges such as lack of reliable yield trends at sub county levels and lack of a cost-effective sampling frame that can be implemented to identify farms to be sampled for

yield assessment. The State Department of Agriculture (SDA) was using a tedious, costly and time consuming method of listing all farmers within a Unit Area of Insurance (UAI) at sub county level. These challenges were identified during a stakeholder's engagement that was conducted in collaboration with the implementing partners.

SERVIR-ESA together with University of Maryland (UMD) State Department of Agriculture (SDA) successfully developed the methodology and piloted the sampling frame in Nakuru County. The Kenya National Bureau of Statistics (KNBS) approved the sampling frame and with the cost cutting benefit (from approximately USD 10,000 to USD 3,000 to sample a county since they no longer need to enumerate farmers), created the demand for expansion of the sampling frame to the 20 counties where SDA is implementing the crop insurance program.

Rangeland assessment and monitoring system

The Northern Rangelands Trust (NRT) which is a group of conservancies focused on better rangelands management expressed the need for a system to assess degradation and monitoring of restoration efforts in the rangelands in North and Eastern Kenya. Stakeholder consultations in Kenya identified low productivity in both the rangelands and croplands as the main challenge which is further aggravated by climatic conditions such as droughts and floods coupled with unpredictable rainfall patterns and changing temperatures.

To meet this need, a rangeland assessment and monitoring system was developed. As part of this system, potential land degradation maps were developed and field validation data was collected. SERVIR ESA also developed the methodology for assessing vegetation productivity indices from Modis NDVI and created long term vegetation productivity maps. NRT stakeholders agreed that these maps were useful to identify areas with declining or improving vegetation conditions. The way forward was to develop near-real time and seasonal products that can be interpreted by non-GIS users for decision making. In addition, a



Rangelands in Kenya, Source: NRT.

rangelands web tool will be developed to ensure that users are able to understand indicators available such as the Vegetation Condition Index, standardized and absolute anomaly maps and NDVI, combined with other relevant datasets (surface water, invasive species, towns, land use and change maps) to produce a map at their desired administrative level that they can interpret for decision making. Surface water maps will also be developed as an input to the web based tool using Google Earth Engine (GEE) platform.

Further stakeholder engagements will be done in FY 2017/18 to assess the needs of other key players in the rangelands and factor in their needs in the development and implementation of the service. These include other potential users of the service such as National Drought Management Authority (NDMA), Kenya Wildlife Service, Mpala Research Centre (MRC), CETRAD, ILRI, PREG partners, County governments, NDMA county officers, Grazing coordinators,

Conservancy managers, local conservation groups, Ranch owners and managers and local communities.

The Frost Mapping and Forecasting

The Frost Mapping and Forecasting service is an initiative that was started with the aim of generating frost information from Earth Observation (EO) data and sharing it with its stakeholders and users in order to reduce frost related losses. However, even though various products were developed to this effect, their uptake was not at the level that was expected. In addition, the challenges and gaps that the stakeholders were experiencing in using these products had not been determined.

Kenya is the third primary producer of black tea in the world, 10% of the Kenyan population depends on the tea industry and tea contributes 4% of the country's GDP (FAO, 2016). Frost is one of the most critical agricultural problem tea farmers face today, generating massive economic losses in the

sector. The development of a frost monitoring system commenced with a focus on the Kenyan Highlands as per the request of the Tea Research Foundation of Kenya (TRFK) and in collaboration with the Kenya Meteorological Department (KMD). Over time SERVIR-ESA has developed the service to not only include daily maps of frost occurrences but to also provide 72hrs frost forecasts. Frost Mapping and forecasting aims to bridge the gap by providing timely actionable information on impending frost occurrence to enhance preparedness of the stakeholders and to kick start prevention/ mitigation measures in the prone areas. A recent evaluation shows that an average smallholder can lose approximately \$200 each year in a frost event, but a 72hr frost warning system will provide enough notice to take preventive measures and reduce losses by \$80 annually. Such measures include picking tea ahead

of schedule, pruning, or warm water irrigation. In addition, these products have generated interest by crop insurance corporations on the potential of generating a frost index to be used to create insurance packages for farmers in case of losses related to frost. Daily frost maps are generated from MODIS Land surface temperature, and the frost forecasting component is based on atmospheric variables obtained from the Weather Research and Forecasting model (WRF). Both products are disseminated to users through email and through the web.

RCMRD through SERVIR ESA project also developed a mobile application for data collection on frost occurrences and capacity building of stakeholders in the use of the app for data collection was done in December 2016. However, with the need to clearly understand the needs

of the stakeholders and specifically how they can apply the maps in specific decision making processes, RCMRD will conduct stakeholder engagements to further refine the service and ensure that the frost products are being utilized by stakeholders. SERVIR ESA has signed an MOU with Kenya Meteorological Services (KMD) and will continue engaging them and building their capacity in frost forecasting, with plans to have KMD disseminate the frost products once the service is fully developed and accuracy assessments have been conducted.

RCMRD conducted a stakeholder engagement and mapping workshop for stakeholders in the tea value chain from the 24th to 26th July, 2017 in Nakuru, Kenya. The workshop was attended by participants from Kenya Meteorological Department (KMD), Kenya Tea Development Agency (KTDA), ACRE Africa, Royal Media Services, KASS FM, Community Based Organization (CBO) representative from Kericho, Tea Research Institute (TRI), and other private multinationals such as Nandi Tea Estate Limited, Eastern Produce of Kenya (EPK), and SIREET Outgrowers Empowerment and Producer Company among other stakeholders.



Tea farmers demonstrate skiving technique to Dr. Robert Mbeche



The engagement workshop conducted for stakeholders working in the tea value chain attracted participation from government, insurance, and private institutions as well as community based organizations (CBOs).

The aim of this workshop was three fold; First, to list, map, and determine specific stakeholders for the project that RCMRD should engage with for better success of the service. Second, to determine the decision making context, both within each institution and between two or more institutions, on issues related to frost, and on the nature of information that would be required to support their decisions. Finally, to identify gaps, data requirements and challenges in interpreting or using EO data and geospatial technologies such as those embedded in the developed frost products.

Outcomes from this workshop showed that more impact in this project will be realized when RCMRD works towards improving the capacity of specific stakeholders (KMD, KTDA and TRI) on developing frost products, collecting and analyzing relevant

data, interpreting and sharing of frost information and products. In addition, RCMRD needs to leverage on existing capacity building efforts that are conducted by these organizations to inform and train users (tea farmers) on how to use upcoming technologies. It was also identified that there was a big gap in the flow of climate information from the source (i.e KMD or TRI) to the users and vice versa as well as in packaging the same information in an easy to understand manner. Custodianship of various types of data collected and observed in the tea value chain was also a contentious issue that came up during the meeting. These observations and conclusions are supported by the stakeholder engagement and mapping report that was generated after the meeting. Moving forward, RCMRD will use these outcomes to plan on future of the frost mapping

and forecasting service. This workshop provided a classic view of how to change a research based project to a user centric project where needs that have been raised by key stakeholders are addressed.



RCMRD has installed a Wireless Sensor Network at Tea Research Institute for validation of satellite data

RCMRD SPACE CHALLENGE 2017

RCMRD in collaboration with partners namely Global Learning and Observation to Benefit the Environment (GLOBE), TAHMO, 4-H Kenya, Kenya Meteorological Department (KMD), Kenya National Commission for UNESCO, Ministry of Education, Kenya Forest Service (KFS), Ministry of Defense (MOD), CANIS-UON and Esri Eastern Africa organized the RCMRD Space Challenge 2017. This was meant to equip students from secondary and primary schools within Kenya and beyond with the necessary skills and awareness in relation to environmental degradation, climate change and its drivers. Furthermore, this contributes to the achievement of Sustainable Development Goals (SDGs), developing the youth in Science, Technology, Engineering and Math (STEM) and ultimately contributing to capacity building of the youth with the objective of promoting sustainable development.

The challenge will help in building resilience to climate change among the youthful generation in our society, and also influence behavior change with regards to climate related issues.

The inception workshop held at RCMRD in April 2017. This workshop was meant to equip the teachers from participating schools with the necessary skills in training the students in preparation for the first phase of the challenge. This initiative is meant to run for three years under the theme of land degradation. At the inception workshop the students were given two months to prepare for the Space Challenge and submit a Space Challenge Report.

The RCMRD Space Challenge 2017 Awards Ceremony was held in July 2017 at the RCMRD premises in Nairobi, Kenya. In total, seven schools participated in the challenge with representation of ten (10) students each namely;

Nyandarua High school, Homa Bay High School, Thome Boys High School, St. Scholastica Catholic Primary School, Nasokol Girls, Moi Forces Academy Lanet and Moi Forces Academy Nairobi. In addition, there were two visiting schools invited namely Murema primary school and Mathare Old Primary School with two students from each. The event had 63 students and 13 teachers.

Nasokol Girls School located at Kishaunet in West Pokot County (Kenya) was declared the winner of the 2017 maiden RCMRD Space Challenge followed by St. Scholastica Catholic Primary School in Nairobi while Moi Forces Academy came in third. RCMRD Director Technical Services congratulated the participants and urged the students to utilize the knowledge acquired to address challenges related to climate change. Moreover, he said the space challenge is part of the RCMRD



RCMRD Space Challenge 2017 participants including teachers, students, judges and RCMRD partners

strategy on engaging the youth within the 20 member States. RCMRD has plans to conduct a similar challenge in Tanzania and then replicate it in our other member States. RCMRD Space Challenge will be held annually in Kenya in collaboration with partners. RCMRD will join 4-H Kenya alongside other partners such as GLOBE and TAHMO in outreach activities on Science, Technology, Engineering and Math (STEM) and agriculture.



Prof. John Kiema, Director of Technical Services presents the RCMRD 2017 Space Challenge Award to the Winners- Nasokol Girls School from West Pokot county

NEW PARTNERSHIP WILL HELP IMPROVE WEATHER AND CLIMATE IN EASTERN AND SOUTHERN AFRICA

RCMRD collaborated with Trans-African Hydro-Meteorological Observatory (TAHMO) on improvement of hydro-meteorological services. Crop productivity and food security in Africa pivot on the weather. However, African hydro-meteorological data are virtually non-existent, and crop failures and disease outbreaks are frequent. Furthermore, there is nearly no basis for the determination of how the African climate is changing. Thus, the partnership with TAHMO will help improve the hydro-meteorological services in RCMRD member States and beyond.

In addition, the partnership included collaboration in activities like the RCMRD Space challenge where the

TAHMO program is deploying automatic Weather Stations in schools in Africa, the RCMRD international space challenge that is a three-year programme. The challenge begun in April 2017 in collaboration with TAHMO, GLOBE (Global Learning and Observation to Benefit the Environment) Kenya and 4-H Kenya and will run until 2019. TAHMO was able to set up automatic weather station (AWS) at RCMRD on 24th July 2017. Furthermore, this collaboration will help some universities obtain automatic weather stations from TAHMO such as Ardhi University (Tanzania), Dedan Kimathi University of Technology (Kenya), Moi university (Kenya) and Jaramog Oginga Odinga University of Science and Technology (Kenya). The

automatic weather stations from TAHMO can be viewed using this link:

<https://school2school.net/>.

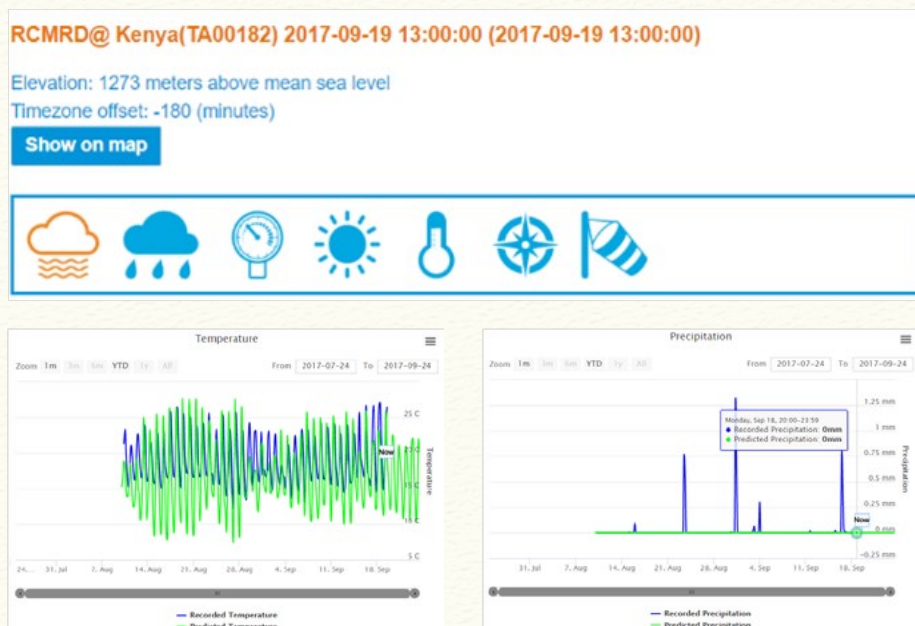
The RCMRD AWS can be viewed

<https://school2school.net/station/?siteCode=TA00182>.





The data from RCMRD AWS is visualized as shown below:



DEVELOPMENT IN TRAINING TECHNOLOGY

Sentinel Data Processing and Analysis Training, Kampala, Uganda, June 2017

There has been the need to update land cover maps in the Eastern and Southern Africa region. However, high resolution remote sensing data is expensive and this has made it difficult to access. There have been developments in free and open remote sensing data such as sentinel data from the Sentinel program. Sentinel is a joint effort of European Space Agency and European Commission to replace and continue existing older earth observation missions ensuring no data gaps on global monitoring of environment and security. It has a series of missions where Sentinel-1 and Sentinel-2 missions launched in 2014 and

2015 respectively, focus on various applications of land monitoring. The satellites in Sentinel mission acquire data in Synthetic Aperture Radar (SAR) mode while in Sentinel-2 mission data is acquired in Multispectral mode. The earth observation data in both modes provide different information complementing each other, for instance, SAR is less sensitive to weather conditions, so it substitutes multispectral data in cloud prone areas. Sentinel data are valuable resources for land monitoring and have proven applications for hydrology, vegetation, crop, and natural disasters. All data acquired by Sentinel program are available at no cost and have great potential to land cover mapping and environment monitoring in Eastern and Southern Africa region. The training on Sentinel data analysis tools

and techniques was meant to advance the capability of the professionals in RCMRD member States and its partners in the region.

The training was held in June 2017 in Kampala, Uganda, twenty (20) participants drawn from Busitema University, Makerere University, Food and Agricultural Organization, Uganda office, National Forestry Authority (NFA), Uganda Wildlife Authority, Climate Change Department (CCD), Ministry of Water and Environment, Uganda National Meteorological Authority (UNMA) and REDD+. The participants expressed interest in working with sentinel data in their organization and may require further support. Plans are underway to conduct a similar training in other RCMRD member States.



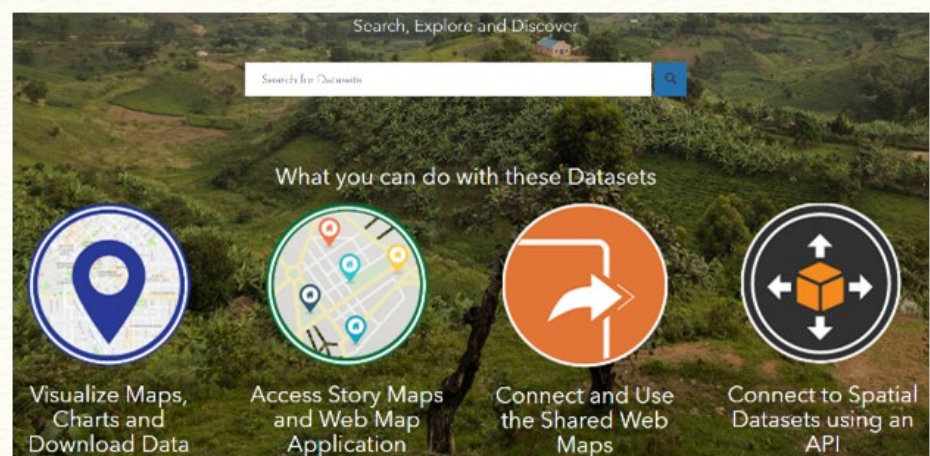
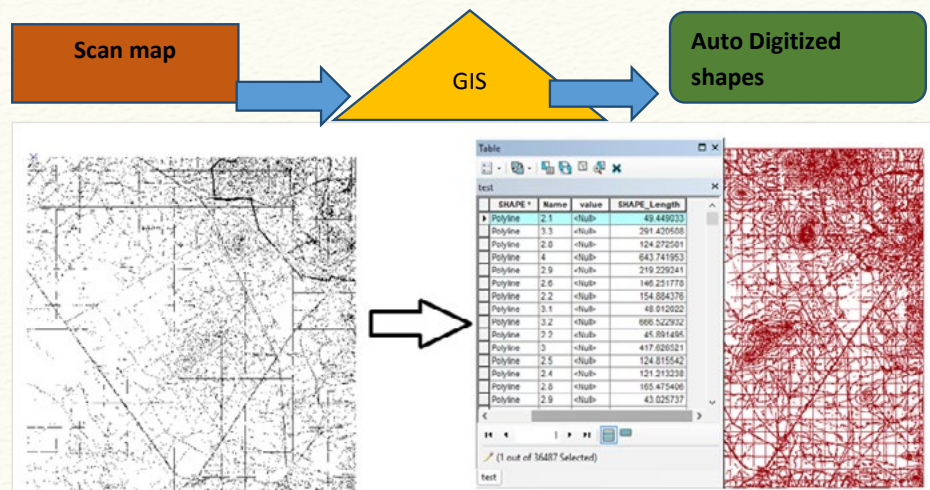
Group photo with participants group exercises

Development in new technology

Training in the use of geospatial softwares evolves rapidly with new algorithms being developed to process datasets in various fields. The new areas of interest on which training focused this year are:

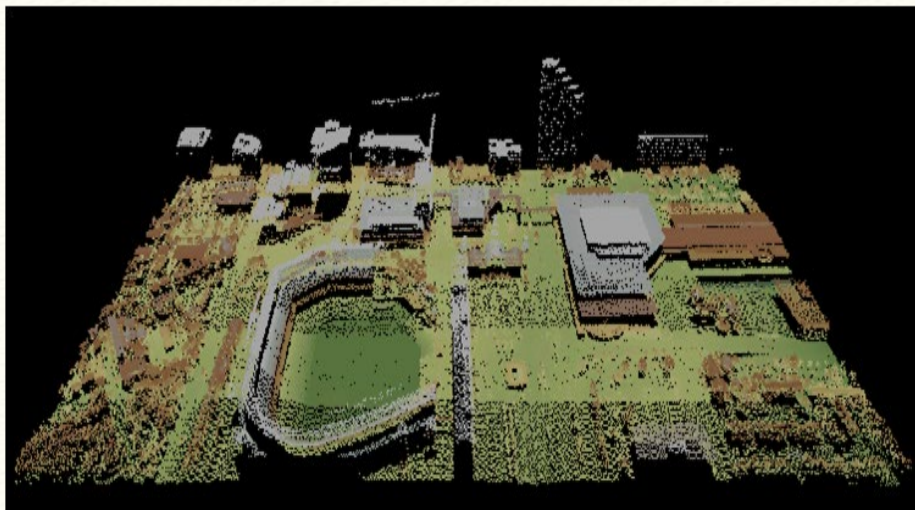
Auto vectorization of scanned maps

Use of auto digitization in map updating of scanned maps is an important new area in digitizing old scanned maps in most surveying and mapping organizations. The Arcscan tool in ArcGIS/ArcMap software works smoothly in delivering outline of the geometry shapes scanned. The operator then does merging and update of attributes as required. This is more efficient than digitizing every geometry of points, line and polygon which might be time consuming. The only requirement is good quality scanned maps, GIS software and skilled personnel in the use of the software.



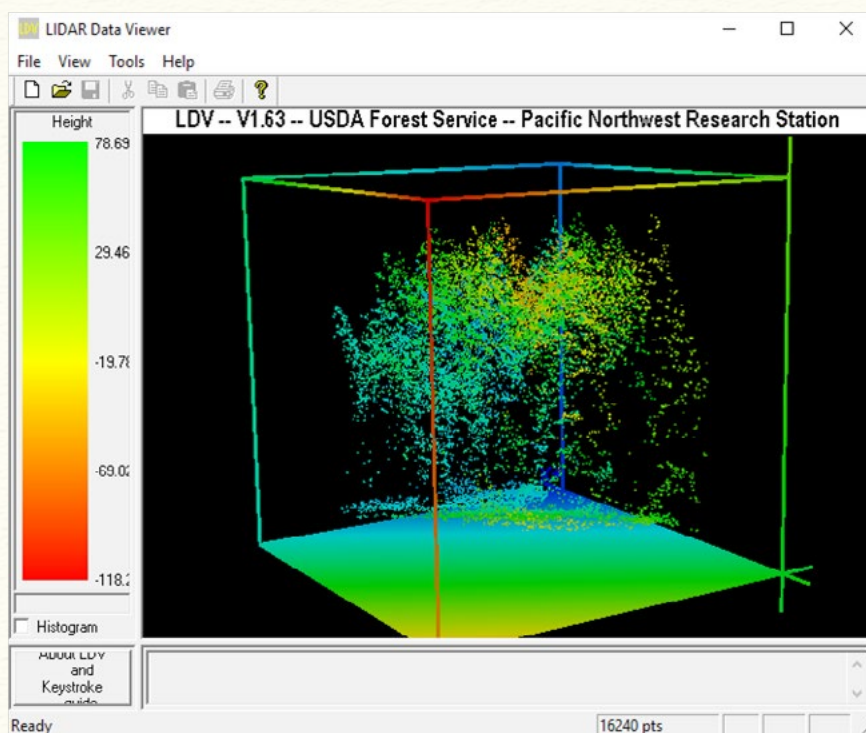
Process LIDAR with Open source software's

The training this year has also focused on processing of Lidar data using Open source soft wares such as Furgo and fusion. Through these soft wares, participants are able to generate 3D views of information and customize dimensions to best understand point cloud datasets.



Use of open source software in social land tenure

Use of open source software for mapping resources in various regions has been well piloted using QGIS and plug in of STDM. The project has been successfully piloted in some regions in Kenya. RCMRD through its partnerships with UNHABITAT, GLTN and others have conducted trainings to equip various stakeholders on this technology.



LEVERAGING OPEN WEATHER DATA FOR AGRICULTURE AND NUTRITION CHALLENGES IN AFRICA,

RCMRD and Global Open Data for Agriculture and Nutrition (GODAN) presented the need for enabling an effective use of open data in tackling food security and nutrition challenges

by building the capacity of potential stakeholders to both understand the potential of open data for agriculture and nutrition and to engage with it practically.

Access to Open data, and particularly weather related data, was identified as a key factor in transforming Agriculture and Nutrition by the G8 in 2013. GODAN Action brings together agriculture and nutrition specialists and open data

experts and will support GODAN in its mission by building people's capacity to engage with open data. GODAN is collaborating with RCMRD on this endeavor. RCMRD has an open data policy and all open data can be accessed here:

<http://opendata.rcmr.org/>.

The datasets include online maps, story maps and other datasets in agriculture, biodiversity, climate, disasters, ecosystems, weather, and water.



RCMRD and partners at the AMCOMET AFRICA hydromet Forum 2017 in Addis Ababa Ethiopia, September 2017

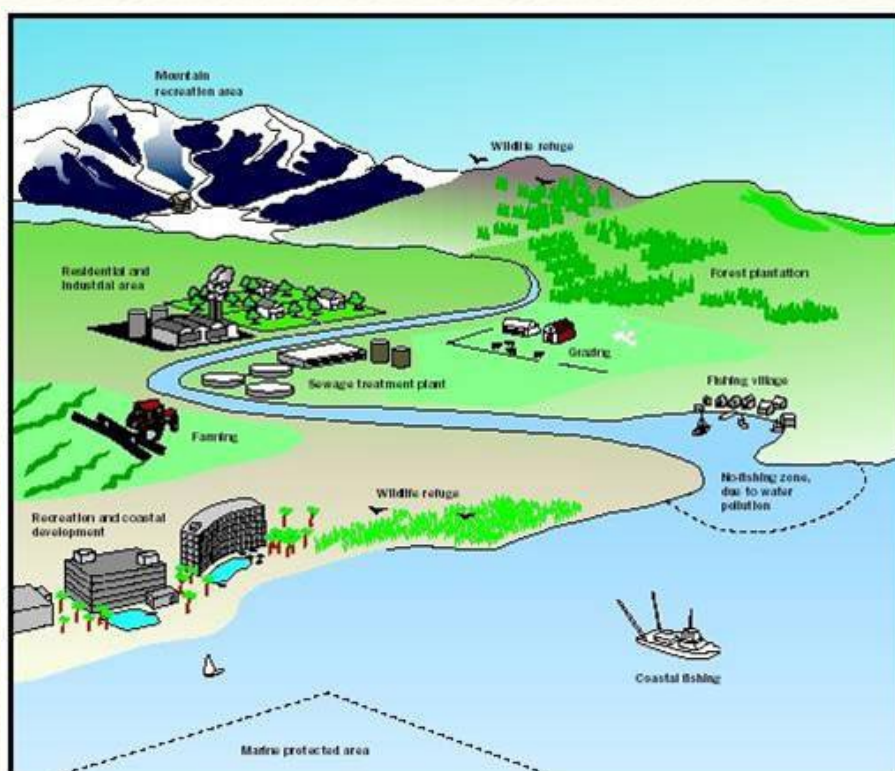
IMPERATIVE TO DEVELOP EFFECTIVE LAND ADMINISTRATION SYSTEMS

By Dr. Nkurunziza

Centrality of Land

The importance of land to mankind's very existence cannot be overemphasized; it is indeed unmatched by anything natural or man-made. This is manifested in various facets including its economic value, social-cultural value, political and even spiritual. Land as a factor of production is of immense importance – everything that we use can ultimately be traced to land – often referred to as the original source of all material wealth. When it comes to social cultural value of land, this is even more pronounced on our continent where customary land ownership holds sway and land is the key factor in the construction of social identity, the organization of

religious life and the production/reproduction of culture. Politically, land is the crucial basis of sovereignty as the reach of each nation's sphere of influence is marked by a delimitation on land or earth's surface.



Virtually all activities essential for man's survival take place on the earth's surface

Besides the indisputable importance, land is also very peculiar in several respects – as a free gift of nature, limited in area (finite), land is permanently Indestructible, lacks geographical mobility, infinite variety etc.

A closer look at the land situation on the African continent shows even greater importance of this resource:

- Importance of land to our populations and economies is even greater than the general global situation, with the majority of our population still deriving their livelihood directly from land (estimated at 60% although in some of our Member States it goes as high as 90%). We are still grappling with issues of food security and access to other critical natural resources for basic survival;

- Agriculture is also still a substantial proportion of our countries' GDP (exceeds 25% in most Sub-Saharan African countries and goes well over 40% in some of our Member states).

- Many land issues persist – access, use and management remain problematic; in most countries less 10% of the land is in the purview of formal institutions, the tenure security deficit is overwhelming; lack of transparency in our land

administration systems resulting in corruption and land grabbing, elite capture; gender discrimination etc.

Land administration challenges

Despite the above noted centrality of land in our countries, development initiatives in many of them have not always reflected this reality. However, there is commendable trend that many African governments have begun to undertake the necessary reforms to enable more systematic consideration of land in national development policies. This has been reinforced by the SDGs in which 6 of the goals have significant land component.

While the land issue is multi-faceted, this article seeks to highlight the urgency of the imperative to develop effective land administration systems. As clearly articulated in the Africa Land Policy Framework and Guidelines (ALPFG), “for land to play a primary role in national and regional development in Africa, attention will need to be focused, as a matter of urgency on the state of land administration systems” (p.20). Two key elements of this are identified: the state of land rights delivery and the efficiency/efficacy of the laws, structures and institutions

for land governance. The first element covers processes of ascertainment/adjudication, demarcation, registration and documentation of land rights and systematic tracking of transactions in these rights. To put in order aspects of land rights delivery, inevitably there must be supportive reforms of laws, structures and institutions of land governance.

Estimates suggest that less than a quarter of the countries in the world maintain complete land administration systems. Therefore, in the overwhelming majority of cases, information about people and the land they use remains unrecorded and obscure to governments, firms or citizens, and reversely citizens, firms or governments cannot legally claim their land rights. This situation impedes all sorts of development activities: land tenure insecurity enables land grabbing and promotes land disputes; land value uncertainty impedes land markets and tax governance; land use and development activities for food security can neither be designed nor implemented properly.

Attempts to bridge the gap between the land administration in more developed and less

developed countries – the cadastral divide – has spun over more than half century but this has largely failed principally because of seeking to transplant western approaches on developing countries. There have been several attempts at reform of the land rights delivery processes in the past in many countries, including large scale titling initiatives, nationalization etc. These reforms have often remained on paper and hardly implemented in most cases and where attempted, results/outcomes are abysmal – especially with respect to the poor/disadvantaged. These failures were mainly due to approaches which were inappropriate to and inconsistent with context. There is need for alternatives that are grounded in legitimate and acceptable societal and institutional practices and customs.

New societal drivers including food security, rapid urbanization, climate change, and post-conflict redevelopment are driving the need for innovation in social and forms of inclusion in land administration systems. The democratization of information & communication technology as well as a growing number

of individual and community initiatives to record land rights in different manners, require new types of solutions and new ways to develop capacity

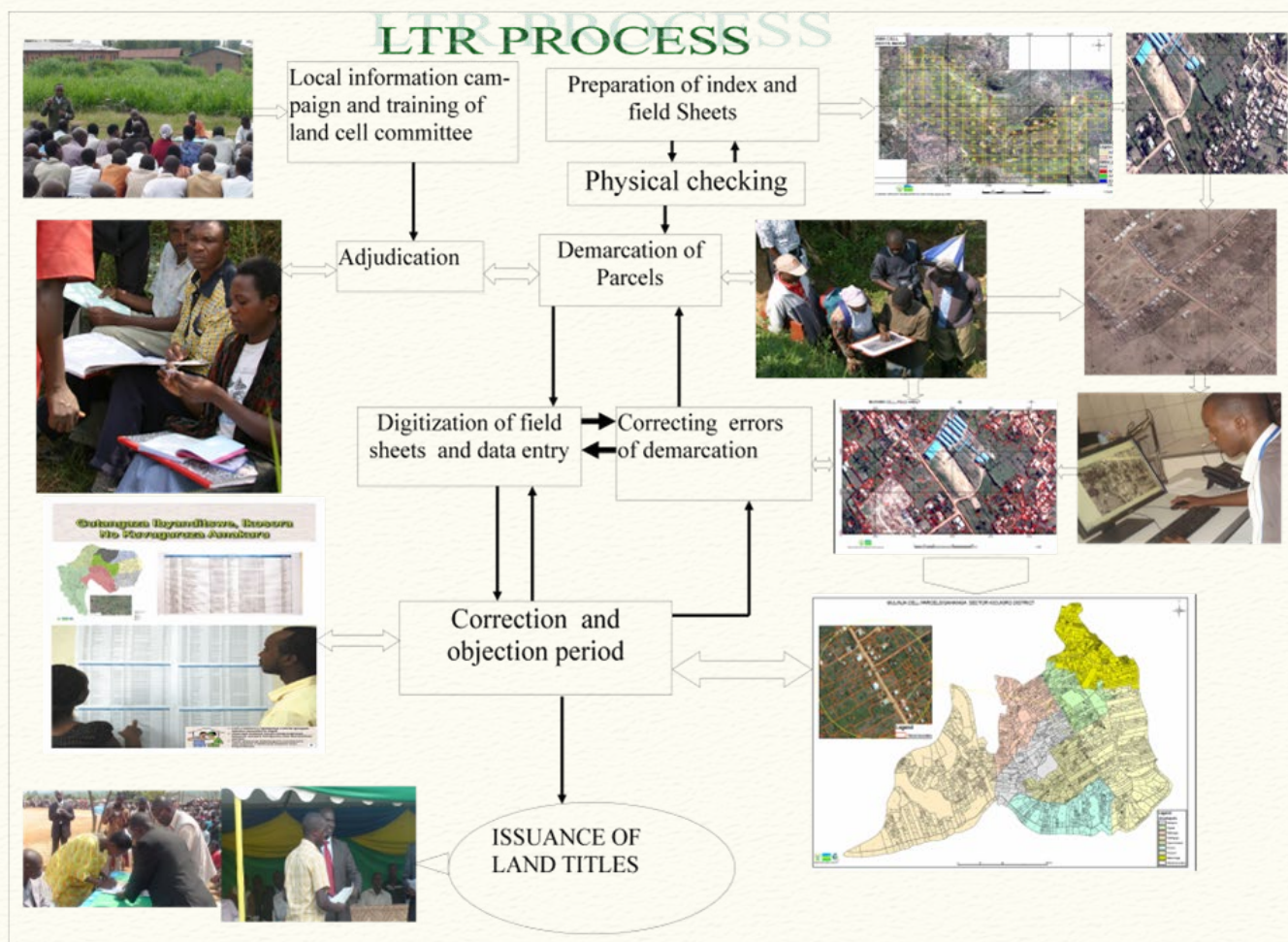
Latest Developments: Fit-for-Purpose Land Administration

Recent Ideas to change these approaches have coalesced into the ‘fit-for-purpose’ land administration solutions. The coining of these unconventional approaches as ‘fit-for-purpose’ has been spearheaded by institutions such as UN-Habitat, FIG and ITC. The terminology aside, these are approaches and practices largely developed by Africans, and implemented mainly on the African continent. Rwanda has gone furthest in using these approaches in ensuring all its land is demarcated, adjudicated and titled. Other countries where implementation is underway include Ethiopia and to some extent Kenya and Namibia while piloting is underway in Zambia and Malawi.

The fundamental characteristics that define fit-for-purpose land administration include: focusing on the purpose (e.g. tenure security, land use

control, revenue collection) instead of being driven by rigid standards and templates (often borrowed from developed countries); participatory, affordable, inclusive, flexible as well as upgradable. In essence it calls for adoption of pragmatic, flexible, context-appropriate and affordable processes and tools in land rights delivery with equally manageable and accommodative institutional / legal framework.

To develop an effective land administration, we urge the use of the fit-for-purpose approach by focusing on three key dimensions: a) **the legal framework** by ensuring secure land rights for all, gender equity as well as continuum of tenure; b) **the institutional framework** by harnessing improvements in ICT technologies for more efficient processes and c) **spatial framework** by moving away from obsession with precision surveying to using aerial imagery to capture general boundaries, participatory field adjudication and affordable IT solutions for registration and archiving.



Typical Fit-for-purpose process for using aerial photos and local community expertise to bring land under registered title – case of Rwanda.



Mapped parcels of land with unique identifiers

The screenshot displays a web application for land administration. The interface includes a top navigation bar with tabs like 'Book', 'Document Summary', 'Real Rights', 'Restrictions', 'Object Annotations', 'Add Parcel', 'Split', and 'Merge'. A search bar is present with the text 'Enter a URI to search'. The main content area is divided into several sections:

- Search Options:** Includes dropdowns for Province (Kigali City), District (GASABO), Sector (Kacyiru), and Cell (Kamukama). A 'Parcel No' field contains '1581'.
- Person Search:** Includes a 'Search type' dropdown (Name, ID) and a 'Person Type' dropdown (Natural, NonNaturalPerson).
- Parcel Details:** A form with fields for UPI (1/02/07/01/1581), Village (Batara), Right Type (EMPHY TEUTIC LEASE), Land Use (Guturu - Ubukaka bwite bw' Akare), and various document IDs.
- Parcel Extract Image for 1/02/07/01/1581:** A section for viewing the parcel's image.
- Real Rights (1):** A table listing real rights with columns for Full Name, Representative, Share Numerator, and Share Denominator. The entry shows 'LETA MINAGRI' as the representative.
- Object Annotations - Under Dispute (0):** A section for object annotations.
- Parcel List:** A list of parcels with columns for Parcel ID and DocID.

Screen shot of electronic land register

The Role of RCMRD in promoting fit-for-purpose land administration

The success of fit-for-purpose approaches hinges on the adoption of rapidly improving geo-information and earth observation technologies. Methodologies for capture, processing and storage of earth observations have advanced leaps and bounds, making them not only easier to use but also affordable. As a premier centre of excellence in geo-information development and use, RCMRD is at the forefront of these developments, including access to high resolution

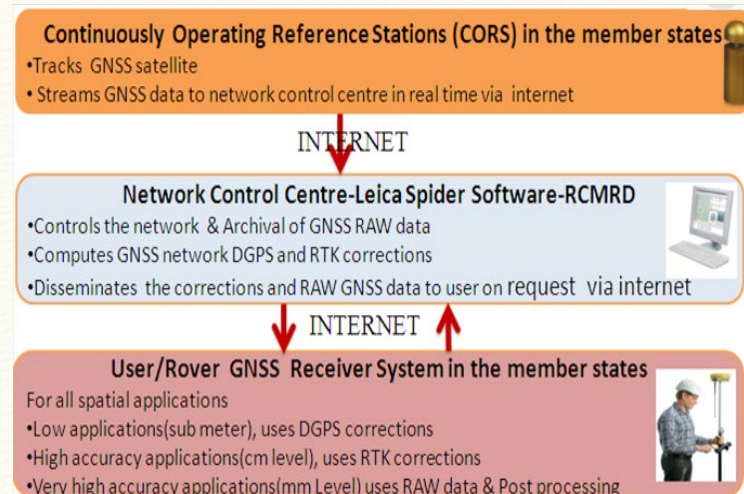
satellite imagery, testing new approaches to parcel demarcation as well as developing appropriate land information systems. Besides in-house capabilities, RCMRD is at the centre of a network of institutions actively engaged in different aspects of fit-for-purpose land administration. As such, through its knowledge management role, the Centre is already engaged in promoting mutual learning between Member states and diffusion of international developments in this area into member States. At the moment, the Centre is providing advisory services to Zambia and Malawi as they seek to pilot fit-for-purpose land administration

while working with the Geo-IT team in Rwanda to make further improvements on their impressive Land Administration Information System. A prototype Land information system has also been developed at the Centre and will soon be tested to see if it can be of use to member States. Member states should thus feel encouraged to call on the expertise at the Centre in this area as they embark on their land reform processes.

CORS, CONTINUOUSLY OPERATING REFERENCE STATION, A BACK BONE TO MODERN AND ACCURATE REAL TIME GEODETIC NETWORK

Continuous Operating Reference Station (CORS) is Global Navigation Satellite System (GNSS). It's basically a GNSS/GPS receiver with capacity to broadcast RTK/DGPS corrections in real time. Tracks GNSS satellites 24/7, processes received GNSS data for various products which are made available to clients via internet. Such products include Real time Kinematic (RTK) and Differential (DGPS) Corrections and raw data RINEX files. CORS are

real time survey control points or Survey monuments-beacons, pillars etc where a network of such station would constitute a real time geodetic network. Traditionally geodetic networks provide the coordinates infrastructure of country or region.



Requirements for establishing CORS

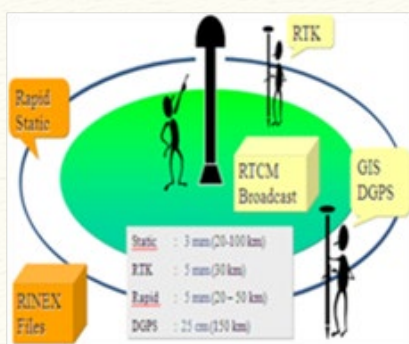
GNSS Receiver with External Antenna

- Stable power available 24/7
- Internet, available 24/7, GNSS receivers comes ready with internet ready devices/ports including SIM card modems supporting GSM and CDMA
- Clear sky and secure site
- Computer with CORS management software, NTRIP server/client is adequate. Some CORS can perform this function and therefore may not require a computer. This is applicable for single CORS.



User's requirements

User would require GNSS receiver system with internet. The GNSS receiver should have the capacity to receive RTK/DGPS corrections. The internet could be internal within the receiver or with data collector. The data collector internet could be from SIM card within or WIFI as an external source.



Data collector comes with field land survey software working under mobile windows or android platforms. The most common mobile windows field software includes

the FieldGenius(FG) and Carlson Ce which supports all possible GNSS hardware in the market. Most GNSS manufacturers also have their own field software. Recently android based field software's are available using smartphones. More often the field software is free and one uses his/her smartphone. This makes the user's hardware component cheaper.

Internet availability: The user communicates with CORS servers at the control center via internet. Whether its raw data or differential / RTK corrections. Almost all our member states have over 80% coverage in GSM/GPRS. This is therefore a necessity!

Applications

All applications in one way or another require to answer the question 'where' and GNSS technologies

has been addressing this question easily. The CORS are however helping improve the positioning accuracies. ALL applications requiring high positioning accuracies, say below 10cm, would require RTK corrections from CORS. These includes boundary and engineering mapping, monitoring of natural and manmade structures, geodynamics, precision farming. And all applications requiring sub meter accuracies, say below 1m, would require using DGPS corrections from CORS



RCMRD WELCOMES DIPLOMA STUDENTS

RCMRD admitted 160 students for Diploma in Land Survey, Diploma in Cartography and GIS, and Diploma in Photogrammetry and Remote Sensing courses in June, 2017. There was a feeling of joy and excitement for the newly admitted students as they were being welcomed into the institution. They asserted that they were eager to start learning at RCMRD.



PROFESSIONAL COURSES, TECHNICAL DIPLOMAS AND CERTIFICATE COURSES IN RCMRD

RCMRD continues to offer professional courses, technical diplomas and certificate courses to students and professionals from all over Africa. In all these courses the emphasis is more hands on skills, practical lessons and field activities. The training Centre is fully registered in the host country and the process of registration in Commonwealth Association of Technical Universities and Polytechnics in Africa is at an advanced stage. The Centre has memorandum of cooperation with several universities across the globe. The Centre prides itself as a premier centre of excellence in provision of geo-information technologies. In this year the training centre has trained 350 participants in the various courses offered. The training centre plans to increase the courses offered, train more participants, increase its visibility worldwide and be the leading trainer in Geo-information technologies. In future the centre plans to offer most of its courses over an online platform to reach more participants and give participants more flexibility while undertaking the courses.

RCMRD MANAGEMENT MEETS WITH OFFICIALS FROM FEDERAL REPUBLIC OF ETHIOPIA AND REPUBLIC OF UGANDA

FEDERAL REPUBLIC OF ETHIOPIA

The Director General met with the Director General, Ethiopia Mapping Agency (EMA), Sultan Mohammed Alyain in Addis Ababa, Ethiopia in June 2017. During the meeting they discussed possible areas of cooperation and provision of service to the Ethiopian Mapping Agency and other Government Ministries by RCMRD. The visit brought closer working relations and cooperation between the Federal Republic of Ethiopia and RCMRD. During his visit he also paid a courtesy call to the Ag. Executive Secretary UNECA, African Centre for

Statistics (ACS), Dr. Hamdok, Deputy Chairperson of the African Union H.E Kwesi Quartey and Dr. Marc Nolting, Head of Programme Strengthening Capacities for Land Governance in Africa, GIZ and Ms. Marguerite Duponchel on secondment to GIZ from World Bank.

REPUBLIC OF UGANDA

The Director General and the Management team travelled to Republic of Uganda in September 2017 for a meeting with officials from Ministry of Lands Housing and Urban Development. The purpose of the visit was to familiarize RCMRD management with the activities of the Ministry

of Lands and Housing, exposé Ministry of Lands and Housing to RCMRD services, discuss possible areas of cooperation and provision of service to the Ministry of Lands and Housing by RCMRD and RCMRD support in the establishment of the National Spatial Data Infrastructure (NSDI) and Modern Geodetic Network. During the visit the team also met with Executive Directors of National planning Authority, National Environment Authority (NEMA), Forestry Authority and senior officials from ministry of Agriculture and Makerere University to discuss areas of cooperation.



RCMRD Delegation led by DG Dr. Nkurunziza was hosted by the PS Ministry of Lands Housing & Urban Development Mrs. Okalany in Kampala Uganda

REPUBLIC OF KENYA

The Director General made a courtesy call to Dr. Ibrahim Mohamed, Principal Secretary, Ministry of Mining, and Republic of Kenya as part of his familiarization with RCMRD partners and to further enhance collaboration between the two institutions. The purpose of his visit was also to discuss areas of common interest and benefit to both organizations. During the meeting Dr. Ibrahim Mohamed advised that RCMRD be included as part of the advisors to the Ministry on the initiative for geophysical (airborne) mapping. Present during the meeting was the Director, Department of Remote Sensing and Resource Surveys, Dr. Patrick Warugute

The Director General also met the Principal Secretary, Ministry of Land and Physical Planning, Republic of Kenya, Dr. Nicholas Muraguri, in September 2017. The meeting discussed areas of cooperation on mapping map the whole country to unlock potential of land as a socio-economic tool for foster development. Also present during the meeting was Mr. Cesare Mbaria, Director Survey of Kenya.



DG meets with Lands PS Nicholas Muraguri

VISIT TO MALAWI AND ZAMBIA

The Director General visited Malawi and Zambia following request by the World Bank Group to provide technical advice on the ongoing National Land Titling Programme (NLTP) for Zambia initiated by the World Bank Group.

VISIT TO RCMRD

UNITED STATES CONGRESSIONAL STAFF DIRECTOR VISIT

The United States House Sub-committee on Africa, Global Health and Human Rights and International Organizations Staff Director Mr. Gregory Simpkins visited RCMRD in April 2017. During his visit he was accompanied by Ms. Lesley Warner a Professional Staff Member from the US House of Representatives, Committee on Foreign Affairs (Democratic Office). Mr. Simpkins tour objectives to the East Africa Region were to familiarize himself on: Counter Violence Extremism, democratic Governance updates of Kenya's election

process and Regional Climate Change. His visit to RCMRD was organized in collaboration with USAID and selected partners



US Congressional staff Director visits RCMRD

UGANDA'S STATE MINISTERS ONSITE VISIT

RCMRD welcomed Hon. Dr. Chris Baryomunsi, State Minister of Housing, and Hon. Isaac Musumba, State Ministers of Urban Planning, Republic of Uganda who toured the Centre, and interacted with staff and witnessed the different activities taking place. During their visit they toured RCMRD facilities and praised the important services RCMRD was providing to its member States and beyond. They assured RCMRD staff of continued support by the Council of Ministers to

enable RCMRD achieves its mission.

Their visit was preceded by a visit from Permanent Secretary, Ministry of Lands Housing and Urban Development, Republic of Uganda, Mrs. Dorcas W. Okalany who is also a member of the RCMRD Governing Council.



Hon. Dr. Baryomunsi and Hon. Musumba at the Remote Sensing lab during their visit

PRINCIPAL SECRETARY, MINISTRY OF LOCAL GOVERNMENT KINGDOM OF LESOTHO VISITS RCMRD

The Principal Secretary, Ministry of Local Government and Chieftainship, Kingdom of Lesotho, Mrs. Nthomeng Mapitso Panyane, visited RCMRD. The Principal

Secretary was accompanied by the Director of Housing, Director of Decentralization in the ministry. The delegates came to familiarize themselves with activities taking place at RCMRD as

well as pay a courtesy call on Dr. Nkurunziza who assumed the mantle of Director General in February this year.



Representatives from the Kingdom of Lesotho during their courtesy call to RCMRD



RCMRD Welcomes New Director General, Dr. Nkurunziza

Workshop on Improving GHG Accounting for the AFOLU Sector in Uganda



Climate change vulnerability mapping training workshop participants in Tanzania

RCMRD Staff in Tree Planting Drive at RCMRD compound





Meeting on exploring areas of collaboration between RCMRD and IUCN



Participants during the forum to engage stakeholders on data sharing challenges, best practices and recommendations at RCMRD



RCMRD Participates in OFESA Project Kick-off Workshop





The Director General,
Regional Centre for Mapping of Resources for Development
Kasarani Road, Off Thika Road
P.O. Box 632-00618,
Ruaraka, Nairobi, Kenya
Tel: +254 20 2680722/2680748
Fax: +254 20 2680747
Email: rcmrd@rcmrd.org
Website: <http://www.rcmrd.org>