



**RCMRD**

# ANNUAL REPORT 2021



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# ACRONYMS

<b>ACC</b>	Africa Conservation Centre	<b>JRC</b>	Joint Research Centre of the European Commission
<b>ACP</b>	African, Caribbean and Pacific	<b>KEBS</b>	Kenya Bureau of Standards'
<b>AFDB</b>	African Development Bank	<b>KWCA</b>	Kenya Wildlife Conservancies Association
<b>AFRICA</b>	African Framework for Research Innovation, Communities and Applications	<b>LASAC</b>	Land Satellite Remote Sensing Application Center
<b>AfriGEO</b>	The African Group on Earth Observations	<b>LULC</b>	Land Use Land Cover
<b>AGRA</b>	Alliance for a Green Revolution in Africa	<b>MODIS</b>	Moderate Resolution Imaging Spectroradiometer
<b>AGCOM</b>	Agricultural Commercialization Project	<b>MBPs</b>	Megabits per second
<b>AU</b>	African Union	<b>MOH</b>	Ministry of Health
<b>AUC</b>	African Union Commission	<b>MoLHUD</b>	Ministry of Lands Housing and Urban Development
<b>ARD</b>	Analysis Ready Data	<b>MRV</b>	Measurement Reporting Verification
<b>AUDA</b>	African Union Development Agency	<b>NCA</b>	Natural Capital Accounting
<b>BIOPAMA</b>	Biodiversity and Protected Areas Management	<b>NDMA</b>	National Drought Management Authority
<b>CCDC</b>	Continuous Change Detection and Classification	<b>NELGA</b>	Network of Excellence on Land Governance in Africa
<b>CCTV</b>	Closed-circuit Television	<b>NEPAD</b>	The New Partnership for Africa's Development
<b>CCROs</b>	Certificates of Customary Rights of Occupancy	<b>OAU</b>	Organization of African Unity
<b>CI</b>	Conservation International	<b>RCMRD</b>	Regional Centre for Mapping of Resources for Development
<b>CIESIN</b>	Center for International Earth Science Information Network	<b>RCTI</b>	Regional Centre Training Institute
<b>CSE</b>	Centre de Suivi Ecologique	<b>RIC</b>	Regional Implementation Centre
<b>CSA</b>	Climate Smart Agriculture	<b>RRH</b>	Regional Resource Hub
<b>CTCN</b>	Centre/Climate Technology Centre and Network	<b>RRIS</b>	The Reference Information Systems
<b>C19RC</b>	COVID-19 Response Committee	<b>R&amp;D</b>	Research and Development
<b>DEA</b>	Digital Earth Africa	<b>RHEAS</b>	Regional Hydrologic Extremes Assessment System
<b>EF5</b>	Ensemble Framework for Flash Flood Forecasting	<b>QC</b>	Quality Control
<b>EO</b>	Earth observations	<b>QMS</b>	Quality Management System
<b>ESIPPS</b>	Environmental Surveys, Information, Planning and Policy Systems	<b>SANSA</b>	South African National Space Agency
<b>ESRI</b>	Environmental Systems Research Institute	<b>SAR</b>	The Synthetic Aperture Radar
<b>EU</b>	European Union	<b>SDG</b>	Sustainable Development Goals, especially
<b>GC</b>	Governing Council	<b>SEE</b>	Sustainable Echo Engineering Ltd
<b>GEE</b>	Global Earthquake Explorer	<b>SERVIR</b>	SERVIR Eastern and Southern Africa, a joint initiative of the USAID and E&SA
<b>GEO</b>	Group on Earth Observations	<b>E&amp;SA</b>	NASA
<b>GeoGLOWS</b>	Group on Earth Observations - Global Water Security	<b>SGS</b>	Société Générale de Surveillance'
<b>GESI</b>	Gender Equality and Social Inclusion	<b>SIS</b>	Soil Information System
<b>GHACOF</b>	Greater Horn of Africa Climate Outlook Forum	<b>SMFM</b>	Satellite Monitoring for Forest Management
<b>GIS</b>	Geographical Information System	<b>TAG</b>	Technical Advisory Group
<b>GMES and Africa</b>	Global Monitoring for Environment and Security and Africa	<b>TAHMO</b>	Trans-African Hydro-Meteorological Observatory
<b>GNSS</b>	Global Navigation Satellite System	<b>TOR</b>	Terms of Reference
<b>GPS</b>	Global Positioning System	<b>TVET</b>	Technical and Vocational Education and Training
<b>GRI</b>	Global Reporting Initiative	<b>UAV</b>	Unmanned Aerial vehicle
<b>HRSL</b>	High Resolution Settlement Layer	<b>UNDP</b>	United Nations Development Programme
<b>ICDL</b>	International Computer Driving License	<b>UNECA</b>	United Nations Economic Commission for Africa
<b>ICIMOD</b>	Integrated Mountain Development	<b>UNICEF</b>	United Nations Children's Fund
<b>ICRAF</b>	International Centre for Research in Agroforestry	<b>UPD</b>	Urban Planning and Design Branch
<b>ICT</b>	Information Communication Technology	<b>USAID</b>	United States Agency for International Development
<b>IGAD</b>	Intergovernmental Authority on Development	<b>WARIDI</b>	Water Resources Integration Development Initiative
<b>IO</b>	Intergovernmental Oceanographic Commission	<b>WFP</b>	World Food Program
<b>IPMS</b>	Integrated Projects Management System	<b>WG</b>	Working Group
<b>IP</b>	Internet Protocol	<b>WMO</b>	World Meteorology Organization
<b>ISO</b>	International Organization for Standardization	<b>WofS</b>	Water Observations from Space
<b>ISUD</b>	Integrated Strategic Urban Development Plan	<b>VLUPs</b>	Village Land Use Plans
<b>IUCN</b>	International Union for Conservation of Nature		

## THE CHAIRPERSON'S NOTE

I am privileged to have had the opportunity to chair the RCMRD Governing Council (GC) meeting in the year 2021, courtesy of my country's membership to RCMRD, and as the Permanent Secretary in the Ministry for Land Management, Water and Sanitation Services, in the Republic of Botswana. My country has been a proud member of RCMRD since April 13, 1989, during which Botswana has provided unwavering support to the Centre. The Centre has also provided important services not only to Botswana, but also to many other member States, mainly in the fields of surveying instrument calibration and maintenance, geospatial product development and training.

I am pleased to note that under my responsibility as the chairperson of the GC in the year 2021, the Centre made remarkable strides in the implementation of its work programme, during a rather difficult year. I am happy to affirm that as highlighted in this annual report, the Centre's profile was significantly improved, and this can be attested to by the ability of the Centre to attract international partners to support its programmes and services. I also take cognizance of the fact that the Centre has improved its infrastructure significantly. Implementation of the GC decision to develop hostels for RCTI students and trainees from member States commenced and I am confident that this strategic move will return dividends to member States in the near future. The GC also noted that the RCMRD finances and assets were prudently managed during the year, and this was evidenced by the clear audit reports presented to the GC. I also note with pride the strides that the institution is making towards growing its competencies as the premier institution for training and capacity development in geo-information and allied technologies in member States.

Honorable member States, while it is impressive to note that the Centre made remarkable achievements in a fairly challenging year, allow me also to remind you that your support to the institution is invaluable. I commend those member States who continued to utilize the Centre's services, honor their annual subscriptions and also provide feedback to the management to improve the Centre's operations. As we get into the year 2022, I am happy to note that the GC approved a work programme for the Centre, in line with the 4-year strategic plan approved by the Conference of Ministers. I request all member States and partners to extend their unwavering support to the Centre to



achieve its goals for 2022. I am confident that the planned activities will bring benefits to our people in the respective member States. I too commend the management of RCMRD for ensuring that the Staff were safe from COVID-19. I wish you all a safe and productive 2022, and hope to hear of the achievements of the Centre and your respective countries in the next GC meeting.

**Ms. Elizabeth Bonolo Khumotaka**  
Chairperson RCMRD Governing Council, 2021.

## FROM THE DIRECTOR GENERAL'S DESK

Under Article VI, Sub Article C of the Agreement establishing the Regional Centre for Mapping of Resources for Development (the "Centre") and on behalf of the RCMRD Management, I have the honor and privilege to submit to Members of the Governing Council and partners, the RCMRD Annual Report for the period of 1st January to 31st December 2021. The year 2021 marked the third year of implementing the RCMRD 2019-2022 Strategic Plan approved by the Conference of Ministers in November 2018. The 2021 Work Programme and Budget, approved by the 54th Governing Council meeting held virtually in November 2020 guided this year's activities. The detailed activities undertaken in this reporting period are in the subsequent chapters of this report.

Despite the challenges experienced during the COVID-19 pandemic, the Centre continued to implement activities while strictly adhering to the COVID-19 restrictions. Most meetings with partners and stakeholders were held in a hybrid format, physically and virtually. The Centre continued to adapt to emerging challenges during the implementation of this year's work plan, including conducting the RCMRD International Conference (RIC) 2021 virtually, which attracted more than 600 participants from all over the world. The RIC is a major event that the Centre has conducted physically since its inception. While we recognize the challenging times that partners and member States have endured and continue to endure during this difficult time, I assure you that the Management of the Centre will do everything possible to ensure that RCMRD continues to provide quality services that meet the needs of the member States. The achievements made in 2021 were largely possible because of the continued support by member States and partners. Honorable Members of the Governing Council, please accept the assurances of my highest consideration and esteem.



**Dr. Emmanuel Nkurunziza**  
Director General, RCMRD

## EXECUTIVE SUMMARY

This report presents the RCMRD 2021 achievements, in line with the six key strategic objectives in the RCMRD 2019-2022 Strategic Plan, which guided the implementation of these activities. The Centre's profile was enhanced through continuous member States and other stakeholder engagements in national, regional, and global events, through mainstream and social media presence and publications. The Centre continued engagements with the existing partners and new partners. The Centre hosted the RCMRD International Conference with over 600 guests, and the 5th AfriGEO Symposium with over 500 guests. RCMRD's staff represented the institution in the following regional and global events: the ESRI Global Conference, GEO Week, Africa GIS 2022, American Geophysical Union (AGU) Fall Meeting 2021, FIG E-Working Week 2021, and UN Climate Change Conference (COP26). Further, the Centre continued to mentor the youth through existing programs like the RCMRD Space Challenge (for Primary and High School Students), where a total of a total of 160 students from 16 schools from Rwanda participated in the 2021 RCMRD Space Challenge. The Centre also introduced "KUZA", a mentorship program for college and university students which attracted participation from 11 universities from the different member States. The Center, through the Small Grants Program, increased its network of organizations through working with eight (8) institutions in Kenya, Tanzania, and Uganda. The Centre was also honored to visit and engage with members States' Ambassadors and High Commissioners representing the following countries: Botswana, Tanzania, and Rwanda. In addition, RCMRD officials held fruitful engagements with the Minister of Lands and Natural Resources Zambia, Hon. Elijah J. Muchima, and the the Secretary General, Ministère de l'Urbanisme, de l'Environnement et du Tourisme Mr. Dini Abdallah Omar. Additionally, the Centre hosted head of missions, FAO-Kenya, European Union (EU) delegation, the CEO of National Drought Management Authority (NDMA) Kenya, a Lake Victoria Basin Commission (LVBC) delegation, the Kenya Space Agency (KSA), and the Liberia Lands Authority (LLA) Chairman Hon. Atty J. Adams Manoah and his team.

Under the human resources management, the organization structure was improved to include the creation of a new Directorate, named the Capacity Building Directorate, and the revision of the staff job titles. The Centre appointed 26 staff to fill in the different vacant positions. Staff members improved their capacity through enrollment in short professional courses and academic studies. The Centre negotiated with its medical insurance provider to enhance the cover for COVID-19 in the contract for 2022. Further, the

Centre implemented initiatives and measures to control the pandemic at the Centre as guided by the Government of Kenya pronouncements and WHO guidelines including the working from home and online meetings, facilitation for PCR tests for staff who have to travel on official missions. Through initiatives made with the Government of Kenya, more than 50 staff members, 26 lecturers and 250 students have been vaccinated. Staff who were yet to receive vaccination were encouraged to do so.

To ensure financial stability, the Centre implemented various strategies to supplement income besides the member States' contributions. These include; diversification of wider partnerships through collaboration, investment in surplus cash, actualizing the capital development fund, financial controls, leasing office space in the new office complex, and continuous proposal writing for funding purposes.

To ensure the Centre's infrastructure was adequate and responsive to meet its mandate effectively, the new RCMRD office complex is now fully functional and operational. The Centre's ICT infrastructure was improved by upgrading the internet service, installation of a high-capacity Server, CCTV network for video surveillance, internet protocol (IP), and video conferencing equipment.

The Centre conducted various customized training workshops both physically and virtually with over 1,485 participants from member States and other stakeholders to build their capacity in geo-information and allied technologies. The RCTI increased its student's capacity from 624 to 850. Additionally, 300 students graduated in Diploma and Certificate programs, with technical skills in GIS, AutoCAD, among others.

The Centre implemented various projects in member States and other countries focusing on the following thematic areas: Agriculture and Food Security, Weather and Climate Change Impacts, Ecosystems Management and Natural Resource Monitoring, Land Use Land Cover Change, Land Governance, and Urban Development, Water and Water Disasters and Geospatial Information Technologies support. Further, the Centre supported calibration and servicing of survey instruments.

The Centre's Library resource unit continued to improve the functions and services to efficiently and effectively meet the needs of both the Centre Staff and RCTI students. The library received 270 theses from the University of Twente, Netherlands, through a donation program.

# ABOUT RCMRD

The Regional Centre for Mapping of Resources for Development (RCMRD) was established in Nairobi, Kenya, in 1975 under the auspices of the United Nations Economic Commission for Africa (UNECA) and the then Organization of African Unity (OAU), today African Union (AU). RCMRD is an inter-governmental organization with 20 Contracting member States in the Eastern and Southern Africa regions: Botswana, Burundi, Comoros, Eswatini, Ethiopia, Kenya, Lesotho, Malawi, Mauritius, Namibia, Rwanda, Seychelles, Somali, South Africa, South Sudan, Sudan, Tanzania, Uganda, Zambia and Zimbabwe. RCMRD also undertakes activities in non-contracting States: Angola, Democratic Republic of Congo, Djibouti, Eritrea, Madagascar, and Mozambique.

## RCMRD 2019 - 2022 STRATEGIC PLAN

RCMRD is implementing a four-year strategic plan for the period of 2019-2022 as approved by the Governing Council in 2018. The strategic plan sets the Centre on a strategic path aimed at improving service delivery and enhancing relevance to member States through; capacity building; advisory services; implementing programmes; and undertaking research and development of innovative solutions and services on geo-information and allied technologies. The strategic plan gives the strategic direction, goals and objectives for the Centre with a clear roadmap for achieving them.

The implementation of the Strategic Plan is undertaken through Annual Work Plans which are rolled out at the beginning of every fiscal year. The implementation of the 2021 Annual Work Plan was executed based on the Centre's six (6) strategic objectives:



01  
**Mission**

To strengthen the member States and our stakeholders' capacity through generation, application and dissemination of geo-information and allied technologies for sustainable development.



02  
**Vision**

To be a Premier Centre of Excellence in the provision of geo-information and allied technologies for sustainable development in the member States and other stakeholders.

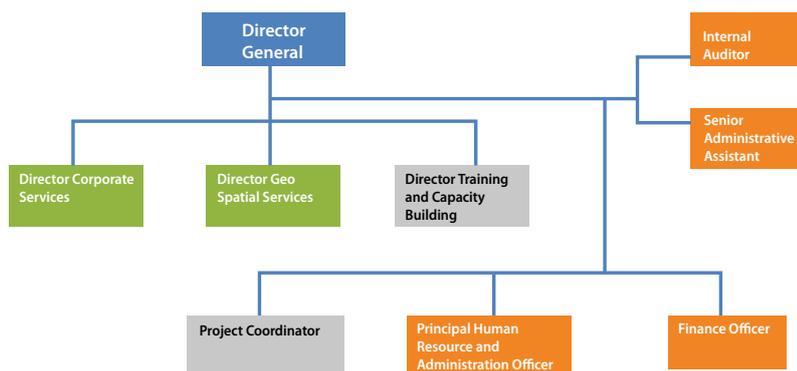


03  
**Core Value**

Customer focus, stakeholder engagement, innovation and creativity, accountability and transparency, team work, equity and inclusiveness.

- **RCMRD Profile** - Enhance the RCMRD profile through member States and stakeholder engagement;
- **Human capital** - Have a competent and motivated workforce;
- **Financial sustainability** - To be a financially sustainable & stable organization;
- **Infrastructure** - Ensure the Centre's infrastructure is adequate and responsive to meet its mandate effectively & efficiently;
- **Products & Services** - Strengthen capacity of our members and other stakeholders in geo-information & allied technologies, undertake programs that positively impact our members and other stakeholders; and
- **Knowledge Management** - Enhance RCMRD capability in knowledge management.

## GOVERNANCE AND MANAGEMENT



The RCMRD organogram

# THE RCMRD'S PERFORMANCE FOR YEAR 2021

## RAISING THE RCMRD PROFILE

### The RCMRD International Conference (RIC)

The annual RCMRD International Conference (RIC) continues to be a success in the national, regional and international arena. Due to the COVID-19 challenges, RCMRD organized RIC 2021 virtually from 17th to 19th August, 2021. The 3-day event attracted more than 600 guests from different parts of the world. RIC provides an excellent platform for policymakers, executives, experts, researchers, developers, and innovators to share experiences, ideas, strategies, technological advancements, and to also engage with key players in the EO and GIS arena around the globe, to promote science policies. The Cabinet

Secretary, Ministry of Lands and Physical Planning, Republic of Kenya, Ms. Farida Karoney, presided over the opening of the conference as a guest of honor. She was joined virtually by the Chairperson of the RCMRD Governing Council, Ms. Elizabeth Khumotaka. Representatives from the United Nations Economic Commission for Africa (UNECA), the United States Agency for International Development (USAID), and the National Aeronautics and Space Administration (NASA), African Union (AU), and International Union for Conservation of Nature (IUCN) also graced the event.



The RIC 2021 digital banners representing the Guest of Honor and the respective Guest Speakers.

## INCREASING THE CENTRE'S NETWORK THROUGH THE SERVIR EASTERN & SOUTHERN AFRICA SMALL GRANTS PROGRAM

RCMRD through the SERVIR Eastern and Southern Africa Project (SERVIR E&SA) implemented the Small Grants Program whose objective was to expand RCMRD/SERVIR E&SA's network of organizations in the region and to generate innovative ideas for applying Earth observation data and geospatial methods and tools for development decision-making in the Eastern and Southern Africa region. RCMRD/SERVIR E&SA awarded grants to organizations in East & Southern Africa to produce Earth observation and GIS applications within the SERVIR E&SA's four (4) service areas: Agriculture and Food Security, Land Use/Land Cover & Ecosystems, Water Resources and related Hydro-climatic Disasters, and Weather and Climate. The countries covered were: Kenya, Tanzania, Uganda, and Rwanda (whose grant was later cancelled due to unforeseen limitations). The anticipated outcome of the grant activities was to stimulate the innovative use of geospatial tools and information to translate science into sustainable policy and practice that addresses the development challenges posed by environmental and climate stresses.

The following are summary outcomes from each of the grantees:

- [Coastal Oceans Research & Development Indian Ocean \(CORDIO\) East Africa \(Kenya\)](#) - Facilitated the use of coral reef and other coastal and marine information in core sectors (ecosystem health, food provisioning, economic development, disaster prevention, etc.) to support the Kwale County government planning and decision making. This was done by compiling the relevant information and making it accessible to the County government and the public where possible, and by developing policy-relevant integrated indices that can integrate uptake of data products in decision-making circles. With relevant County government officials, the project identified and developed outputs designed for their internal processes, such as the County Spatial and Integrated Development Planning document.
- [Earth Consult \(U\) Ltd. \(Uganda\)](#) - Strengthened the capacity of National Agricultural Research Organization (NARO) institutes in integrating geospatial tools for climate-smart precision agriculture. The overall objective was to enhance agricultural production so as to ensure food security, particularly among vulnerable groups.
- [E-Link Consult \(Tanzania\)](#) - The activity produced valuable data sets and maps, which were shared with various relevant stakeholders across scale and levels within the district including policy and decision makers for effective communities' adaptation to climate change impacts. Through a tailor-made participatory process, strategic adaptation interventions were developed and supported in one hotspot village in Chalinze district in Tanzania. This research contributed valuable information to the newly formed Chalinze District in Tanzania, spearheading the development agenda in light of climate change impacts and vulnerability knowledge, thus building community resilience and embracing sustainable development agenda.
- [Kenya Meteorological Society \(Kenya\)](#) - Strengthening community understanding and uptake of climate forecasts interfaced with indigenous knowledge systems in Kenya to promote agriculture adaptation to the effects of climate change and variability. The grant addressed lack of reliability in data and how in-situ observations and knowledge and information held by vulnerable communities can be used to address these gaps. The grant developed a strong climate information service (CIS) that interfaces climate information from in-situ and Earth observations, and spatial data with locally owned indigenous knowledge through co-production and pilot activities with the affected communities. It also developed the capacity to use climate information through community engagement. Activities included data collection, use and analysis using field surveys, face to face interviews, community engagements, meetings with key informants among others.
- [Laikipia Wildlife Forum \(Kenya\)](#) - Leveraging citizen science in invasive species data collection and management in northern Kenya rangelands. The grantee mapped invasive species, particularly *Opuntia stricta* and *Acacia reficiens* in areas of northern Laikipia rangelands as part of their control and management. This was part of a wider effort to improve rangelands on pastoralist community lands. This mapping and monitoring effort used an App pioneered by RCMRD/SERVIR E&SA and is a citizen science project.
- [Wetlands International Kenya \(Kenya\)](#) - Applied geospatial data in water resource management for sustainable ecosystems and improved livelihoods in the mid-Athi catchment. The grantee aimed to develop and make available a reliable data monitoring system for stakeholders to inform decision making for improved water resources management, sustainable livelihoods and strengthened community resilience. The evidence produced from the collected geo-data will be used to develop a business case that will influence private sector institutions to make business decisions that take into account social and environmental safeguards.
- [Ardhi University \(Tanzania\)](#) - Equipment were provided for GIS and remote sensing of groundwater to enhance community resilience in Tanzania through improved management and sustainable water resource

conservation. This increased the capacity of the University to conduct research activities and improve ways to assess disaster risk in flood prone communities.

- **National Fisheries Resources Research Institute (NaFIRRI) (Uganda)** - Through equipment provided by the grant, the institution increased its capacity to collect

and use remote sensing data on key indicators of water and catchment conditions to monitor water quality (algae, etc.) and freshwater biodiversity, and process data, produce maps, and provide analysis to better predict aquatic habitat conditions and improve natural resource management.



A graphic representation of the SERVIR E&SA Small Grants-Phase 2 activities and outputs

## COMMUNICATION AND OUTREACH HIGHLIGHTS

**RCMRD** over the last year enhanced its visibility in both mainstream and social media. The Centre organized for appearances and advertisement of RCMRD activities in the newspapers and other print publications, on TV and radio stations in some member States. There was an increase in social media features on platforms such as Twitter, Facebook, YouTube, Instagram and LinkedIn. These initiatives coupled with the physical interactions in conferences, seminars, workshops and meetings led to an increased visibility of RCMRD products and services. The positive feedback received points to an increased interest in the RCMRD information by a wide spectrum of stakeholders which cuts across professionals in the geospatial sector, students, decision makers, researchers, scientists, development partners among others.



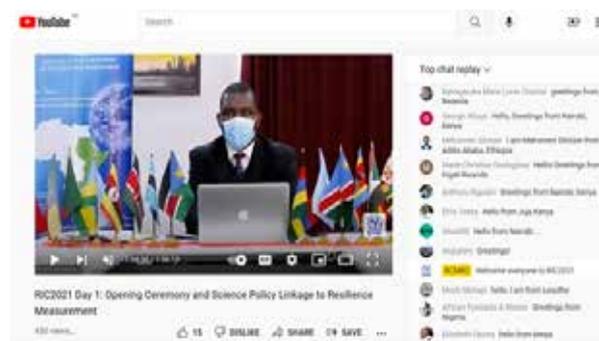
The RCMRD 2021 social media audience distribution statistics



The User Engagement Lead, Mr. Kenneth Kasera, featured by a national publication in Uganda



One of the RCMRD’s projects (GMES-Africa) featured in The Ethiopian Herald newspaper.



The Director, Corporate Services, Mr. Paul Idude, addresses participants virtually during the RIC 2021, streamed live on YouTube

## THE GMES AND AFRICA OPEN DAY EVENTS



Participants at the GMES and Africa Open Day in Ethiopia

RCMRD through the Global Monitoring of Environment for Security (GMES) and Africa program introduced the Open Day activities whose main aim was to engage the stakeholders and create awareness about RCMRD and GMES and Africa products and services in the member States. In 2021, the Open Day events were conducted (physically and virtually) in Djibouti, Ethiopia, and Uganda. These forums provided an opportunity to the local media both print and mainstream to tell and spread ‘our’ story. In addition, approximately 2000 visibility materials (RCMRD and GMES branded), were issued to stakeholders. Further, the GMES and Africa Geoportal was officially launched. The portal provides the public access to the GIS related data, literature and training materials developed by the project.

### SHOWCASING RCMRD PRODUCTS AND SERVICES IN THE REGIONAL & INTERNATIONAL ARENA

The Centre continued to increase its visibility through participation in the following regional and international conferences:

- ESRI Global User Conference - RCMRD showcased the various services, EO methodologies and concepts to the user conference audience.
- The Centre organized a Data Awareness and Access Workshop which was attended by 123 participants from different parts of the world with the discussion and presentations geared towards data access and acquisition procedures at the Centre. The workshop provided a platform for sharing of experiences on data challenges in the member States.

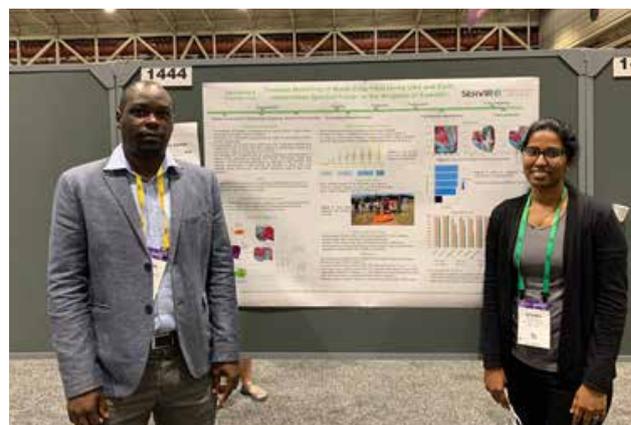
- The Centre participated in the Africa GIS 2021 convened by EIS-Africa in partnership with the African Union Commission (GMES and Africa);
- The Centre participated in the Regional Committee of the United Nations Global Geo-spatial Information Management for Africa (UN-GGIM: Africa) in November 2021, Abidjan, Côte d'Ivoire. The RCMRD booth attracted delegates who were provided with information about the Centre's services and products through banners, posters and brochures. Assorted visibility materials were distributed that include branded diaries, T-Shirts, bags and flash disks.
- Participation in GEO Week - The AfriGEO Secretariat also registered good representation at the GEO Week which took place on 22-26th November 2021. The AfriGEO regional focus was on the LDN activities. The Centre also appreciated working with the University of Free State to collate LDN related needs, gaps and

existing tools, regionally. This shall go a long way in orienting RCMRD's (the AfriGEO Secretariat) efforts as it plans for the year 2022. At the same event, RCMRD also collaborated in a joint side event with GEO Blue Planet, DE Africa, GEO Human Planet, national governments (Seychelles and Senegal) to discuss the continental challenges on Marine Debris and Marine Hazards. Also, the GMES program has made significant efforts that contribute to AfriGEO's work program in this area in terms of developing and sharing proxy indicators for ocean health on the Indian Ocean Coast.

- At the 2021 American Geophysical Union (AGU) Fall meeting, the Centre was represented through presentations made by the SERVIR staff.
- The RCMRD was also part of a group presentation made at the UN Climate Change Conference (COP26) in Glasgow, by USAID and NASA, which featured SERVIR's work in Africa.



Ms. Lilian Ndung'u (SERVIR E&SA) presenting during the UN Climate Change Conference (COP26).



Dr. Benson Kemboi (SERVIR E&SA) and Dr. Githika Tondapu (NASA-SERVIR) during a poster presentation at AGU 2021 in the United States.



Ms. Mary Gasper Makondo, Permanent Secretary in the Ministry of Lands, Housing and Human Settlements Development, in the Republic of Tanzania, planted a commemorative tree at the RCMRD grounds, during her visit in 2021.



The Tanzania's High Commissioner to Kenya, Dr. John Stephen Simbachawene, receives Mr. Paul Idude, Director Corporate Services, RCMRD, at the High Commissioner's office in Nairobi.

## NEEDS ASSESSMENT FOR BOTSWANA, MALAWI AND ZAMBIA.

Under the SERVIR E&SA project, the RCMRD conducted stakeholders' consultation and needs assessments activities in Botswana, Malawi and Zambia. Consultation and needs assessment in the three countries resulted in information and data upon whose analysis a decision was made to offer the following services:

- **Botswana** - Capacity building in Continuously Operating Reference Stations (CORS), remote sensing in forest management using radar and optical data; advisory and support for National Spatial Data Infrastructure (NSDI); capacity in underground water mapping, network analysis and pipe mapping, integration of RS & GIS with SEAP system; fire and flood early warning, vulnerability and hotspots mapping, e-Station and sector specific bulletins improvement; national spatial data implementation and review, capacity building in network analysis and utility planning, scenario planning and database management.
- **Malawi** - Capacity building in EO applications in forest monitoring, capacity building on use of EO tools to address agricultural monitoring, sampling frames and seasonal forecasting, drought forecasting and capacity building on the application of EOs for water resources monitoring and flood forecasting.
- **Zambia** - Basic training in post installation maintenance of CORS, advisory on NSDI, monitoring and mapping charcoal burning hotspots, extension of agricultural activities and timber logging, fish stock and species mapping, use of GIS/RS in yield estimation, capacity building for drought and flood vulnerability data processing.

## THE RCMRD SPACE CHALLENGE

In 2021 the Centre, through (SERVIR E&SA) Project, implemented the RCMRD Space Challenge- Rwanda Chapter. The overall goal of the Challenge is to equip primary and secondary school students with necessary skills and awareness to visually interpret features in satellite images and related weather patterns and trends, and thus contribute to improved capacity to understand environmental and climate-related issues. The activity also supports capacity in science, technology, engineering and mathematics (STEM) subjects.

The Space Challenge in Rwanda which was done in partnership with the Ministry of Education, Rwanda Education Board, Rwanda Meteorological Agency, Rwanda National Commission for UNESCO (CRNU), Trans Africa Hydro-meteorological Observatory (TAHMO), and Albertine Rift Conservation Society (ARCOS). The RCMRD Space Challenge - Rwanda Chapter targeted secondary school students across Rwanda. Participating institutions came together in May 2021 to develop a 3-year Space Challenge implementation plan for Rwanda. In the same year, a teachers training was conducted where 30 schools were involved, and each school was represented by two teachers. This activity prepared students for the first round of the

challenge. The teachers were taken through the RCMRD Space Challenge Concept and an implementation plan. They were also equipped with the essential skills for guiding and preparing the students during the implementation of the challenge at school. The main objective of the round one Challenge was to determine the relationship between weather parameters (temperature, air pressure, relative humidity, and precipitation) and their applicability in daily decisions. Data for this Challenge were acquired from the TAHMO automatic weather station located at Groupe Scolaire Rushaki in the Northern Province in Rwanda. Ten students per school presented the results of their study to a panel of judges composed of RCMRD, CNRU and TAHMO.

The assessment of the student's performance was based on submitted study reports, concept mastery and poster development and presentation. As a result of the practical sessions conducted during the round one Challenge, a total of 160 students from the 16 schools were equipped with knowledge of how to compute trends and plot air pressure, humidity, temperature, and precipitation in various zones and how to determine climate change drivers and applications. The students also learned the link between the weather parameters. The outcome was evident through the successful completion and presentation of the Challenge by the students. All the schools were awarded trophies for the successful completion of the Challenge.



*Students celebrating their trophy win shortly after the certificate and trophy award ceremony of the RCMRD Space Challenge-Rwanda Chapter.*

## KUZA

The Centre through the SERVIR E&SA Project is implementing a mentorship program known as the RCMRD KUZA program (a Swahili word meaning "to grow"), a strategy of engaging universities and colleges within RCMRD member States on skills development and quality education. The programme is anchored in various universities specifically under Geomatics Departments, Engineering, Research and Development, Environmental Departments and any other science and social related departments. This is the beginning to the path of establishing a network of universities within the members to enhance sharing of knowledge and skills in the use of Earth observation and allied ICT technologies. The purpose of RCMRD-KUZA program is to: (1) provide guidance to students in



L-R: Eng. Benjamin Ssekamuli (Water Resources Modeller, LVBC), Eng. Hilda Luoga (Projects Development Officer, LVBC), Mr. Isaac Nyarwaya (Acting Deputy Executive Secretary, LVBC) and Dr. Emmanuel Nkurunziza, DG-RCMRD, during a visit at RCMRD.



Participants during the KUZA event at RCMRD in 2021.

universities and colleges in Earth observation data access and awareness, provide platforms for hackathons or joint problem solution findings, (2) provide platforms for RCMRD summer school initiative, and (3) provide mentorship in EO fields and skills development. The Centre put in place a mentorship framework and policy to guide the activities and implementation of the program. The mentorship program follows the approach of establishing various scientific groups or clubs governed by a defined code of conduct developed and agreed upon by both RCMRD and the members of the club.

In 2021, the Centre engaged the following public and private colleges and universities in the member States: Regional Centre Training Institute (in Kenya), University of Zambia (in Zambia), Malawi University of Science and Technology (in Malawi), Jaramogi Oginga Odinga University of Science and Technology (in Kenya), Ardhi University (in Tanzania), University of Rwanda (in Rwanda), Makerere University (In Uganda), Addis Ababa University (in Ethiopia), Namibia University of Science and Technology (in Namibia), University of Botswana (in Botswana), and Kenyatta University (in Kenya).

## The RCMRD WORKFORCE

RCMRD continued to enhance the institutional capacity through adequate resourcing, capacity building and enhanced competence of staff to enable them undertake various activities successfully. The previous organization structure was improved to include creation of a new Directorate known as the Capacity Building Directorate. Further, in line with this change, implementation of new positions and titles was effected. In order to support implementation of the new structure, a number of appointments were made in acting capacities to enable continuation of operations. Additionally, the Centre outsourced the cleaning and security services to private companies. Additionally, as part of the approved structure 26 staff were appointed to fill in the different vacant positions.

### STAFF TRAINING

In 2021, the Centre through the HR and Administration Division implemented a few physical staff training programs for staff members as the country was beginning to open up following the lockdown brought about by COVID-19. These included the ISO 9001:2015 QMS Lead Auditors Training for the Principal Quality Management and Assurance Officer, Training for Executive Assistants which was attended by the Ag. Executive Assistant to DG, Customer Care Skills Development attended by the Ag. Receptionist and Professional Skills Development attended by the Senior Procurement Officer. Further, other staff members attended self-sponsored courses such as the Director of Corporate Services continued pursuing PhD studies, a part

time Lecturer was undertaking her MSc, Manager Finance pursued certification as a Financial Analyst, Thematic Lead Weather & Climate begun his PhD studies in USA, Manager Remote Sensing registered for his PhD in Finland and Acting Director Capacity Building & Training attended a course on how to conduct training during COVID-19. For group training programs for staff, seven (7) staff attended a Training of Trainers course offered by Digital Earth Africa and two staff from RCTI attended TVET career services officers training.

### STAFF INSURANCE

The staff medical insurance policy was renewed in 2021, with an improvement of the cover for COVID-19. The cover also enhanced some of the previous benefits.

### COVID-19 Response

At the onset of COVID-19 in Kenya in March, 2020, the RCMRD Management set up an inter-departmental Response Committee to monitor the COVID-19 situation and advise Management on appropriate response measures to take. To date the Committee has been behind initiatives and measures to control the pandemic at the Centre as guided by the Government of Kenya pronouncements and WHO guidelines. Such measures have included enforcing the wearing of face masks by all staff, students and visitors, monitoring body temperature on entrance, use of sanitizers, disinfecting premises, social distancing including in common work spaces, implementing working from home and online meetings. Support has also been provided to staff members who have been affected one way or another by the disease as well as contact tracing, where necessary. Facilitation for PCR tests is undertaken for those members of staff who have to travel on official missions. Worth noting is that the Centre negotiated with its medical insurance provider to enhance the cover for COVID-19 in the contract for 2022. This has translated into an increase in the resources set aside for treatment and hospitalization of COVID-19 infected staff and their dependents.

In view of the increasing number of students under RCTI, the Institute also set up a sub-Committee on COVID-19 response to feed into the RCMRD main Committee as well as enforce COVID-19 control measures within RCTI and among students.

To move towards normalization of work, the Centre through the Committee has encouraged vaccination against COVID-19 amongst staff and students, through initiatives made with the Government of Kenya. More than 50 staff members, 26 lecturers and 250 students have been vaccinated. Staff who were yet to receive vaccination were encouraged to do so. This will ensure that all staff and students as well as visitors feel protected thus enhancing a conducive work environment. The Committee will continue to monitor the COVID-19 situation and liaise with Government authorities to ensure that the Centre continues operating in spite of the ever-evolving virus and the negative impact it has posed to economic activity.

### INTEGRATING GENDER AND SOCIAL INCLUSION INTO CENTRE'S ACTIVITIES

RCMRD through the SERVIR E&SA project with support from USAID is promoting Gender Equality, Disability and Social Inclusion (GEDSI) efforts to ensure the gender component is effectively integrated into the institution and its projects are informed by the understanding of the international frameworks and best practices. In 2020, a gender consultant was hired to conduct capacity building activities for staff members and support development of the Gender Equality and Social inclusion (GESI) strategy. The Centre's staff underwent a training on the tenets of gender in order to build their capacity to integrate gender in their departments and programs. A full time Gender and Environment Specialist was recruited for technical and programmatic support in integrating gender and inclusion at the Centre across all units. The Gender Component focuses on the following key areas:

- **Women's access to gender sensitive satellite-based agricultural insurance:** The GESI Strategy will continue to inform RCMRD work plans and thus its implementation will be achieved in subsequent years on a rolling basis.
- **Gender Sensitive Activities/Services:** SERVIR E&SA with the assistance of International Union for Conservation of Nature's (IUCN) Advancing Gender in the Environment (AGENT), a ten-year collaboration between the IUCN and the USAID Office of Gender Equality and Women's Empowerment (GenDev), has developed a gender analysis tool which will be used to provide data and information in integrating gender and social inclusion into service design.
- **Student Mentorship:** RCMRD conducted an induction session of newly enrolled students (youth inclusion) at RCTI who were introduced to the concept of gender equality as a human right, promotion of gender equity in STEM subjects as well as stereotypes and biases that bring about gender discrimination.
- **Flexible Work Hours Program:** RCMRD has introduced work-from-home and telecommuting options which increased the ability to work from home for women and men alike. Given that mothers currently carry a disproportionate burden in combining work and child care duties, they stand to benefit as these changes are likely to push social norms towards more equality in the provision of child care and house work.
- **Team Composition for Project Implementation:** Deliberate gender equality in team formation for field assignments, organizing and participation in conferences is a key consideration in the Centre's operations. There has been an increase in the number of female staff as leads in the various thematic areas, for example, in the SERVIR E&SA project, among other sections.
- **Targeted Sessions for Women's Training in Specialized Disciplines:** The Centre organized a gender-oriented vulnerability mapping and mentorship training for women in Lusaka Zambia and attracted participants for Southern and Eastern Africa. Participants were taken

## CENTRE'S FINANCIAL MANAGEMENT, APPROACH AND SUSTAINABILITY

For stronger financial and accounting controls and in line with ISO requirements, the Finance Unit continued reviewing the financial rules and regulations. This has seen a tremendous improvement in the overall controls at the Centre and has continued to ensure consistency by avoiding conflicts in the system and operations. The Centre took advantage of the favorable interest rates in the market and invested the surplus cash in secure fixed deposits. The newly constructed RCMRD Office Complex continues to provide alternative investment options through lease of office space and conferencing facilities. The freed-up space in the old buildings has been used as a Training Centre under the new Directorate of Capacity Building and Training. On asset management, the institution's assets were maintained in a fixed asset register. New assets acquired during the year were tagged and posted in the fixed assets register. The fixed assets register was also updated with information collected during the asset's verification exercise.

To ensure that the Centre's internal controls, processes and policies are adequately effective and in compliance with government requirements, Centre's policies and other key stakeholders' requirements, an external audit was conducted for the year ended 31st December 2020. The external auditor

confirmed that the financial statements gave a true and fair view of the financial position of the Centre. The external auditor gave an unqualified opinion. The recommendations given by the external auditor after the audit of the Financial Statements were fully implemented.

The Centre ensured timely issuance of invoices and statements of accounts to the member States on a quarterly basis. This also served as a reminder to the member States of the need to honour their membership contributions to enable the Centre offer services effectively and efficiently. On the provident fund, the Centre engaged reputable fund management companies to make proposals and recommend the best approach to invest/secure the fund.

### Settlement of Court Cases for Former Employees

On 21st February 2020, the employment and labour relations court at Nairobi made a judgement on the court case by the former employees that the Claimants were all paid their full terminal benefits with the exception of interest on provident fund. In 2021, the Centre made payments to two families. The pending payments will be completed as soon as the remaining parties present their paperwork as guided by the court.

## INFRASTRUCTURE

### THE ICT INFRASTRUCTURE

The Centre's ICT infrastructure was improved by upgrading the internet service by Safaricom, from a bandwidth of 30 to 70MBPs, installation of a high-capacity Server, CCTV network for video surveillance, internet protocol (IP) Phones and video conferencing equipment. An online e-learning platform was developed to support professional, RCTI and customized project trainings.

### THE RCMRD OFFICE COMPLEX

As part of the Business-park Masterplan, previously approved by the Governing Council in 2017, the Phase one of this masterplan; The RCMRD Office Complex was successfully completed and all contracts with the building and service contractors finalized. In 2021, the Office Complex became fully functional with staff occupying the various offices. The complex has a spacious conference room with modern facilities such as audio visual and video conferencing rooms that can accommodate upto 400 guests. There are spacious fully furnished corporate/professional training rooms that can accommodate upto 170 trainees per session. The

building also has a mother's room which enables staff who are nursing babies to have a private space where they can attend to young ones while in the office. There are spacious meeting rooms in every floor which are used for meetings with smaller groups of people. The complex also has a recreational space (pergola) at the rooftop of the building which allows for a relaxed working environment for staff and visitors. The building is also designed as a "green" structure, with large windows and open reception area which allows natural lighting and ventilation. On energy efficiency, it is fitted with solar panels for powering all lights and the office power sockets.



*The RCMRD Office Complex*

### **RCTI COMPLEX**

In addition to the scheduled maintenance checks and remedial servicing, when need be, proposals to create more classrooms in the old block are at an advanced stage. The aim is to create bigger classrooms from what was initially office spaces before shifting most of the offices to the new complex. The blocks that will be affected are: Block A, Block B, Block C, Block D.

### **RCMRD-RCTI MASTERPLAN**

In line with the Centre's vision on provision of services to member States, the Centre embarked on a second master plan, to complement the Business Case Masterplan. This would cover about 45% of the remaining area, currently hosting the college; Regional Centre Training Institute (RCTI). The proposal would create modern facilities for the school to enable a better training and learning environment. This would also increase revenue generation streams for the Centre. The proposal had the following amenities: Administration Block, Tuition Block with classrooms, halls and laboratories, and Accommodation Blocks with rooms, playing areas, eateries and a health clinic.



*An artist's impression of the approved RCTI Master plan*

## RCMRD-RCTI MASTERPLAN PHASE-1 HOSTEL BLOCK-1 CONSTRUCTION

Subsequently, after the design of the masterplan and review of the feasibility studies on the same, the GC approved construction of Accommodation Blocks. This would involve the construction of the 2 accommodation blocks, in two phases: Block 1- as Phase 1A and Block 2- as Phase 1B. Approvals for the same have already been acquired in readiness for construction. Construction of the first phase of the accommodation blocks was officially commenced in November 2021, with the excavation for the foundation. The Materials Testing Division, under the Ministry of Public works, has been contracted to undertake geotechnical surveys of the excavated area to assist in proper engineering designs for the construction. The building will have the following amenities: single bed rooms, shared rooms (2PAX to 6PAX), common lounges, basement parking, lift for disabled and user access, solar powered lighting and powering, solar power water heating, indoor games area, restaurant, swimming pool, outdoor games area (volleyball, basketball etc), health clinic, laundry area, and airing, biometric access control, shop area, cyber, stores, and accommodation management offices.



An artist's impression of the approved RCTI Students' Hostels



The RCMRD Governing Council Chair, Ms. Elizabeth Bonolo during the RCTI hostel block foundation laying ceremony.

## DEVELOPMENTS TO THE KISAMESE LAND PARCEL

A feasibility study for the Centre's Kisamese land in Kajiado County, Kenya was conducted. The approved proposal was to construct cottages.

# PROVISION OF PRODUCT AND SERVICES TO THE MEMBER STATES

## CAPACITY BUILDING ACTIVITIES IN THE MEMBER STATES

No	Course Name	No. of Participants	Country
1.	Global Navigation Satellite System (GNSS) Data Processing	15	Botswana, Burundi, Kenya, Rwanda, South Africa, Swaziland, Uganda
2.	Earth observation data processing for national development	20	Kenya, Burundi, Ethiopia, Rwanda, Sudan, South Sudan, Uganda
3.	Capacity building in the use of the Earth Observation for Crop Conditions Monitoring and Reporting	24	Ethiopia
4.	Data collection on Agricultural Monitoring	46	Kenya
5.	Stations-Satellite Data Blending and Development of Thematic Products Using Geo CLIM	2	Kenya
6.	Advanced GIS, Total Station & Levelling	4	Kenya
7.	Application of GIS & RS in Conservation Management	20	Kenya
8.	Application of SAR for Forest Biomass Estimation	9	Kenya
9.	Applied GIS for Climatological analysis	24	Kenya
10.	AutoCAD Civil 3D	12	Kenya, South Africa, Zimbabwe, Uganda, Namibia

11.	GIS & RS using QGIS	246	Kenya, Congo
12.	GIS, Remote Sensing & Web Mapping	41	Kenya
13.	GIS for Monitoring and Evaluation	7	Kenya, Tanzania
14.	Remote Sensing and Digital Image Processing	6	Kenya
15.	Harnessing Synthetic Aperture Radar (SAR) data in supporting all Weather response to development challenges "	22	Malawi, Rwanda
16.	Earth Observation Data Processing for National Development	22	Eswatini, Botswana, Lesotho, Malawi, Namibia, South Africa, Tanzania, Zambia, Zimbabwe
17.	Advanced GIS & Introduction to Remote Sensing	105	Burkina Faso, Ghana, Malawi, Mozambique
18.	Mobile Data Collection Tool and Geoportal User	103	Burkina Faso, Ghana, Malawi, Mozambique
19.	Geoportal and Mobile Administrator Training	11	Burkina Faso, Ghana
20.	Digital Image Processing Using QGIS	28	Burundi, Cameroon, Ethiopia, Eswatini, Kenya, Malawi, Rwanda, South Africa, Uganda, Zimbabwe
21.	Application of Remote Sensing Technologies for Improved Decision Making in Agriculture	24	Burundi, Cameroon, Ethiopia, Eswatini, Kenya, Malawi, Rwanda, South Africa, Uganda, Zimbabwe
22.	Impact Tool and Application in Forest Mapping	37	Burundi, Cameroon, Ethiopia, Eswatini, Kenya, Malawi, Rwanda, South Africa, Uganda, Zimbabwe
23.	Hazard Mapping Using Geoinformation Techniques for Samburu County Officers	23	Kenya
24.	Hazard Mapping Using Geoinformation Techniques for Isiolo County Officers	24	Kenya
25.	GMES and Africa land Productivity Analysis	250	Eastern western and southern Africa countries
26.	GMES and Africa Wetlands Vulnerability Analysis	250	Eastern western and southern Africa countries
27.	GMES and Africa E-Station training	6	Kenya and Rwanda
28.	Introduction to Digital Earth Africa	55	Kenya, Ethiopia, Zimbabwe, Uganda, Namibia, Lesotho, Eswatini, Malawi, South Sudan, Burundi, Tanzania, Zanzibar, Rwanda,
29.	GIS and RS tools to various application areas	18	Zambia
30.	EO climate integrations and validation	4	Eswatini
31.	AFREF and GNSS Data Processing	14	Kenya, Uganda, Tanzania, Ethiopia, Burundi, Rwanda, Malawi, Namibia, Zambia, Eswatini and Lesotho
32.	Remote Sensing & Digital Image Processing	10	Lesotho
33.	GPS for General applications & Mobile mapping	3	Nigeria
	<b>Total</b>	<b>1,485</b>	



Classroom session during the training on QGIS for the Ministry of Lands staff, Kenya

## HAZARD RISK MAPPING AND HAZARD ATLASES PREPARATION PROJECT

The Centre implemented the Hazard Risk Mapping and Hazard Atlases Preparation project in the Elgeyo Marakwet, North Pokot, and Wajir Counties in Kenya. The United Nations Development Programme (UNDP) funded activities in Elgeyo Marakwet and North Pokot Counties, whereas the World Food Programme (WFP) funded activities in Wajir County, Kenya. The project implementation commenced with needs assessment and consultations with key stakeholders; the County officials, local leaders, and the community members.

The team used datasets from various sources to map and develop the Hazard Maps and Atlases. The datasets included baseline data, administrative units, transportation systems, rainfall data, drought indicators, surface water, and

flood situation. The main hazards identified in the counties include floods, drought, landslides, land degradation, animal diseases, human diseases, plant diseases, and pests and accidents. The Centre used a participatory and ground-truthing approach during the hazard mapping process. Further, a validation workshop was conducted that brought together key stakeholders including the County Officials, to evaluate and validate the maps and the Atlas. More than 90 stakeholders participated in the participatory mapping exercises. The team incorporated the feedback from the stakeholders to improve the draft Hazard Maps and Atlases. The final copies of the Hazard Atlases were printed and disseminated to the stakeholders.



Participatory mapping exercise in Elgeyo Marakwet, Kenya

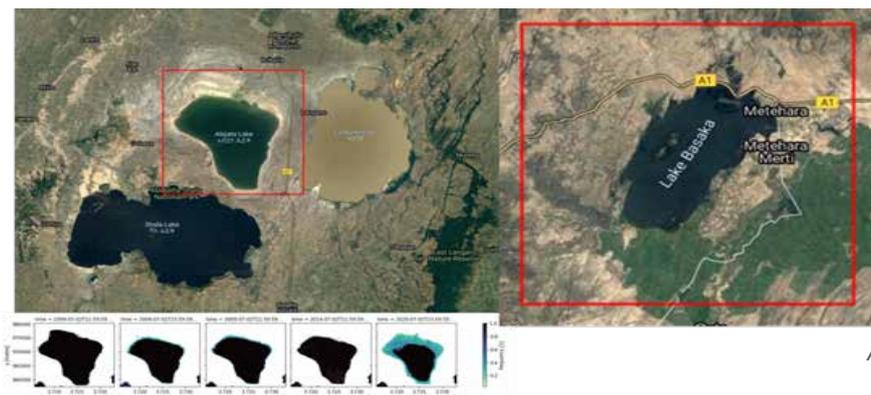


Hazards observed during the ground truthing field exercises

## GMES AND AFRICA PROJECT

RCMRD is implementing the GMES and Africa project, funded by the European Commission to support land and water sectors using Earth observation systems. The Centre is one of the consortium members of the GMES and Africa project, tasked to implement three applications in the IGAD and IOC regions. They include: (i) Land Degradation Monitoring and Assessment, (ii) Wetlands Monitoring and Assessment, and (iii) Open Geographic Regional Reference Vector Dataset for Water and Agro-ecological zonation. Through the GMES project, implementing countries are: Djibouti, Eritrea, Ethiopia, Kenya, Mauritius, Rwanda, Somalia, South Sudan, Sudan and Uganda. In 2021, the plan was to disseminate the results and complete the remaining deliverables. The following activities were implemented:

- Land Degradation Monitoring and Assessment: The main causes of the land degradation in Eastern Africa are two, namely anthropogenic and geological. The anthropogenic ones are related with human activities like agriculture, deforestation and overgrazing while the geological ones are natural mainly along the rift valleys and mountains as well as some of the gorges. The activities included the validation process which captured discussions with the stakeholders and confirmation of hotspots in various countries.
- Wetlands Monitoring and Assessment Eastern Africa is one of the areas where the wetlands are badly affected due to many human induced factors like



A Screenshot of the Wetlands Dynamics Analysis

encroachments related to agricultural land expansion, grazing areas and urbanizations. In addition, droughts occurring in the region have negatively affected the wetlands. In some cases, there are few areas where wetlands expanded mainly due to hydro-dynamics in some of the rift valley lakes. The data processed for the wetlands were validated in collaboration with the local partners and communities. Opportunities were provided to comment on the preliminary products with a discussion around utilization.

- Open Geographic Regional Reference Vector Dataset for Water and Agro-ecological Zonation -The Centre was the only consortium given the assignment to implement this application. Different vector data were gathered from various countries and stored in the Geoportal in a user-friendly format for public use and utilization of the datasets. The RCMRD-GMES Geoportal had more than 27 000 website visits in 2021. This Geoportal is one of the most appreciated products in the continental project.

- Support for MSc Students -the program supported eight (8) MSc. students from Ethiopia, Kenya, Rwanda and Uganda. The students were drawn from Addis Ababa University, University of Nairobi, University of Rwanda, and Makerere University respectively.
- Trainings- the Centre through the GMES & Africa program in collaboration with Makerere University conducted the following trainings: (i) Wetlands Vulnerability Analysis Tool utilization conducted in Makerere where more than 35 students attended physically and over 300 students participated virtually, (ii) Land Productivity Analysis Tool utilization conducted in Makerere where more than 35 students attended physically and over 300 participated virtually, (iii) Socio-economic Valuation of Land Degradation and Wetlands Analysis Tool Utilization conducted in Makerere where more than 35 students attended physically and over 300 participated virtually, and (iv) Earth Observation Data Analysis for Eastern and Southern Africa Countries conducted in Lusaka Zambia and at the RCMRD.



RCMRD-GMES and Africa Geoportal



Participants attending one of the trainings conducted at Makerere University.

## SERVIR EASTERN & SOUTHERN AFRICA (SERVIR E&SA) PROJECT

The Centre entered its third phase in the implementation of the SERVIR Eastern and Southern Africa project, a joint initiative of the U.S. Agency for International Development (USAID) and National Aeronautics and Space Administration (NASA). The project's goal is to increase the ability of African institutions to apply geospatial technologies to improve the resilience of the region to the impacts of climate change and ensure land use management reduces greenhouse gas emissions. The Centre through the project continued to implement activities in the member States and more specifically in Botswana, Ethiopia, Kenya, Malawi, Rwanda, Tanzania, Uganda and Zambia. The project implements activities under four main service areas, as well as cross-cutting activities that support the service areas activities and the Centre in general. The following services were implemented under the four main service areas: 1) Agriculture and Food Security Service Area

implemented the: (i) Regional Cropland Assessment and Monitoring, (ii) Range- land Assessment and Monitoring, and (iii) Frost Monitoring and Forecasting services. 2) Land Use Land Cover Change (LULC) and Ecosystems Service Area implemented the: (i) LULC Mapping and (ii) the Mapping and Modelling of Invasive Plant Species services. 3) Water Resources and Hydro-Climatic Disasters Service Area implemented (i) the Regional Streamflow Monitoring and Forecasting and (ii) Satellite-based Water Quality Monitoring (platform development is on-going) services. 4. The Weather and Climate Service Area continued work on the Climate Change Vulnerability, Impacts and Assessments Service, where two activities were undertaken.

### REGIONAL CROPLAND ASSESSMENT AND MONITORING - DEVELOPMENT OF A GIS-BASED SAMPLING FRAME

The Centre, through the SERVIR E&SA project, provided imagery and sampling frames for the Kenya Crop Insurance program during the 2020 short-rain season and the 2021 long-rain seasons for all the 33 crop insurance implementation counties. Methodologies to map climate homogeneity were also developed. Maps for 10 Counties in Kenya have so far been developed. The Counties include Kajajado, West Pokot, Baringo, Kericho, Makueni, Machakos, Tharaka Nithi, Meru, Kitui, and Kisii. The Maps are used to

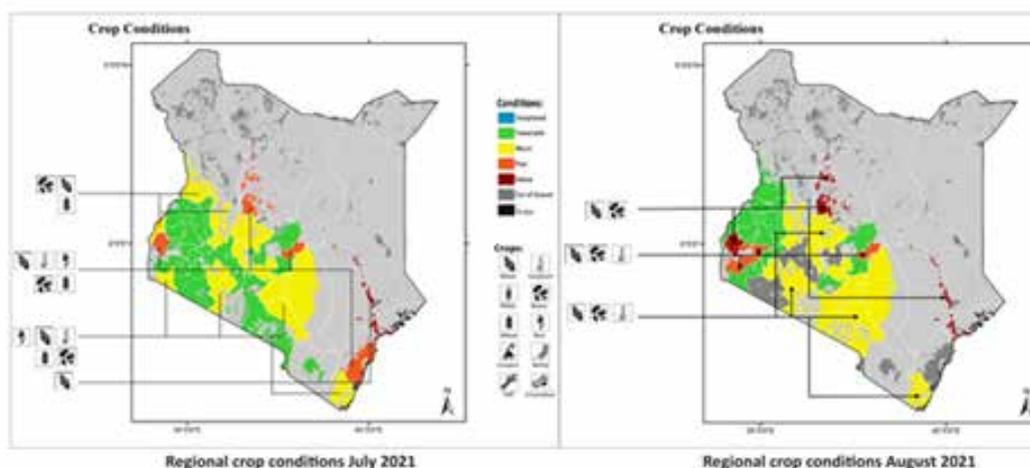
inform the development of Unit Areas of Insurance. Through the project, the Centre collaborated in the planning for data collection through the Lacuna funding that seeks to collect

crop labels in Kenya and Rwanda. The contractual process phase is complete.

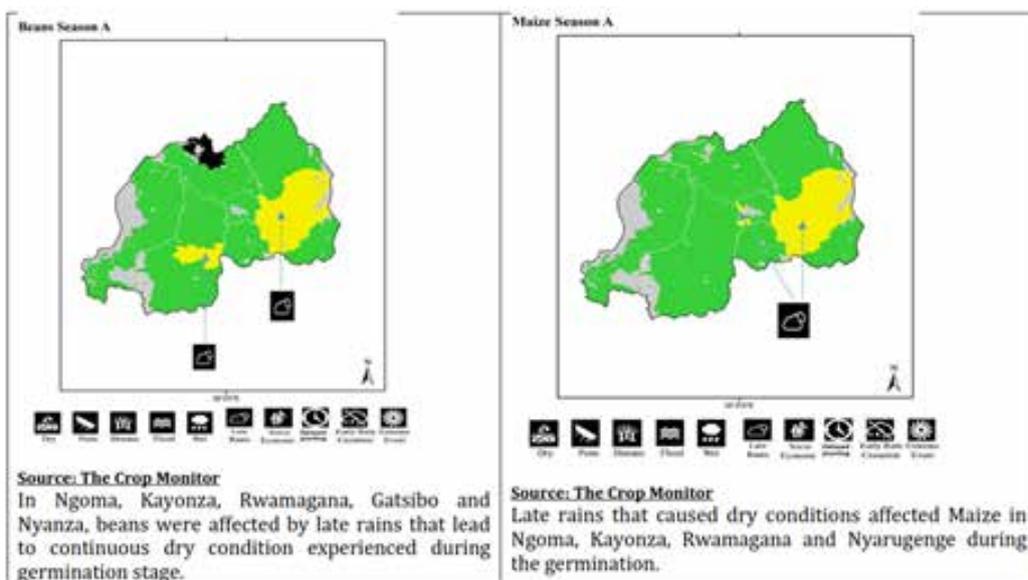
**SUPPORTING IMPLEMENTATION OF THE NATIONAL CROP MONITOR**

The Centre through SERVIR E&SA project continued to scale the implementation of the crop monitors, strengthening capacity in the existing crop monitors in Kenya and Rwanda, with the newest addition being the Ethiopia Crop Monitor. Two training events were conducted for Ethiopia in the year 2021. The crop monitors have been improved to include quantitative information to inform an understanding of how reported crop conditions will influence end of season yields. The crop monitors can be accessed at: Kenya Crop Monitor and Rwanda Crop Monitor.

A screenshot of the Crop Monitor's comparative analysis showing seasonal progression from the previous months.



A screenshot of Rwanda- development of end of season reports and reports on vegetables during the lean season.



**COLLABORATIONS FOR STRENGTHENING DATA SHARING AND TECHNICAL EXCHANGES**

An MOU was signed between RCMRD and Kenya Agricultural Livestock Research Organization (KALRO) to support collaborations in agricultural data collection and monitoring. This collaboration will ease data sharing, co-developments and research between the two organizations as well as supporting the establishment of Joint Experiment for Crop Assessment and monitoring (JECAM) monitoring sites.

**RANGELANDS MONITORING AND ASSESSMENTS**

- Development of Monitoring and Forecasting Indices - In collaboration with the University of Sussex, the Centre co-developed the implementation pipeline on the Vegetation Condition Index forecasts which provide six weeks advance information to support early warning decisions. The VCI forecasts are circulated to a wide audience including conservancies.
- Rangeland Decision Support Tool (RDST) - The Rangelands Decision Support Tool (RDST) was improved, the team integrated the forecasts into the RDST tool to facilitate easier accessibility by National Drought Management Authority (NDMA).

- Kenya RAPID and Mercy Corps LMS activities - The Centre through SERVIR E&SA project supported Kenya RAPID and Mercy Corps Livestock Market Systems projects in participatory mapping of rangeland resources and training the County Officers. The team developed maps for Garissa County (Balambala and Waberi wards), Wajir County (Eldas ward), Isiolo County (Cherab ward), and Marsabit (Loiyangalani ward). A technical guide for the Training of Trainers (ToT) was also developed and shared with the County stakeholders. The maps support the identification of priorities for investments by the counties through the ward planning committees.

### HARNESSING SYNTHETIC APERTURE RADAR (SAR) TRAINING

Two training sessions on Harnessing Synthetic Aperture Radar (SAR) were conducted in Rwanda and Malawi. In Rwanda, 12 participants were trained, from the Ministry of Agriculture, University of Rwanda, Rwanda Water Board, Rwanda Housing Authority, Rwanda Forest Authority, Rwanda Land Management & Use Authority, the Ministry of Environment and the Ministry of Local Government. In Malawi, 10 participants were trained, from the Ministry of Agriculture, Department of Land Resources Conservation, Ministry of Agriculture, Department of Animal Health and Livestock Development, Centre for Development Management (a Research Institution), Mwapata Institute, Ministry of Forestry and Natural Resources, Department of Forestry and the Ministry of Lands, Housing and Urban Development, Department of Surveys. Malawi, being very prone to flood events particularly in the south, appreciated the flood application training as an easy and ready to use tool that can support decision making context during flood events.



SAR training classroom session in Malawi

### SUPPORT TO THE GLOBAL FOREST OBSERVATIONS INITIATIVE

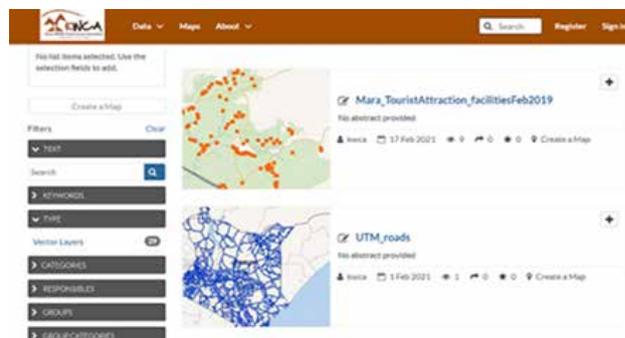
The Centre through SERVIR E&SA project participated in a review process supported by the World Bank and Global Forest Observations Initiative (GFOI) to develop open Measurement, Reporting and Verification (MRV) tools that can be used extensively. Regional contacts for Kenya, Uganda and Zambia were provided to make contributions on the tools being used and to review the three-part series of the MRV tools created as a result of these activities.

### MAPPING AND MODELLING OF INVASIVE PLANT SPECIES (ECOLOGICAL MODELLING)

The Centre, through the SERVIR E&SA project, being a member of the consortium of institutions involved in the monitoring and mapping of the invasive species in northern Kenya and beyond, has continued to provide technical support and advisory services on the mapping of the invasive species activities. The consortium is currently developing management plans for invasive species. The invasive species data is currently being used to create an atlas on wetlands and other critical assets in the dryland areas in Kenya. These maps will be used to inform stakeholders of the extent of invasion and to differentiate palatable and non-palatable plants within the wild animals and livestock migration corridors, a project of Centre for Training and Integrated Research in ASAL Development (CETRAD) and The Wyss Academy for Nature in collaboration with Government of Kenya.

### KENYA WILDLIFE CONSERVANCIES ASSOCIATION (KWCA) CONSERVATION GEOPORTAL

The Centre through SERVIR E&SA project collaborated with Kenya Wildlife Conservancies Association (KWCA) to develop a geoportal which enables users (KWCA and its partners) to host conservation data, analyze and create maps of key conservation areas. KWCA also uses the portal to manage documents, for instance, the status of conservation reports.



Screenshot of the KWCA Geoportal showing GIS layers

### THE REGIONAL STREAMFLOW MONITORING AND FORECASTING

The Centre through the SERVIR E&SA project continues to implement the Regional Streamflow Monitoring and Forecasting Service. The Service provides real-time stream flow and flood forecasts for watersheds in East Africa through hydrological models driven by bias-corrected satellite precipitation products among other inputs that enable the timely prediction and monitoring of water resources and extreme hydrological events (flood and drought). The products, tools and platform use Earth observation and remote sensing products to complement scarce in-situ data. It currently supports the Ministry of Water and Irrigation (MoWI) and the Basin Water Boards (BWBs) of Rufiji and Wami-Ruvu basins in Tanzania through technical capacity building and development of a basin operational hydrological model for streamflow monitoring.

## SATELLITE-BASED WATER QUALITY MONITORING SERVICE

The Satellite-Based Water Quality Monitoring Service leverages Earth-observing satellite information to assess historical water quality changes of in-land transboundary lakes. The Service also analyses Earth observation data to generate static maps of the coverage of water hyacinth, land use, and land cover for specific epochs. To further understand the variation of water quality of a lake as shown by the Inland Water Quality Tool in this service, and to establish any relationship between the land surface fluxes as a result of anthropogenic activities and the Lake Water Quality, a pilot catchment-based water quality hydrological modelling has been undertaken from 2010 to 2019 for Nyando River Basin in Kenya. The Soil Water Assessment Tool (SWAT) model is being used to estimate land-based fluxes such as runoff, sediments, nutrients (nitrogen and phosphorus(N&P)), Biological Oxygen Demand (BOD), and Chemical Oxygen Demand (COD) into the lake hence contributing to the lake's poor water quality and eutrophication.



Screenshot of the updated the updated Water Quality Application

## ESTABLISHMENT OF COMMUNITY BASED FLOOD EARLY WARNING SYSTEMS (CBFEWS) IN SELECTED FLOOD PRONE DISTRICTS OF MALAWI

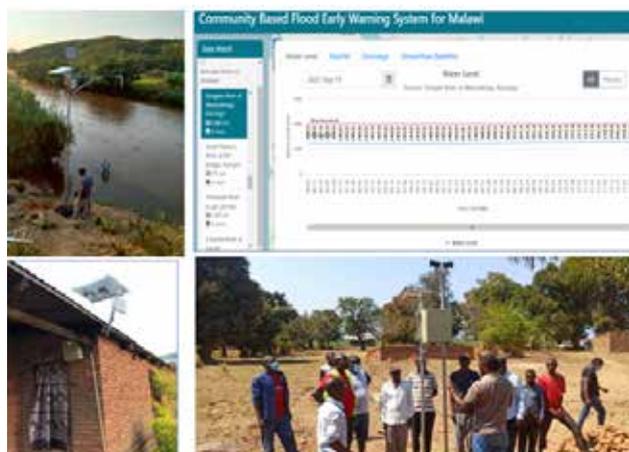
The Centre, the International Centre for Integrated Mountain Development (ICIMOD) and Sustainable Eco Engineering (SEE) Ltd of Nepal were jointly awarded a UNDP project to establish a Community Based Flood Early Warning System (CBFEWS) in a selected flood disaster prone district of Malawi to support flood disaster risk reduction. The project is being implemented in collaboration with the Government of Malawi through the Department of Disaster Management Affairs (DoDMA), Department of Water Resources (DWR), Department of Climate Change and Meteorological Services (DCCMS) and Malawi University of Science and Technology (MUST). The inception workshop, scoping, design and installation activities have been completed, and the project team is working towards the development of the standard operating procedures. The CBFEWS visualization platform was built to help with data management and visualization.

## INTEGRATION OF EARTH OBSERVATIONS WITH GROUND CLIMATE DATA

The Centre supported two basin water boards in Tanzania (Wami-Ruvu and Rufiji basins) with climate data quality assessments from their in-situ stations and integration with EO based products, specifically Climate Hazards Group InfraRed Precipitation with Station data (CHIRPS). Leverage was made on an automated R-based algorithm developed by the International Research Institute for Climate and Society (IRI) and customized by the Centre to merge basin data with CHIRPS rainfall for the year 1981-2020 at monthly and dekadal periods. Evaluations and validations were conducted in order to perform bias improvement of the merged rainfall products.

## EARLY WARNING EARLY ACTION (EWEA) PARTNERSHIP WITH KENYA RED CROSS SOCIETY

RCMRD supported the Kenya Red Cross Society in its Early Warning Early Action (EWEA) program by attending monthly national forecast-based financing meetings to develop and review early action protocols for floods and droughts. The Technical Working Group (TWG) composed of disaster related agencies and institutions managed to finalize drought Early Action Protocols and are at the trigger development stage, while the flood early warning protocol has been finalized. A risk analysis framework has also been developed, and vulnerability and exposure analysis conducted across all the 47 counties in Kenya. RCMRD is providing data and technical advice to the TWG and has also been part of the flood early action protocol (EAP) simulation planning exercise that is organized by Kenya Red Cross Society Kenya.



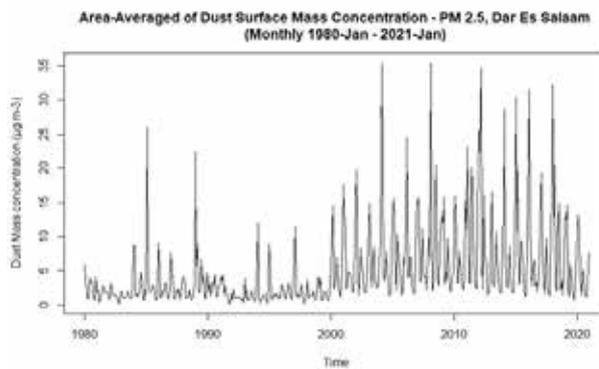
Installed CBFEWS system for Songwe River (Data Acquisition Unit (DA), Data Upload Unit (DU) and Alarm Unit (AU)).

# THE CENTRE'S GIS UNIT

## C40 EMPOWERING CITIES WITH DATA (ECWD)- DAR ES SALAAM AIR QUALITY MONITORING BASELINE STUDY PROJECT

Measuring air pollution is an important step in understanding risks and designing effective policies to reduce community exposure to improve public health. The Dar es salaam City Council (DCC) is committed to achieving a sustainable, equitable and healthy future for residents. The Centre in partnership with Dar es Salaam City Council through the Stockholm Environment Institute (SEI) sought to create an estimate of current baseline air pollution characteristics in the city through: (i) Conducting an air monitoring study, (ii) Reviewing existing monitoring and satellite data in ambient pollution, and (iii) Report on the analysis of satellite data estimates of current baseline ground concentrations levels of aerosols and particles including Carbon Monoxide (CO), Nitrogen Dioxide (NO<sub>2</sub>), Sulphur dioxide (SO<sub>2</sub>), fine particulate matter, PM<sub>2.5</sub>, PM<sub>10</sub>. In 2021, the Centre developed products that presented the state of the current baseline ground concentrations levels of aerosols and particles including Carbon Monoxide (CO), Nitrogen Dioxide

(NO<sub>2</sub>), Sulphur Dioxide (SO<sub>2</sub>), fine particulate matter, PM<sub>2.5</sub>, PM<sub>10</sub> in Dar es Salaam from Earth Observation data.

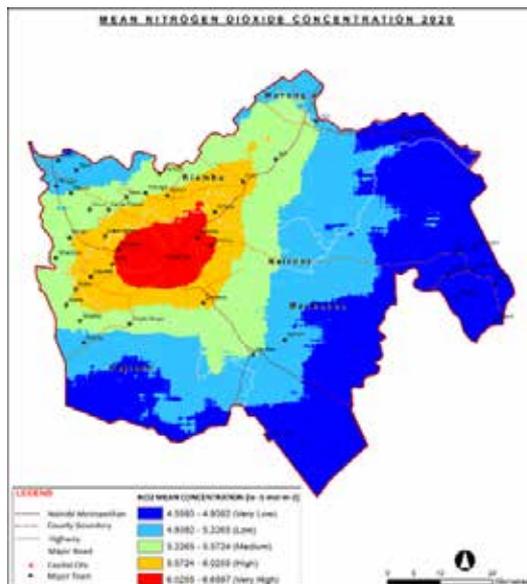


Air quality products presented to the city of Dar es Salaam to aid in the air quality management

## SUSTAINABLE WATER AND AIR QUALITY MONITORING SYSTEMS IN AFRICA - NAIROBI AND ADDIS ABABA PILOT PROJECT

Through a Small-Scale Funding Agreement (SSFA) entered between UN Environment (UNEP) and RCMRD, UN Environment agreed to cooperate with the Centre to implement a project entitled "Sustainable Water and Air Quality Monitoring Systems in Africa (Nairobi and Addis Ababa Pilot Project)". The project sought to address surface water and ambient air of both Addis Ababa and Nairobi Metropolitan Region. Among other goals, the project seeks to dive deeper into Sustainable Development Goals, especially, SDG 11.6.2; on Air Quality in the cities and SDG 6 on water and sanitation. The project will contribute towards mapping of air pollution hotspots in the city of Nairobi and Addis Ababa. This will support the visualization of the deteriorating air quality in both cities over the years and develop story lines to highlight the dynamics and key drivers of state and scenarios for the future. This will help to inform policy and decision making in the county and influence the formulation of appropriate remedial measures.

In addition, the project seeks to undertake mapping of the catchment of rivers passing through the city by demarcating



Nitrogen dioxide products presented to UNEP for Nairobi

riparian boundaries/zones and identifying their trend in terms of boundaries/zones, identify areas where stormwater and surface runoff affects rivers, identify water pollution 'hotspots', map the current groundwater boreholes especially those near the rivers, those in industrial setups, settlements and urban (Metropolis) agricultural zones. The project will also identify potential areas for restoration, and map sanitation facilities. This will help identify current and potential areas for Blue and Green Economies. Among the deliverables that RCMRD submitted are: maps of the cities

metropolitan areas, maps and reports detailing air quality trends dating to 50 years back, maps and reports on the status of surface water quality in the rivers draining the cities, maps detailing riparian boundaries/zones and identifying their trend in terms of boundaries/zones, maps identifying areas where stormwater and surface runoff affects rivers, maps showing surface and groundwater pollution 'hotspots', maps of the current groundwater boreholes especially those near the rivers, those in industrial setups, settlements and urban (Metropolis) agricultural zones, and maps of sanitation facilities.

## DESIGN, SUPPLY, INSTALL AND COMMISSION A LAND INFORMATION MANAGEMENT SYSTEM (LIMS) FOR MALAWI

Spatial Dimension South Africa (Pty) Limited, in association with Africa Bees Limited, RCMRD and Kennedy Z36 Systems, signed a contract with the Ministry of Agriculture under the Agricultural Commercialization Project (AGCOM) to design, supply, install and commission a Land Information Management System (LIMS). The primary intention of the project will be to design and implement a system for land administration and management consistent with the needs of the Land and Valuations, Physical Planning and Survey Departments. The key objectives of the project are:

- Carry out a detailed review and analysis of the existing situation in the Ministry related to the land administration services, including review and analysis of documentation and laws, information systems and ICT infrastructure, business processes, reports and key performance indicators.
- Develop technical specifications for the system design and development, including System Requirements Specification (SRS), System Design Specification (SDS) and a Test Plan.
- Develop the LIMS and appropriate tests, based on prepared technical specifications and test plan.
- Carry out the transformation and migration of existing digital records into the LIMS as well as the data conversion of land-related paper records and cadastre maps for establishing a comprehensive land record in the LIMS database, including vectorization of cadastre maps for capturing parcel boundaries.
- Introduce LIMS in the offices selected by the Ministry, populated with land records from the data conversion and migration exercise.
- Conduct extensive trainings for end users, administrators, and developers.
- Provide further maintenance and support based on prepared maintenance and continuity plan.
- The project officially commenced on the 1st June 2021 and will be carried out over a period of 56 months which will include 20 months of implementation and 36 months of support. Current activities on the ground include; land folio analysis for LIMS, LIMS infrastructure assessment, and training needs assessment at higher level.

## THE AFRIGEO SECRETARIAT AT RCMRD

The AfriGEO is an initiative of the African community in GEO aimed at providing a coordination framework and platform for Africa's participation in GEO. In addition, it is a: (i) Pan African initiative to raise awareness and develop capacity on EO for governments, research organizations and the commercial sector; (ii) Framework for strengthening partnerships and collaborations within Africa; (iii) Gateway into Africa for international partners; and (iv) Support mechanism for the implementation of GEO objectives and programmes in Africa. The AfriGEO Secretariat, through a resolution of the 2018 Steering Committee meeting held in Gabon, was moved to the RCMRD in Nairobi, from Geneva where it had been hosted since its inception. Further details on the AfriGEO objectives and action areas guiding the

collaboration with RCMRD are available at <https://www.earthobservations.org/afrigeo.php>. The main activities implemented in 2021 are:

- (i) Launch of the MSc/MPhil and PhD curriculums - in 2021, the MSc/MPhil and PhD curriculums were officially launched in Accra, Ghana with representatives from the Ministry of Education, Ghana, Vice Chancellor University of Energy and Natural Resources, United Nations Convention to Combat Desertification (UNCCD), GEO Secretariat, GEO LDN Co-Chairs, AfriGEO Secretariat, local media stations and participants from Kenya, Zimbabwe, Burkina Faso and Ghana. The event was aired on national TV stations in the country. AfriGEO provided opportunities that shall lead to

accreditation through advanced education at Masters and PhD levels, at the same time recognizing the need to rapidly build technical skills of institutions through specialized short courses via Massive Open Online Courses (MOOCs) or face to face trainings.

(ii) AfriGEO representation by the University of Energy and Natural Resources (UENR), Ghana through Prof. Amos Kabobah as Co-Chair in GEO Land Degradation Neutrality (LDN) initiative provided a unique model for implementation that considers engagement of diversified regional inclusion in co-design of the capacity building approach in a way that shall benefit Africa much more realistically while at the same time providing strengthened human capital at local institutions. Land degradation is a major development challenge and a priority SDG 15.3 reporting action.



*A session during the GEO LDN Meeting in Accra, curriculum review and launch*

(iii) Capability Building Exchanges - AfriGEO recognizes the contributions of the Centre through the SERVIR E&SA project. Further, the efforts of the SERVIR West Africa hub have also been recognized. The SERVIR project particularly made connections to GEO activities that could be utilized in supporting member States. The Centre participated in a workshop with GEOGLOWS co-Chair, Prof. Jim Nelson. SERVIR E&SA has since used the GEOGLOWS data to calibrate the SWAT hydrological model outputs to compensate for data gaps experienced while supporting water resources monitoring and management activities in 33 river basins in Malawi and the Lake Victoria basin covering Mara: Tanzania and Kenya, Nyando and the Nzoia (Kenya). The SERVIR E&SA and the SERVIR West Africa have also been able to make connections with GFOI and participated as reviewers of the "Open MRV" toolkit that GFOI launched this year to support countries in their Monitoring, Reporting and Verification. Through capacities transferred from GEOGLAM in early warning systems for crop productivity, the Centre through SERVIR E&SA has also been able to downscale crop monitors at national levels.

The crop monitors now implemented in Kenya, Uganda and Tanzania and most recently in Ethiopia and Rwanda have been adopted by the countries as early warning systems on crop performance. This goes a long way in enhancing AfriGEO commitments in supporting member countries' utility of EO in decision making processes. Along with these implementations, Ministries of Agriculture within the member countries have also been trained on using EO skills to

monitor crop productivity.

(iv) AfriGEO supports Digital Earth Africa (DEA), a regional GEO initiative, for the contributions it makes to the AfriGEO Work program on capacity building and data access. DEA enhances capacity building through its networks of partners. The model adopted to have regional institutional (Central-OSS, South-SANSA, East-RCMRD and West Africa-AfriGIST, AGRHYMET and CSE) representation by implementing partners is one to be exemplified. The recognition that capacity building is key to strengthening local institutions and requires breaking barriers such as language and addressing Gender Equality Diversity and Inclusion (GEDSI) into their implementation framework ensures sustainability. Through DEA, AfriGEO has an opportunity to access analysis ready data and derived data products developed through priority application identification by the implementing partners.

(v) South Africa re-activated its national GEO. It is the first country on the continent to have a national GEO, which will be supported by Lulu Makapela. South Africa has been very proactive in its support for GEO and GEO-related activities and contributes financially to support the operations of the AfriGEO Secretariat. The contributions made at institutional levels by SANSA, the Department of Science and Innovation, and the South Africa Weather Service just to mention a few institutions, ensures that adoption of EO technologies at the national level provides evidence of EO capabilities in improving decision making in many countries and on the continent at large. AfriGEO receives other member contributions by commitments to the AfriGEO Steering Committee that constitutes representation from Uganda, Kenya, Nigeria, Senegal, Gabon, Ghana, South Africa, and Seychelles which recently joined as a member of the Steering Committee. Other countries include Egypt, Morocco, Mauritius, and participating organizations such as RCMRD, AGRHYMET, and UNECA.

(vi) The 5th AfriGEO Symposium - The 5th AfriGEO Symposium took place virtually from 17-19 November 2021. The symposium's theme, "Open Science for Growing African Industries in Earth Observation" was strategic to catalyze conversations leading to partnerships, sustainable economic growth and enhancing utilization of EO data in supporting economic development in Africa. The symposium focused on five key areas: Climate Change, Agriculture and Food Security, Industry (SMME), EO for Health, Disaster Risk Reductions, Data and Infrastructure as a cross cutting theme in the 5 sessions. The event drew interest from all over the world, with 533 participants.

The event was streamed live on YouTube to increase participation. The event provided a platform for experts and decision makers to share their expertise and experiences. Participants were able to learn and be informed of current issues being addressed using Earth observation in terms of measurement, response, understanding risks, deriving value added products that will sustain small and medium scale businesses. The event was honored to have keynote addresses delivered by Prof. Francois Engelbrecht, the Director and Professor of Climatology, Global Change

Institute, University of Witwatersrand; Prof. Justine Blanford - ITC Professor of GeoHealth and Education in the Department of Earth Observation Science, just to mention a few. The AfriGEO Secretariat is most grateful to all the presenters, panelists, keynote speakers, participants and the symposium secretariat.



Guest Speakers of the Symposium on the Opening session on 17th November, 2021

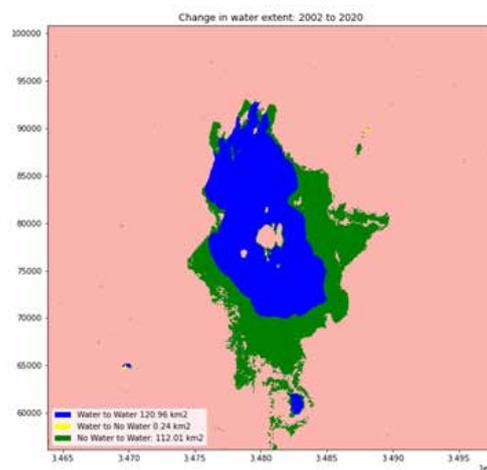
## DIGITAL EARTH AFRICA

DE Africa is a not-for-profit initiative funded by US-based Leona M. and Harry B. Helmsley Charitable Trust and the Australian Government. In collaboration with the Implementing Partners (IP) based in Africa, DE Africa is providing reliable, operational analysis ready EO data to deliver decision ready products and services to address social, environmental and economic changes in Africa. DE Africa is a Group on Earth Observations (GEO) community activity. Geoscience Australia (GA), on behalf of DE Africa, and the RCMRD signed a Memorandum of Understanding, which stipulates that the Parties anticipate collaboration in the following areas: (i) Supporting the leadership of DE Africa through nomination of people at leadership levels for the DE Africa Technical Advisory Committee, (ii) Access to DE Africa infrastructure. RCMRD may have (non-exclusive) access to DE Africa for use by RCMRD, including its member countries and beyond, benefitting the mission of both RCMRD and DE Africa, (iii) Capacity building both within RCMRD and more widely, such as training programs to build expertise in Open Data Cube and the production and use of DE Africa products, and (iv) Country-level engagement including the leveraging of relationships that RCMRD holds with its member countries and involvement of DE Africa in country level engagement and events.

Project accomplishments so far include: (i) the Centre staff have undergone various trainings on DEA Toolbox and crop mapping, (ii) the Centre started outreach to organizations locally, so far LocatelT, OAKAR services, and ESRI, (iii) Use case development using the DEA platform has been conducted for Rift Valley lakes, burnt area mapping and Lake Baringo rising water levels. The project management office will be hosted in South Africa by South African National Space Agency (SANSA). The current running RCMRD-DEA-SANSA contract will be operational for the next five years.

Digital Earth Africa provides open self-paced learning through the Sandbox and access to its data is available to all. This has an enhanced capacity of 38 trainers that can

now train others within their institutions and stakeholders' base in utilizing the DE Africa cloud computing resources and data access. DE Africa as part of its capacity building strategy is also participating as a partner in the EO Challenge for Africa 2021, with partners from RIIS, ZA Space, SANSA, AWS, AfriGEO, Maxar, Gen Space, and Space and Africa. The challenge gave awards i.e., access to Earth observation data packages from Maxar and Amazon Web Services credits, to 4-month incubation starting December and virtual mentorship with GEN Space, Digital Earth Africa and Amazon Web Services. The challenge is a good model to strengthen and build budding EO businesses in Africa, at the same time build the capacity of finalists. The winners of the challenge were: 1st Place- Astral Aerial Solutions, Kenya; 2nd place- Ijumaa Data Analytics, Kenya; 3rd Place- Agrispace, Zimbabwe; and 4th Place- (3 institutions) Nyasa Aerial Data Solutions Ltd, Malawi; Ignitos Logistics Limited, Zambia; and Aqua Fisheries, Nigeria. Further to this, the Women's Sprint held in June, 2021, provided an opportunity for women to participate in an Open Data Cube Hackathon. Through this activity, participants were able to not only learn from each other but also create lasting networks with experts on the subject.



Change extents of Lake Baringo, Kenya

## SOILS 4 AFRICA PROJECT

RCMRD was contracted to implement the Soils4Africa project during the year 2020. Funded by the Horizon 2020 programme of the European Union, the Soils4Africa project will put in place an open-data Soil Information System (SIS) by 2024. The SIS will enable farmers, agri-businesses, scientists, and policymakers in their efforts towards sustainable intensification of agriculture and boosting food security; by improving the quality and availability of African soil data. The RCMRD's key role in the project is development of user requirements for the SIS (Work package 3); technical design of the SIS; building the SIS; developing demonstration soil information products based on SIS use cases; capacity building of the SIS hosting institute (Work package 6). RCMRD being a spatial data hub is also supporting input data acquisition for continental mapping of agricultural land. So far RCMRD has achieved the following in this project: (i) Processed fractional cover of land cover classes (cropland/forest/shrubland/grassland) for the African continent, (ii) Developed draft Map of Agricultural Land for African Continent, and (iii) Attended the Annual Project Meeting on 9th September 2021 where the progress for each Work Package was reviewed; confirmed future tasks for each partner including re-adjustments where necessary; discussed opportunities and possible risks during implementation including risk mitigation measures.

## MALAWI AGCOM PROCESS MONITORING OF PILOT IMPLEMENTATION OF THE NEW LAND LAWS IN MALAWI

The Government of Malawi is implementing the Agricultural Commercialization Project (AGCOM) with support from The World Bank. This project is being implemented by the Ministry of Agriculture (MoA) in collaboration with the Ministry of Lands. The objective of the AGCOM Project for Malawi is to increase commercialization of agriculture value chain products selected under the project. Under the AGCOM project, The World Bank is funding the Land Reform Programme (LRP) which is being implemented by the Ministry of Lands (MoL). The Programme aims at strengthening land administration and management services of the Ministry in order to promote land tenure security as a basis for raising agricultural productivity in the country. Land reforms entail the creation of customary estates to enhance land tenure security and encourage investment on land in Malawi. This is meant to improve the livelihoods of rural farmers and allow them to commercially use their land. The key land-related laws that were being piloted under the Land Reform Programme include; The Land Act (2016), The Physical Planning Act (2016), The Land Survey Act (2016), The Customary Land Act (2016), The Registered Land (Amendment) Act (2016)

and The Land Acquisition (Amendment) Act (2016). The activities under AGCOM will contribute to Component 2: Access to Land for Commercial Agriculture by providing support for the policy and regulatory environment for increasing access to land and tenure security for commercially oriented smallholder and commercial farmers as well as other actors in agricultural value chains. RCMRD was contracted as an external reviewer to monitor the processes during the implementation of key land-related laws in six pilot districts - Karonga, Rumphi, Nkhosakota, Mchinji, Chikwawa and Nsanje before national roll out. Further, RCMRD developed the national roll out proposal. This is the document that will guide the scaling up of the program to the entire country. As at the reporting date, all the deliverables for this assignment had been handed over to the client and the project was officially closed. These include an inception report on project kick off, assessment of start-up arrangements report, monitoring framework and tools, a digital dashboard, monthly flash reports with two quarterly reports, proposal for national roll out of the programme, and a final project report.

# ALLIANCE FOR A GREEN REVOLUTION IN AFRICA (Agra)

## Regional Food Balance Sheets (RFBS) for Eastern and Southern Africa

RCMRD is in contract with AGRA towards the development of a Regional Food Balance Sheet. The project dubbed: Strengthening Agri-Foods Data Systems to inform Food Security Policies & Trade in Sub-Saharan Africa, seeks to contribute to the enhancement of regional food security and sustainable agriculture transformation. Its implementation is planned to begin in 2021 and run for three years. This program is funded in the initial stage by the PIATA Partners through AGRA's Africa Food Trade & Resilience Programme. The RFBS initiative seeks to develop and maintain a user-centric digitally enabled web platform which uses near real-time data feeds to generate intuitive and value-additive analytics and dynamic visualizations. An initial version of the RFBS tool, known as the Minimal Viable Product (MVP), will be completed in Wave 1 and launched in January 2022, covering six countries in East and Southern Africa, including Kenya, Uganda, Tanzania, Rwanda, Malawi, and Zambia. It will present data and analytics on three crops (maize, beans, and rice).

Eventually, the platform will cover eleven countries in East and Southern Africa, including Kenya, Uganda, Tanzania, Rwanda, Burundi, Ethiopia, South Sudan, Malawi, Mozambique, Zambia, and Zimbabwe. Following the initial build, the eventual scope will include Central and West Africa. The RFBS initiative is a collaborative and multi-stakeholder engagement, including participation from a range of analytical and technology partners to provide data and forecasts on crop production, cross-border trade, input supply, data aggregation, and platform development. So far RCMRD has achieved the following: (i) During the first week of September 2021, RCMRD staff underwent an introductory training on machine learning for cropland mapping and production estimation using the GeoCIIF Model courtesy of the University of Maryland, (ii) Collaboration with Ministry of Agriculture in 6 RFBS countries, (iii) AMIS Platform has been set up to help in reporting on project progress, and (iv) EWX product development where RCMRD liaised with IGAD Climate Prediction and Application Centre (ICPAC) towards development of agriculture hotspot products (Concept Note and MOU).

## LESOTHO RURAL LAND REGISTRATION STUDY

The USA, acting through the Millennium Challenge Corporation ("MCC") and the Government of Lesotho entered into a Grant and Implementation Agreement to support the development and facilitation of a compact program. The Government, acting through Lesotho Millennium Development Agency, intended to apply a portion of the MCC Funding to fund the Rural Land Registration study. This was a six-month undertaking. The goal of the study was to design a sustainable and equitable approach to land registration in rural areas of Lesotho, where land allocation mechanism and land registration system (register and issue land leases) are not functioning properly. The study was meant to support future investments in agriculture and the rural sector. The focus was to bring out the challenges that women face in accessing and registering land in rural areas. The deliverables include: (i) Fact-Finding and Initial Assessment Reports, (ii) Fact-Finding and Initial Assessment on Rural Land Registration, (iii) Special Assessment of Land, Gender and Equity Issues in Rural Areas, (iv) Development of a cost effective, sustainable and efficient approach to rural land registration in Lesotho, and (v) Preparation of a paper that will present an analysis of the rural land tenure environment in Lesotho.

## GEOHUB AFRICA

This is an initiative by the Centre to foster and promote innovation in the geospatial field across Africa. Through capacity building in key areas such as computer programming, machine learning and artificial intelligence, the Centre hopes to spur innovation of services and products to address societal issues in our member States. GeoHUB will also act as an incubator for innovative ideas, business idea start-up, application development, and research. Currently the Centre is developing a geospatial artificial intelligence course prototype to be delivered as part of this initiative. The course has attracted Radiant Earth Foundation with whom RCMRD has signed an MoU to see this through.

# THE CENTRE'S ENGINEERING UNIT

The Engineering Unit's main role is calibration of surveying instruments. In 2021, approximately 150 instruments were serviced and calibrated in Kenya. Two participants from Liberia were trained on "Basic Service, Maintenance and Calibration of Surveying Instruments". The Centre continues to improve staff skills under this Unit to ensure the provision of quality services in the member States. The Unit has also been compiling a Surveying Instruments Inventory in the member States in order to establish the type, number and the status of instruments available for the Centre to make appropriate preparation and training needs.



Officers from the Liberia Land Authority during a practical session at the RCMRD Surveying Equipment workshop. The training was on servicing, repair and maintenance of equipment.

# SPEARHEADING KNOWLEDGE MANAGEMENT

## THE RCMRD LIBRARY

The Centre's Library has continued to improve the functions and services to efficiently and effectively meet the needs of both the Centre Staff and students of the RCTI. The RCMRD Library provided quality resources and services to students and college teaching and training staff. This supports research, maintaining a healthy work environment for students, staff and all Library users. The RCMRD Library also reviewed and developed strategies and policies where there was need, effectively managed the existing collections and maximized utilization by students and staff by publicizing the library services through e-mail. The library also received of up to 270 theses from the University of Twente in the Netherlands, through a donation program. The library usage statistics indicated physical and internet-based usage of services was up to 3000 and over 2500 users respectively. Renewal of subscription to online-based digital newspapers was done, as well as payment for support and upgrades for a search site of the library's data. The Acting Librarian attended a training on gender mainstreaming (sponsored by the employer) and a webinar for university and research institutions' librarians on "shared experiences in the past 12 month during Covid-19".

## ISO 9001:2015 QMS

The Quality Management and Assurance section has continued to spearhead its main role of ensuring that the Centre keeps on providing its customers and stakeholders with quality products and services by ensuring compliance with ISO 9001:2015 Quality Management Subsystem. This has been possible through quality control and assurance of all activities, products and services by carrying out QMS internal audits, external recertification audit by the certification body-KEBS which assured RCMRD of continued certification to the international standard ISO 9001:2015 QMS, management review of processes, training and sensitization of staff in matters QMS, review of procedures for suitability and compliance to emerging trends among others. RCMRD is therefore, ISO 9001:2015 certified, which is a great milestone in achieving customer satisfaction as detailed in RCMRD's Quality Policy.



ISO 9001:2015 QMS

## REGIONAL CENTRE TRAINING INSTITUTE (RCTI)

With the mission to promote sustainable development through the generation, application, and dissemination of Geo-Information and allied ICT services, the Regional Centre Training Institute (RCTI) continued to offer Geospatial and IT courses that utilize the current technologies (GIS, AutoCAD, GPS, Drone among others). The training section has Diploma programs in Land Survey, Photogrammetry, and Remote Sensing, Cartography and GIS, and Information Technology (IT) whereas, the Certificate program has IT, Land Survey, Geospatial short courses, ICT short courses, and the newly introduced business program that has Kenya Accountants and Secretaries National Examinations Board (KASNEB) courses.

In 2021, the institution held three intakes in January, May, and September resulting in an increase in the number of students from 624 to 850. Also, 300 students successfully completed and graduated in Diploma and Certificate programs with technical skills in GIS, AutoCAD among others, making them highly competitive for the job market and self-reliant for employment.

The RCTI signed an MOU with ESRI and conducted training on Utilizing ArcGIS Machine Learning and AI tools. As a way

of increasing awareness and sensitizing the public on the geospatial field, the RCTI hosted a virtual career talk. The event provided the general public with an opportunity to interact with geospatial experts in the industry. The RCTI aims at developing motivation, commitment, cooperation, leadership, self-discipline, self-awareness, teamwork, sportsmanship, time management, and communication for all its students. In 2021, the institution organized a Cultural Sports Day which increased students' and lecturers' interactions and further enhanced teamwork. The event provided a platform for the students to showcase their talents and explore their creativity.

The RCTI continuously produces highly skilled and knowledgeable students required for the modern workplace. The students are prepared adequately for full-time employment by ensuring they develop the necessary hands-on skills using the latest IT and geospatial technologies.



The RCTI Students during a practical session at RCMRD grounds



The RCTI students during classroom sessions at RCMRD



RCTI students during the Cultural Sports Day in 2021

Regional Centre for Mapping of Resources for Development RCMRD	
COURSES	DURATION
Web Mapping	3 weeks
UAV Technology	4 weeks
Certificate In GIS & Remote Sensing For Water Resource Management	2 weeks
Service, Repair & Adjustment of Opti-mechanical Surveying Instruments	3weeks
Tailor Made Training in Geo-information	3weeks
SAR/Lidar Remote Sensing	2weeks
Introduction To Digital Cartography & GIS Mapping -	32weeks
Image Processing & Transformation	2weeks

A list of some of the courses offered at RCTI



COURSE	DURATION	COURSE	DURATION
Global Navigation Satellite Systems 1	1week	GIS, Spatial Database Development & Web Mapping	4 Weeks
Global Positioning System (GPS) 11	2weeks	Mobile GIS	2 Weeks
GIS Data Collection And Mapping Using Mobile Phones	3 Weeks	GIS Modeling & Multi-variant Analysis	2 Weeks
GNSS Base Station Installation & Data Processing	2weeks	Specialized Remote Sensing & GIS	4 Weeks
Land Management Information System (LMIS)	3weeks	Fundamentals of GIS	3Weeks
Introduction to Earth Observation (RS)	3weeks	AutoCAD/Civil 3d	3 Weeks
Introduction to Geographic Information Systems (GIS) -	3weeks	Remote Sensing and GIS	4weeks
Digital Photogrammetry	2 Weeks	Crime Mapping & Advanced Crime Mapping	3Weeks

A list of some of the courses offered at RCTI

### SNAPSHOT OF THE 2022 RCMRD WORK PROGRAM

The RCMRD 2022 Work Program activities will mark the fourth and last year of the RCMRD 2019-2021 Strategic Plan and shall draw insights from the preceding three years of implementation. The six (6) key strategic objectives in the strategic plan will steer the overall priorities in 2022. The Centre has placed strategic and innovative approaches and measures adopted from the lessons learned in the last two years of the COVID-19 pandemic. The Centre will continue to utilize the rich feedback and experiences from engaging with partners and the member States, to ensure that all the activities planned for 2022 will be executed excellently.



REGIONAL CENTRE FOR  
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FOR DEVELOPMENT

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