A holistic, demand-driven and impact-oriented approach to Capacity Development for DIGITAL EARTH AFRICA

"GENIUS IS IN THE IDEA, IMPACT HOWEVER COMES FROM ACTION"

Simon Sinek

DOCUMENT VERSION HISTORY

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CONTENT

LIST OF ABBREVIATIONS

ARDC	African Regional Data Cube
CD	Capacity Development
CDS	Capacity Development Strategy
CEOS	Committee on Earth Observation Satellites
CoP	Community of Practice
DE Africa	Digital Earth Africa
DFAT	Australian Department of Foreign Affairs and Trade
GA	Geoscience Australia
GEO	Group on Earth Observations
ITC	Faculty of Geo-information Science and Earth Observation / University of Twente
MEL	Monitoring, Evaluation & Learning system
MOOC's	Massive Open Online Courses
OECD/DAC	Organization for Economic Co-operation and Development/Development Assistance Committee
SP	Strategic Pathways
TAC	Technical Advisory Committee
TNA	Training Needs Analysis
ToA	Theory of Action
ToC	Theory of Change
ToT	Training of Trainers
UNDP	United Nations Development Program

INTRODUCTION

The vision of *Digital Earth Africa (DE Africa)* is to provide a routine, reliable and operational service, using Earth observations to deliver decision-ready products enabling policy-makers, scientists, the private sector and civil society to address social, environmental and economic changes on the continent and develop an ecosystem for innovation across sectors.

DE Africa will process openly accessible and freely available geospatial data to produce decision-ready products. *DE Africa* will be responsive to the (users) information needs, challenges and priorities of the African continent. *DE Africa* will leverage and build on the existing capacity to enable the use of Earth observations to address critical challenges across the continent.

Capacity Development is considered a core component of the *DE Africa* program. This Capacity Development Strategy (CDS) aims at guiding the roll-out of the *DE Africa* CD program, supported by pre-defined principles, a CD framework and internal organisational capacities. This CDS is a reference guide for all CD interventions which will be described and developed further in the CD Implementation Plan.

The CDS consists of three main sections. Section 1 describes the *DE Africa* approach to Capacity Development and includes the principles that guide the CD interventions, Section 2 provides a framework for coordinated capacity development, and Section 3 points out the capacity, capability and conditions needed for effective coordination and implementation of the CD interventions.

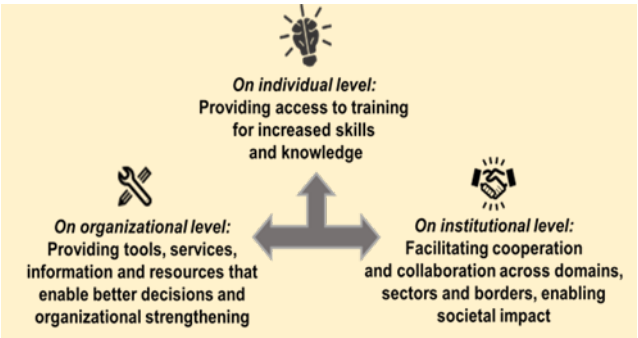
SECTION 1: THE *DE AFRICA* APPROACH TO CAPACITY DEVELOPMENT

The *DE Africa* CD strategy builds upon a set of principles which guide the design, development, implementation and evaluation of all CD interventions. Figure 1 presents the main underlying principles of this CD strategy.

Figure 1: The *DE Africa* CD principles

THE CORNERSTONE: Promoting a holistic approach to Capacity Development

DE Africa's interpretation of CD follows the definition established at the 1992 United Nations Conference on Environment and Development (UNCED) which encompasses human, scientific, technological, organisational and institutional resources and capabilities. UNCED recognises that a fundamental goal of capacity development is to enhance the abilities of stakeholders to evaluate and address crucial questions related to policy choices and different options for development. Other (similar) definitions exist. According to the definition of the United Nations Development Program (UNDP), it is about transformations that empower individuals, leaders, organisations and societies. The Organization for Economic Co-operation and Development/Development Assistance Committee OECD/DAC defines CD as the ability of people, organisations and society as a whole to manage their affairs successfully. All these definitions refer to a holistic and systemic approach to CD, which encompasses different levels of interventions; individual, organisational and institutional (eco-system level). The following scheme visualises the interrelation between the three levels:



"Impact of CD can only be ensured when support is provided to create an enabling environment, ensuring the conditions are in place to apply the acquired knowledge and skills".

Figure 2: Different levels of intervention

Examples of what can be expected as the final results of these activities for a public or private entity are:

On the individual level: acquiring, understanding, applying and up-taking new geospatial knowledge, skills, technologies, tools and applications

On the organisational level: development and implementation of a corporate strategy (infrastructure, resources, policies, etc.) to obtain, interpret and disseminate the best analysis-ready-data and spatial information for domain-specific applications. It includes engagement with and commitment from the decision- and policymakers.

On (eco-)system level: liaising with technology and data providers and alignment across institutions (e.g. governmental, private sector, civil society, innovators and knowledge institutions) to ensure the information outputs are aligned with the expectations and needs of the end-users and respond to the overall development policies.

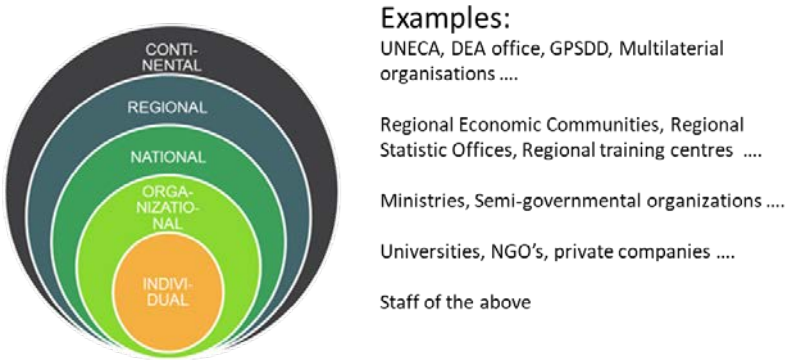


Figure 3: The levels of engagement

Hence, a holistic approach implies taking into account the ecosystem context and the need for domain-specific decision- & policymaking on the continental, regional and national level and understanding the specific needs at the organisational and individual level.

a. Leveraging existing capacities and strengthening participating institutions

The CD strategy and implementation plan call on the capacities and capabilities that exist within Africa on continental, regional, national and even grassroots levels, especially those that are accessible through the current TAC membership. The ability to provide local (geographic) reach is an important consideration. Capacities in terms of skills and knowledge of human resources and capabilities of institutions will be strengthened by bridging the gap between existing and required competencies of staff and identifying the organisational needs.

b. Building upon exisiting similar initiatives

DE Africa will establish linkages (and where posible promote transition) and take advantage of experiences and best practices of several existing initiatives on the African continent to provide geospatial tools to access and analyze geodata (satellite imagery and RS) such as the African Regional Data Cube[1] (GPSDD), the Africa Geoportal[2] (ESRI), the tools and geoportal of the NASA-Servir Hub[3] (RCMRD) and the Global Earth Observation System of Systems[4] (GEO), among others.

[1] The Africa Regional Data Cube (ARDC) is a tool that harnesses the latest Earth observation data and satellite technology to help Ghana, Kenya, Sierra Leone, Senegal, and Tanzania address various issues relating to agriculture, food security, deforestation, urbanization, water access, and more.
[2] The Africa GeoPortal gives users access to the leading geospatial tools to easily map, analyze, and share geospatial information. Combine your data with open data, apply powerful tools, and create engaging outputs.
[3] RCMRD GeoPortal is a platform for disseminating open geospatial datasets and maps for the Eastern and Southern Africa region.
[4] GEOSS is a set of coordinated, independent Earth observation, information and processing systems that interact and provide access to diverse information for a broad range of users in both public and private sectors.

c. The Theory of Change model as a reference for developing, implementing and evaluating a demand-driven and impact-oriented CD strategy

The Theory of Change (ToC) is a useful model to define the complementary strategic pathways that lead to the desired impact or change. This model is essentially a full description and illustration of how and why a desired change is expected to happen in a particular context. It focuses on mapping out or "filling in" what has been described as the "missing middle" between what a program or change initiative does (its activities or interventions) and how these lead to desired goals being achieved. Reflecting on cause-effect relations and the underlying assumptions is pivotal for the ToC design.

The *DE Africa Theory of Change and Phase II Investment Logic*, established on request of Geoscience Australia (GA) and the Australian Department of Foreign Affairs and Trade (DFAT), is the reference model for the development of the CD framework and strategic pathways into a Theory of Action model. The ToA visualises how the program contributes to the achievement of the intermediate and immediate outcomes, by defining the activities, inputs and outputs.

The horizon of any CD intervention is the final result and impact we want to achieve on the short and long term. Different frameworks can be used to understand the demand/user needs and to assess the desired impact, such as Baseline Studies, Logical Frameworks, Result Chains, etc. In a broader context the Sustainable Development Goals, the Paris Agreement on Climate Change, the Sendai Framework for Disaster Risk Reduction and/or Aichi Targets of the Convention on Biodiversity, among others, can be used as a reference. These frameworks, as well as the *Agenda 2063: The Africa We Want,* should be taken into account when designing further the Theory of Action in support of the established outcomes.

d. Co-creation or co-design as guiding principle for developing capacity development interventions

The concept of co-creation (or co-design) goes hand-in-hand with the ToC as a reference model that visualises the pathways or strategic directions needed to achieve the desired impact or change. Additionally, a Monitoring, Evaluation and (co-)Learning system is required to assess the efficiency and effectiveness of the envisaged strategic pathways and to collect the lessons learned for further improvement.

In the world of Development Cooperation, CD is perceived in different ways. Many running CD initiatives tend to focus on individual capacity strengthening through training, Massive Open Online Courses (MOOC's), webinars, etc. sharing new knowledge, skills and insights (which is seen as the traditional approach to CD). However, as indicated before, a more holistic vision on CD creates added value and sustainability when a real and measurable impact is strived for. Co-creation of CD efforts where supply and demand come together is a methodology in support of this holistic approach. The best way to introduce and explain the concept of Co-Creation is by presenting an example.

Traditional CD approach: *Party A, the training provider, develops a training program based on a specific request or organizational needs assessment, introducing their field of expertise and experiences. Party B, the requesting organization or end-user, participates in the event as recipient. Assessment takes primarily place on the level of participant satisfaction and understanding.*

Co-creation approach: *A wicked or complex problem is addressed by a joint effort, combining state of the art technologies provided by party A, with cultural and contextual knowledge by party B and expressions of specific needs in terms of knowledge and skills by party C. Assessment takes place on the level of real learning, performance improvement on the job and a better understanding and future management of the problem.*

Co-creation is about equal partnership, shared ownership, joint responsibility and stakeholder engagement, recognising the needs, ambitions, knowledge and specific expertise of the participating parties. It is about a collaborative process of problem-solving within a learning cycle, rather than just providing the solutions. It is

about merging and strengthening the capacities and capabilities of all involved (individuals, organisations and society as a whole) to create value. It taps into the collective insight and potential of groups, generating breakthrough solutions. The collaboration and discussions between parties can lead to ideas for research or project development when knowledge gaps are identified. Hence, it is about addressing the desired change by jointly achieving outcomes, results and even societal impact, rather than focusing on the quality and quantity of inputs and outputs.

e. Differentiation of audience and level; a "fit-for-purpose" approach

A "fit-for-purpose" or "good-fit" approach requires a clear understanding of the specific needs of the different audiences and builds upon existing capabilities. The "uniqueness" of the participating public and private institutions does not allow a "one-size-fits-all" development process of the CD interventions. The ability to uptake the data products for decision-making processes will vary per country, institute and even per individual. Hence, each of the identified sub-audiences, being a service developer, service receiver, political authority, end-user or influencer, will become part of targeted CD interventions and will be addressed according to their role, needs, capacity, interest and influence.

f. Engaging multiple stakeholders

Multiple stakeholders relevant for *DE Africa* will be engaged and identified based on their specific role, interest and influence. The spectrum of stakeholders goes from a technical up to the highest political level, within between a broad range of actors. Hence, political, civic as well as professional engagement is crucial.

Many stakeholders will be engaged through existing networks like CEOS, AfriGEO, GPSDD, the ITC partnership and alumni network in the African continent and the broader GEO community of flagships, initiatives and community activities with presence in Africa. Figure 4 presents a global stakeholder mapping of users and partners. This stakeholder mapping will be elaborated further in the CD Implementation Plan.

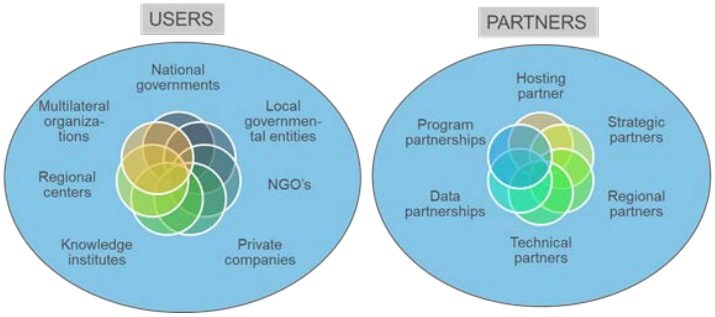


Figure 4: Overview of the main stakeholders

g. Ensuring national ownership and sustainability of the program outcomes

Ensuring organisational, technical, financial and academic sustainability will be addressed during the full program period through the development of a sustainable business and financial plan, the establishment of secure networks for information and knowledge sharing, the buy-in at political level within the national, regional and international Geospatial community and through the updating of relevant technical infrastructures.

The CD strategy is an integral part of the Phase II investment plan, which focuses on ensuring the foundations for ongoing functionality of *DE Africa* are established, and that it continues to operate as a sustainably financed, and demand-driven African led initiative in the longer term.

It is pivotal to develop the sustainability plan already at the start of the implementation phase.

h. Promoting social inclusion and gender equity

Promoting gender equity is reducing the disparities in employment, education, political participation and legal rights, which severely constrain women in their ability to contribute to Africa's development growth and to benefit from that growth.

Social inclusion is the process of improving the terms on which individuals and (marginalised) groups take part in society, improving the ability, opportunity, and dignity of those disadvantaged based on their identity.[5]

DE Africa will encourage development and application of products which support the interests and specific needs of women and marginalised groups and will actively seek opportunities to support the application of information and products in support of greater equality and inclusion. A DE Africa Gender and Inclusion Strategy will be developed. The Gender and Inclusion Strategy will articulate and set out practical entry points for the inclusion of strategies.

[5] Definition by the Worldbank

SECTION 2: A FRAMEWORK FOR COORDINATED CAPACITY DEVELOPMENT

The main goal of the CD framework is to build and demonstrate a growing capacity to manage and apply EO information, analysis-ready-data and products, across a diversity of relevant sectors including (semi-) governmental institutes, the private sector and civil society. The principles as described in Section 1 are crosscutting when strengthening the capacities and capabilities of the different actors and champions by targeted CD interventions.

CD interventions will take place on individual, organisational and (eco-)system level and build further on the *DE Africa* Theory of Change. The underlying Theory of Action will consist of intermediate and immediate outcomes and a suite of strategic pathways. The relation between the Theory of Change and the Theory of Action[6] is presented in Annex 1. The figure describes how the *DE Africa* program contributes to the long-term outcomes employing a Theory of Action.

The Theory of Action describes a logistical sequence of long-term outcomes (impact), intermediate outcomes, immediate outcomes, outputs, activities and inputs. The different strategic pathways represent the way the outcomes will be achieved by a suite of CD interventions (figure 5). It also provides input for the Monitoring, Evaluation and Learning system.

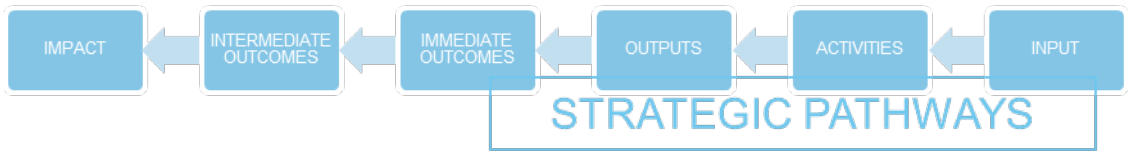


Figure 5: The Theory of Action

DE Africa operates within different spheres of influence. Understanding the three spheres helps to formulate realistic ambitions and expectations as well as a realistic planning in time.

The **Sphere of Control** refers to everything the program can control and is fully responsible for: the inputs, activities and direct results of those activities (outputs) as well as the quality of activities, products and engagement with stakeholders and other actors.

The **Sphere of Influence** refers to the reaction the program expects to see as a result of its activities: how stakeholders (management, policymakers, decisionmakers) and other actors in the context use and/or respond to the outputs of the project.

The **Sphere of Interest** is the sphere of lasting, structural change: changes in the lives of people and conditions in society. It represents long term changes, beyond the control of any single actor or factor. In a ToC process, the desired change is often formulated at this level, or the level of (indirect) outcomes.[7]

[6] Also referred to as Investment Logic
[7] Hivos ToC Guidelines. THEORY OF CHANGE THINKING IN PRACTICE: A stepwise approach (www.hivos.org), November 2015

2.1. LONG-TERM OUTCOMES AND IMPACT

The overall aim of the CDS is to contribute to the achievement of the long-term outcomes or impact during and beyond the duration of the work program as defined in the *DE Africa* ToC.[8] It also helps to the development of concrete partnerships, critical especially when looking at transboundary or regional issues. Long-term outcomes are expected to be achieved within a 10-years period.

***DE AFRICA* LONG-TERM OUTCOMES: (under revision)**
1.Countries are empowered, with national data and information relating to challenges of land, water, the environment, resources, and human population.
2.Lives are improved, through access to information that empowers governments, individuals and communities to make informed decisions and choices.
3.Development activities are more effective, through access to and use of information that improves the understanding of issues and solutions. Continental assessments, reporting, and responses are advanced through access to continental scale data and information products relevant to Agenda 2063 and the 2030 Agenda for Sustainable Development.
4.Digital transformation is advanced, through industry uptake and innovation using products and services from DE Africa.
5.Economic development and job creation are increased, through access to data for commercial products and services development.

2.2. INTERMEDIATE AND IMMEDIATE OUTCOMES

In line with the long-term outcomes, figure 6 presents the intermediate and immediate outcomes of the CD strategy. The intermediate and immediate outcomes are grouped according to the level of CD intervention, visualising the proposed holistic approach to CD. These outcomes should be achieved within Phase II and III of the DE Africa programme.

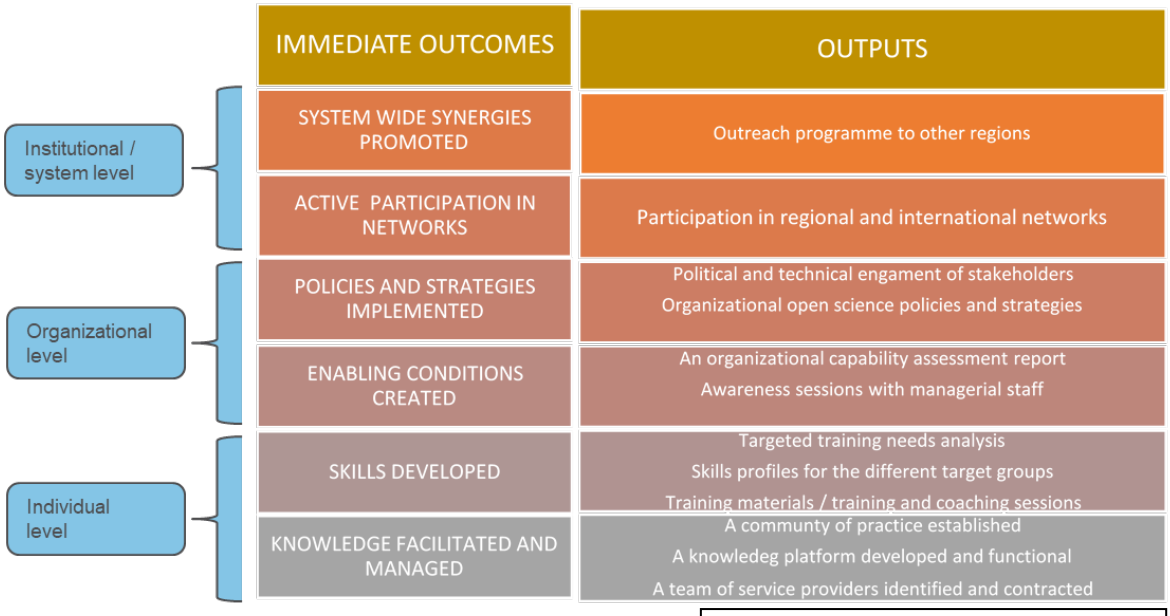


figure 6: The Theory of Action intermediate and immediate outcomes

[8] Digital Earth Africa Governance Framework, June 2019

2.3. THE STRATEGIC PATHWAYS

As shown in figure 5, each Strategic Pathway consists of several inputs, activities and expected outputs needed to achieve the immediate and intermediate outcomes.

The next table presents a short description of the different Strategic Pathways and a preliminary prioritisation and time schedule. Annex 2 offers a full description of the strategic pathways.

The development and employment of the required infrastructure within the implementing partners as well as the establishment of networks among them is crucial for efficient implementation of the strategic pathways.

STRATEGIC PATHWAY	DESCRIPTION	TIME SCHEDULE
SP 1: Training of Trainers	A set of modules to train staff of the regional centres, for them to be able to train staff of the national institutions	Priority 1: 2020
SP 2: Training of end-users	A set of modules to train the end-users of the data cube technology	Priority 1: 2020
SP 3: Awareness Training	Support for decision-and policymakers to uptake the technology by creating enabling organizational conditions to apply the acquired skills and knowledge	Priority 1: 2020
SP 4: Alignment with GEO	Embedding of the expertise of the different GEO flagships and initiatives and AfriGEO in the CD implementation	Priority 1: 2020
SP 5: Fellowship program	Intensive training in a hosting institution (universities, research centres) through exchange between African countries and universities and at Geoscience Australia.	Priority 1: 2020
SP 6: Innovation and entrepreneurship	Supporting the establishment of new businesses by facilitation, training and coaching by tapping into established regional and national innovation hubs and entrepreneurship centres	Priority 2: 2021
SP 7: On the job coaching	Coaching of staff in the uptake of the technology in their working environment	Priority 2: 2021
SP 8: Alignment with other platforms and initiatives	Incorporating existing training opportunities in the CD Implementation Plan. The transition of the ARDC into DE Africa	Priority 1: 2020
SP 9: Community of Practice / helpdesk	A platform for knowledge exchange and management & technology transfer at continental, regional and national level	Priority 2: 2021
SP 10: (Post-) graduate education	New or revised academic curricula for educating the next generation	Priority 3: 2022

DE Africa applies a "FIT-FOR-PURPOSE" approach, building upon already existing capacities and capabilities in the participating countries and institutions. This implies the development of national/organisational action plans, consisting of a tailor-made selection of CD interventions / strategic pathways and contextual use-cases based on the specific needs and expectations of each country and/or participating institution (figure 7).[9]

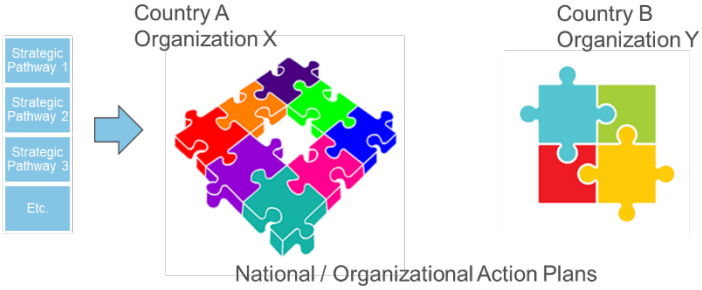


figure 7: Tailor-made selection of CD interventions (based on national needs assessments)

[9] The roll-out of the Strategic Pathways and the development of the National / Organizational Action Plans will be described in more detail in the CD Implementation Plan.

2.4. OPERATIONALIZING THE CD STRATEGY

The *De Africa CD Coordination Team,* falling under the *DE Africa Management Team* (see section 3), will have a vital role in the operationalisation of the CD strategy and the coordination of the Strategic pathways.

The Strategic Pathways should ideally follow three operational phases:

1. BASE-LINE ANALYSES AND HARMONIZATION
2. PLANNING AND SERVICE DESIGN
3. DEVELOPMENT AND SERVICE DELIVERY

Figure 8 presents the different process steps for each of the three phases.

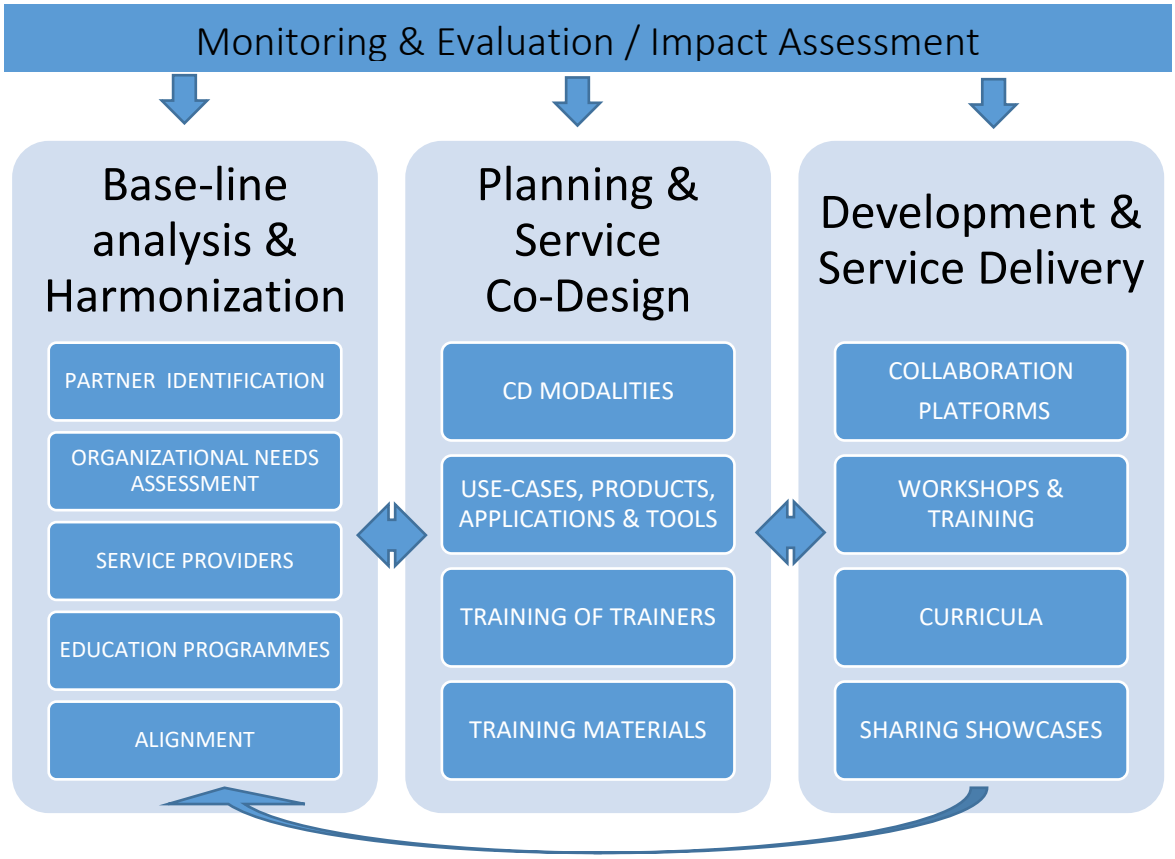


figure 8: The three implementation phases of the CD strategy

1. BASE-LINE ANALYSES AND HARMONIZATION

DE Africa will identify and establish partnerships with regional and national public and private entities, African and international universities and research institutions, as well as civil society organisations (CSOs) working on development issues.

To ensure engagement on the continental, regional, national and local/grassroots level, an anchor institution (or CHAMPION) per country or region will be selected which will, based on an organisational needs assessment, receive dedicated support and training from the *DE Africa CD Coordination Team.* This champion should ideally be a knowledge institute with training, education and outreach responsibilities. Together with the *DE Africa CD Coordination Team,* this champion will have a dominant role in the performance of the national base-line studies and seeking alignment with existing programs and initiatives and the ARDC and develop an overview of service and education providers as well as national CD programs).

2. PLANNING AND SERVICE DESIGN

Based on the results of the base-line studies and the organisational and individual needs assessments, a selection of targeted CD interventions (the strategic pathways) will be available for the different target groups.
These targeted CD interventions or strategic pathways are described in Annex 2.

Crucial in this phase is the Training of Trainers approach to ensure dissemination of the CD interventions to local partners. Training of Trainers (ToT) is a high-level professional learning process for qualified trainers and experts who will be providing training and capacity-building assistance for programs implementation.

3. DEVELOPMENT AND SERVICE DELIVERY

Different modalities will be applied for service development and delivery:

- A collaboration, knowledge and sharing platform (through the DE Africa website) to support national and regional Communities of Practice
- Technical and awareness training workshops (f2F, distance learning, blended learning)
- Revision and/or development of curricula on (post-) graduate level[10]
- Intensive training at Geo-science Australia, African and international (academic) knowledge institutes (fellowships)
- On-the-job training and coaching
- Business support
- Etc.

The Monitoring, Evaluation and Learning (MEL) system

This system will be supportive of the three phases and will be linked to the levels of outcomes as described in the overarching Theory of Change and the M&E matrix will be included in the CD Implementation Plan.

The MEL system consists of the following actions :
-Set goals and Indicators as presented in the overarching Theory of Change
-Collect, Store and Validate Data on the CD interventions and outcomes of the Strategic Pathways
-Analyse the Data
-Report on the Data
-Make Data-Driven Management Decisions
-Collect Lessons Learned

The MEL matrix includes an overview of what will be evaluated, when, by whom, how and where. Evaluations of the achievement of the outcomes of the CD interventions normally take place during and after the full program duration and at the three intervention levels. Impact evaluations are part of the MEL system and take normally place after finalisation of the program (3 to 5 years period). Crucial within the MEL system is that the evaluation of CD interventions should not only focus on the learners satisfaction and the level of understanding, but also on the resultys, impact and return on investment of the training, focusing on the ability of the particiopants to apply the new skills and knowledge in their working environment.

This MEL system is an integrated part of the project cycle, supporting the impact-driven approach of the CD interventions. It fits within the concept of a Learning Organization. Figure 9 presents the MEL system as part of a Learning Organisation.

[10] Besides the training of geospatial professionals already employed by the identified and participating public and private entities, we will prepare the future generation on the use of geospatial data and information. For this, the revision and adjustment of the current curricula on the level of secondary and higher education in the field of geo-information sciences, will be supported by DE Africa through regional curriculum development workshops.

figure 9: The MEL system

Organisational learning is a fundamental pillar of a holistic approach to capacity development. The capability to adapt and self-renew requires that people and institutions learn from experiences, share information and improve themselves. A learning organisation is “an organisation where people continuously expand their capacity to create the results they truly desire, where new and expansive patterns of thinking are nurtured, where collective aspiration is set free and where people are continually learning to see the whole together”.

SECTION 3: THE REQUIRED CAPACITY, CAPABILITY AND CONDITIONS FOR EFFECTIVE CD COORDINATION

Besides strengthening the capacities and capabilities of the participating institutions, the capacities and functions of the *DE Africa* staff members of the DE A office will also be assessed and reinforced by training and coaching.

The capacity and capability to roll-out the CD strategy is the availability of resources and the efficiency and effectiveness with which *DE Africa* deploys those resources to identify and pursue their development goals on a sustainable basis. This relies on three conditions:

- ✓ The availability of resources (human, financial, technical), necessary for achieving the development goals
- ✓ The effectiveness and efficiency with which resources are acquired and used
- ✓ The sustainability of the CD interventions, which results should be locally owned and replicated and scaled up by local actors.

Within the office of the *DE Africa Management Team*, a *DE Africa CD Coordination Team* will be made responsible for the coordination and efficient implementation of the CD strategy based on the generally accepted CD principles and for overseeing the design, development, implementation, monitoring and evaluation of the CD interventions. This coordination team will be supported by a team of regional and international partners for service design and delivery.

To ensure a multiplier effect of the CD interventions, a structure with regional CD hubs and national anchor institutions or champions, will be managed and coordinated by the DE-Africa continental CD support hub. Figure 10 visualises this set-up. DE Africa forsees the staffing of people within the supporting entities on all three geographical levels.

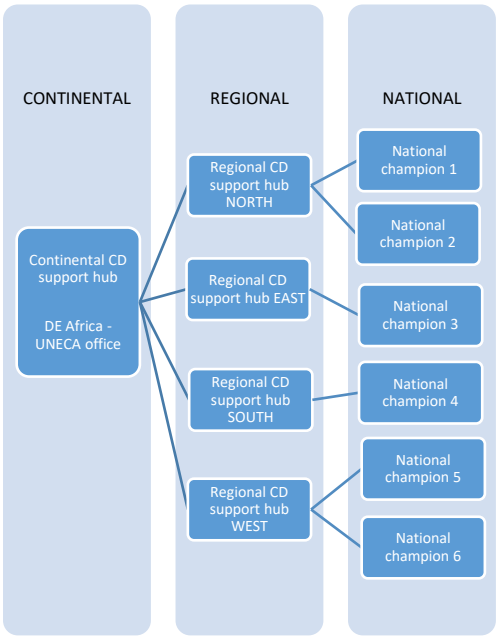


figure 10: The CD support structure

For developing the CD Implementation Plan, the identification and selection of suitable regional and national institutions is crucial. Two overviews of these institutions are presented in annex 3 and 4 for further consideration:

Annex 3: presents an overview of the Regional hubs, Regional Economic Communities and Regional Statistic Training Centres and the African countries they represent.

Annex 4: presents a preliminary overview (under construction) of ITC's contacts with African educational institutes in Geo-Information Science and Earth Observation – project partner, research collaboration, double degree programs, etc.

Besides a dedicated team of high-level experts to support the development and delivery of the technical and technological content and infrastructure (GIS and earth observation technologies, python programming, data analytics, data cube development, cloud based computing skills, etc.) and the development of use-cases, additional expertise is needed to coordinate the analysis, design, development, implementation and evaluation phases of the CD strategy. Hence, the DE Africa office has a double responsibility, being both a centre of extertise for content and technology transfer and a program coordination unit to support and coordinate the CD process, as visualized in figure 11.

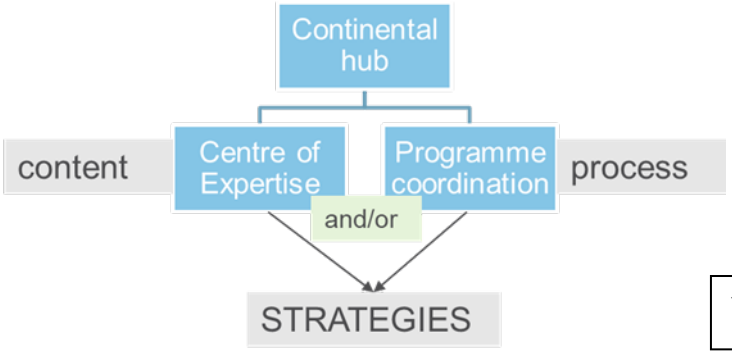
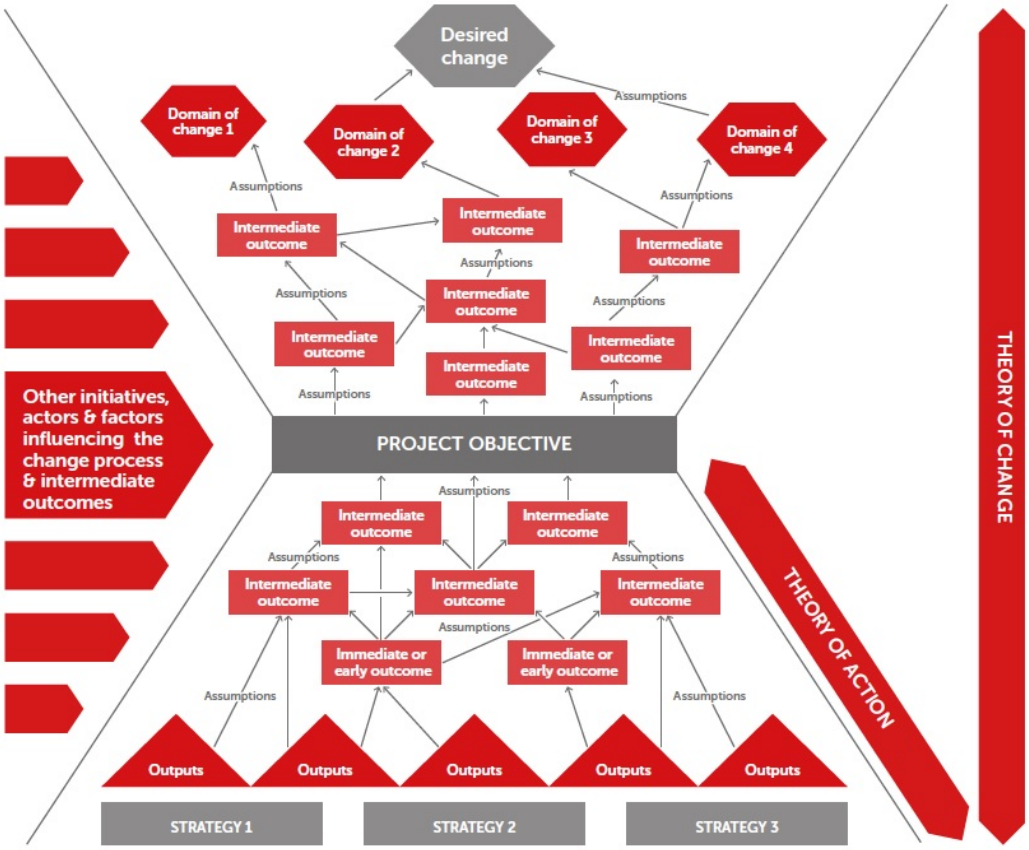


figure 11: The DE Africa office responsibilities

- Knowledge and understanding of the in-country priorities, the national (political, social, economic) context and its challenges in the main application sectors
- Program / project management
- Entrepreneurship/business development
- Organisational and individual needs assessments
- Monitoring & evaluation / impact measurement
- Training and curriculum development (methodologies and modalities)
- Training and coaching
- E-learning/distance education
- Knowledge exchange and management platform

The required expertise will be strengthened within the DE Africa main office, but delegation of responsibilities to the main regional centres and champion organisations will also be explored. By this a network of specialised centres and/or champion organisations will be established in support to the implementation of the capacity development strategy.

Annex 1: A Theory of Change – Theory of Action model



Hivos ToC Guidelines: THEORY OF CHANGE THINKING IN PRACTICE
A stepwise approach (www.hivos.org), November 2015

Annex 2: The Strategic Pathways

STRATEGIC PATHWAYS (to ensure proper uptake and further development of technical skills and DE Africa data products).						
	STRATEGIC PATHWAY	**INPUT**	**ACTIVITIES**	**OUTPUTS**	**OUTCOMES**	***OBSERVATIONS***
1	**Training of Trainers**	Methodology for organisational and individual needs assessment Technical and didactic /pedagogic expertise (DEA Office, GA, partners)	Organisational and individual needs assessment Development of a ToT curriculum / Development of educational materials	Staff of regional training centres (RCMRD, AGRHYMET, CSE, CSIR, AFRIGIST) & Regional Official Statistics Offices, trained	Regional centres and implementing partners strengthened to design & deliver targeted training to national institutions	*Pre-selection of countries, national institutions and professional profiles is needed.* *The ToT addresses the training needs of the different target groups / professional profiles (technicians, application developers, decision-makers, etc.)*
2	**Training of end-users**	Expertise from regional centres, knowledge institutes, CEOS, GPSDD, FAO, UNEP, GA, ARDC Overview of existing training opportunities	Development of training modules in different delivery formats	Proper uptake of DE Africa data products and tools for decision-making, policy and action	National public and private institutions strengthened	*Use can be made of the extensive ITC partner and alumni network and existing suite of refresher and tailor-made courses*
3	**Awareness Training**	Expertise from DEA Office, GA, Thunderbird, Governing Board and TAC	Providing managers, policymakers and decision-makers with information and tools needed for the implementation of the DEA program at the continental, regional and national level and to create the enabling conditions on organizational level	Decision- and policymakers / politicians aware of the benefits of the DEA data products for proper decision making	Uptake of the DE Africa program, analysis-ready data set and applications by decision- and policymakers of pre-selected institutions	*The Awareness training focuses on middle- and higher management level of governmental institutions*
4	**Alignment with GEO**	Expertise from DEA office DEA secondment at GEO	Identification of use-cases and case studies Development of applications and tools	Use-cases and applications adopted by GEO flagships and Initiatives	Better use of ARD in monitoring focus areas of the GEO flagships and Initiatives	*The DEA secondment at the GEO Sec to take the lead in this strategic pathway*

		Expertise from GEO flagships and Initiatives				
5	**Fellowship program**	GA office International and African Academic Institutes	Training of fellows	Fellows (champions) positioned in key national partner organisations to support the uptake of DEA data products and services	Partner organisations strengthened in the uptake of DEA data products and services	*Fellowship programmes should be limited of duration to avoid the absence of expertise within the institutions*
6	**On the job coaching**	Expertise of DEA office and implementing partners	Provide on-the-job coaching to ensure uptake of data products	Use of data products for decision- & policymaking	Regional, national public and private institutions strengthened	*Supporting infrastructural arrangements and improvement of facilities might be needed*
7	**Innovation and entrepreneurship**	Expertise from DEA office Expertise from renowned private companies (ESRI, Google, etc.), incubators and innovation hubs	Provide small businesses and industry to more readily access satellite data and knowledge to innovate and create new products and services	Private sector strengthened and new businesses established using EO data and ARD for service provision	Creation of new jobs in the GEO field	*Entrepreneurship should be a mandatory component is all training*
8	**Alignment with other platforms and initiatives**	DEA office DEA secondment at GEO DEA GB and TAC ARDC Africa Geoportal (ESRI)	Sharing of technologies, expertise, data sets, tools and applications with other platforms and initiatives	Alignment with numerous platforms, initiatives, projects, implemented at the subnational, national and regional levels	Reduction of required financial resources Increase of available data sets	*Linkages with AFRIGEO, UN-GGIM, GMES AND AFRICA, UNECA, GRID3, AFRICAN SPACE PROGRAMME*
9	**Community of Practice / helpdesk**	DEA office DEA Stakeholder Community	Establishing a CoP and sharing platform on products, tools, experiences, showcases, case studies	Continuous learning on the organisational level	Partner organisations strengthened	*The CoP platform to be hosted and maintained by the DEA hosting organisation*

10	**(Post-) graduate education**	Inventory of existing curricula in the field of GEO science Expertise from inter(national) universities and knowledge centres	Establishment of a consortium of African and international academic partner institutes Development and/or revision of curricula in the field of GEO science. Training of academic staff	International recognised and accredited curriculum in Geoscience with focus on ODC, cloud computing, EO data analysis, etc. / Academic staff trained to deliver the curriculum	Universities and knowledge centres strengthened in the field of GEO science Students trained based on labour market needs of the GEO community	*Use can be made of the current curriculum revision process of ITC's master courses in GEO science and by establishing a consortium of academic institutes*

Annex 3: Countries represented by the Regional Hubs, Regional Economic Communities and Regional Statistic Training Centres

	Countries	Regional Hubs						Ex (6)	Regional Economic Communities								Regional Statistic Training Centres				
		RCMRD	AFRIGIST	AGHRYMET	SSO	CSE	SANSA (SADC)		SADC	UMA	COMESA	CEN-SAD	EAC	ECCAS	ECOWAS	IGAD	EASTC	ENSSEA	ISSEA	PANSTAT	UNECA
1	Algeria				X					X								x		ALL (African Union m	
2	Angola						X		X					X							
3	Benin		X	X	X	X						X			X						
4	Botswana	X				X	X		X								x				
5	Burkina Faso		X	X	X	X						X			X						
6	Burundi	X									X		X	X							
7	Cabo Verde			X	X	X									X						
8	Cameroon		X		X	X								X					x		
9	Central African Republic					X		x				X		X					x		
10	Chad			X	X	X						X		X					x		
11	Comoros	X					X		X		X	X									
12	Congo, Democratic Republic						X		X		X			X					x		
13	Congo, Republic of							x						X							
14	Cote d'Ivoire		X	X	X	X						X			X						
15	Djibouti				X						X	X				X					
16	Egypt				X						X	X									
17	Equatorial Guinea							x						X					x		
18	Eritrea				X						X	X				X	x				
19	Eswatini (Swaziland)	X					X		X		X										
20	Ethiopia	X			X						X					X	x				
21	Gabon							x						X					x		
22	Gambia			X	X	X						X			X		x				
23	Ghana		X			X						X			X						
24	Guinea			X		X									X						
25	Guinea Bissau		X	X	X	X						X			X						
26	Kenia	X			X						X		X			X	x				
27	Lesotho	X					X		X								x				
28	Liberia		X			X									X						
29	Libya				X					X	X	X									
30	Madagascar	X					X		X		X										
31	Malawi	X					X		X		X						x				
32	Mali		X	X	X	X						X			X						
33	Mauretania			X	X	X				X		X									
34	Mauritius	X					X		X		X						x				
35	Morocco				X	X				X		X									
36	Mozambique						X		X												
37	Namibia	X				X	X		X								x				
38	Niger		X	X	X	X						X			X						
39	Nigeria		X		X	X						X			X						
40	Rwanda	X									X		X	X							
41	Sao Tome and Principe							x						X							
42	Senegal		X	X	X							X			X						
43	Seychelles	X					X		X		X						x				
44	Sierra Leone					X		x				X			X						
45	Somalia	X			X							X				X	x				
46	South Africa	X					X		X								x				
47	South Sudan	X			X								X			X	x				
48	Sudan	X									X	X				X	x				
49	Tanzania	X					X		X				X				x				
50	Togo			X		X						X			X						
51	Tunesia				X					X		X									
52	Uganda	X			X						X		X			X	x				
53	Zambia	X					X		X		X						x				
54	Zimbabwe	X					X		X		X						x				

SSO: Sahara and Sahel Observatory / CSE: Centre de Suivi Ecologique / RECs: https://au.int/en/organs/recs /

Annex 4: A preliminary overview (under construction) of ITC's contacts with African educational institutes in Geo-Information Science and Earth Observation

1. WATERNET

In the framework of the WATERNET program there is a Master program on Integrated Water Resources management, offered by the University of Zimbabwe and the University of Dar es Salaam (http://www.waternetonline.org/). Within this context, and jointly with the University of KwaZulu Natal a specialization on earth observation and GIS can be selected. ITC is a contributing partner to the WATERNET program.

2. Kenya

University of Nairobi - http://www.uonbi.ac.ke/

The University of Nairobi has a Department of Geospatial and Space Technology. Thematic areas are: GIS, Photogrammetry and Remote Sensing, Land Information Systems, Cartography, Geodesy and Geodynamics. The University offers a Bachelor program in surveying within the School of Engineering (http://engineering.uonbi.ac.ke/uon_degrees_details/3234) and a MSc program in Geospatial Information Systems/Geomatics (www.nairobicampus.dkut.ac.ke/cbd-programmes/ msc-in-geospatial-information-systems-geomatics). There are several thematic programs where GIS and earth observation are used as techniques, but not extensively.

Technical University of Kenya - http://tukenya.ac.ke/

The Technical University of Kenya has a Department of Geospatial Science and Engineering and a School of Surveying and Geospatial Sciences under the Faculty of Engineering Sciences and Technology. Within the School there are Departments on Geodetic Science and Navigation, Land Administration and Information, Surveying Science and Technology, and Geoinformation and Earth Observation. The School is offering several programs and courses in Geo-Information Technology, Land Administration and Cartography (http://ssgs.tukenya.ac.ke/)

Jomo Kenyatta University of Agriculture and Technology - http://www.jkuat.ac.ke/

Jomo Kenyatta University of Agriculture and Technology has a School of Civil Environmental and Geospatial Engineering, that is home to a Department of Geomatics Engineering and Geospatial Information Systems. Research and training is provided in remote sensing, GIS, geo-computing, digital mapping, etc. The School is offering a Bachelor program in Geomatic Engineering and Geospatial Information Systems, and Master programs in Environmental Information Systems, and in Geospatial Information Systems and Remote Sensing. The School also offers PhD in the same areas of specialization (http://www.jkuat.ac.ke/schools/scege/programmes/)

Regional Centre for Mapping of Resources for Development – www.rcmrd.org

The Regional Centre for Mapping of Resources for Development (RCMRD) is a knowledge institution that operates under the auspices of the United Nations. It has a regional mandate for eastern and Southern Africa, offering professional training, as well as technical Diploma and Certificate courses. Training topics include (among others) earth observation and digital image processing, GIS, digital cartography and GIS mapping, mobile GIS, and digital photogrammetry.
RCMRD is a long-term partner of ITC and operates as NASA-Servir Hub.

3. Tanzania

University of Dar es Salaam - https://www.udsm.ac.tz/

The University of Dar es Salaam has a College of Social Sciences that is home to a Department of Geography (https://www.udsm.ac.tz/web/index.php/colleges/coss/department-of-geography). The Department offers a Bachelor program in Geography and Environmental Studies in

which subjects are offered on surveying and mapping, remote sensing and GIS. It also offers a Master program in Geographical Information Systems. Subjects in GIS and remote sensing are included in some of the other programs that the Department is offering.
The Institute of Resource Assessment (IRA) is also offering courses on GIS and Remote Sensing (www.udsm.ac.tz/web/index.php/institutes/ira/gis-and-remote-sensing).

Sokoine University of Agriculture - https://www.sua.ac.tz/
Sokoine University of Agriculture (SUA) has Colleges of Agriculture, Forestry, Wildlife and Tourism. Within these Colleges programs are offered in (among others) Agriculture and in Forest Resource Assessment that include applied courses in GIS remote sensing and digital image processing (https://www.sua.ac.tz/programme/master-science-forest-resource-assessment-and-management; https://www.sua.ac.tz/programme/msc-land-use-planning-and-management).

Ardhi University – www.aru.ac.tz
Ardhi University is the former University College of Lands and Architectural Studies (UCLAS), and has its origin as training institute for the Ministry of Lands in Tanzania. ARU has a School of Earth Sciences, Real Estate and Business Informatics that offers a Bachelor program, a Diploma program and a Master of science in Geomatics. Besides that there is a School of Environmental Science and Technology that offers courses in Disaster Risk Management, and a School of Spatial Geospatial Science and Technology that is offering courses in Urban Planning and Management.

4. Uganda

Makarere Univesity – www.mak.ac.ug
Makarere Univesity is home to 10 Colleges, of which the College of Computing and Information Sciences is offering courses on Geographic Information Systems and remote sensing as part of the Master program in Information Systems. In the different Colleges and Departments Master courses are offered in several application domains (a.o. Geology, Agriculture, Natural Resources, Geography) where courses on remote sensing and GIS are also included.

5. Rwanda

University of Rwanda – www.ur.ac.rw
The University of Rwanda is offering Master of Science programs in Geo-Information Science for Environment and Sustainable Development, both on the campus in Kigali and in Butare (Huye). The curriculum for this Master program has been developed jointly with ITC under a series of NPT and NICHE programs funded by Nuffic.
In several academic units within UR programs are offered in application domains (Geography and Urban Planning, Surveying and Geomatics Engineering, Water and Environmental Engineering, Geology and Mining Engineering) where courses on GIS and remote sensing are also included.

6. Ethiopia

Addis Ababa University – www.aau.edu.et
Addis Ababa University (AAU) runs a program on Geography and Environmental studies that has as part of its curriculum some courses on basic and applied GIS and remote sensing. It covers application domains in Geography that to some extent are similar to the specializations in M-GEO.

Bahir Dar University – www.bdu.edu.et
Bahir Dar University (BDU) has a Geospatial Data and Technology Centre that is home to GIS, remote sensing, surveying, and geo-tech and database departments. The departments provide input in programs from other faculties and Schools. Under Geography, a Master program in Geo-Information (http://www.bdu.edu.et/fss/?q=content/geographic-information-systemsgis)

Mekelle University – www.mu.edu.et
Mekelle University (MU) is offering a Master program in Geo-Information and Earth Observation for Natural Resource Management. A specialization track is offered on water resources and integrated watershed management. The program is offered by the Institute of Geo-Information Management and Earth observation Sciences (I-GEOS), and is modelled on the ITC program for M-GEO (http://www.mu.edu.et/index.php/programs/28-institutes/institute-of-geo-information-and-earth-observation-sciences/121-master-of-science-m-sc-program-in-geo-information-and-earth-observation-for-natural-resource-management).

7. Namibia

Namibia University of Science and Technology – www.nust.na
The Namibia University of Science and Technology (formerly known as the Polytechnic of Namibia) in Windhoek has a Faculty of Natural Resources and Spatial Sciences. The Faculty is offering programs in spatial planning, town and regional planning, regional and rural development, and natural resources management. It also offers programs in geospatial sciences and technology (geo-information sciences and earth observation, and geo-information technology. This is mainly done in the Department of Geo-Spatial Science and Technology (http://fnrss.nust.na/?q=courses) at Bachelor, Master and Diploma level. NUST is a long-term partner of ITC and parts of the curricula of the programs that are offered have been developed in close cooperation with ITC (and in some cases with ARU in Tanzania).

University of Namibia – www.unam.edu.na
The University of Namibia, also in Windhoek, is offering a specialization in geographic information systems and remote sensing in its Bachelor program in Geography and Environmental Sciences. Courses on GIS and remote sensing are also included in several thematic Bachelor and Master programs (for example: Integrated Environmental Science, and Rangeland Resources and Management).

8. Nigeria

Obafemi Awolowo University - https://oauife.edu.ng/
Part of Obafemi Awolowo University in Ile Ife is the African Regional Centre for Space Science and Technology Education (ARCSSTEE). Under the name Space Application there is a Remote Sensing and GIS Division, and the Centre Is offering a Postgraduate Diploma Program on RS and GIS and, in cooperation with the Federal University of Technology Akure (FUTA), it also offers an M. Tech degree in RS and GIS.

AFRIGIST – www.afrigist.org
The African Regional Institute for Geospatial Information Science and Technology (AFRIGIST, formerly known as RECTAS) was established as a sister institute of ITC in 1972, under the auspices of the Economic Commission for Africa (UN-ECA). AFRIGIST is located within the campus of Obafemi Awolowo University in Ile-Ife, Nigeria. AFRIGIST is both Anglo- and Francophone, and serves the Western African region. The current Executive Director, Dr. Adewale Akingbade, is an ITC alumnus. Prof. Ikhuria and Prof. Jide Kufoniye (also ITC alumni) are two of his predecessors. AFRIGIST is offering a wide range of courses in GIS, remote sensing, cartography, geo-information production and management, and applications (including land administration) at several levels: Technical Diploma, Diploma, Professional Master, Professional Diploma, Postgraduate Diploma, as well as Professional Master and Master Degree. Until 2014 ITC and AFRIGIST jointly offered a joint Postgraduate Diploma and Master program. More information on the courses offered by AFRIGIST can be found at: http://afrigist.org/courses/. AFRIGIST is a consortium member in the NASA SERVIR Hub for Western Africa (Lead: Agrhymet in Niamey, Niger).

9. Ghana

Kwame Nkrumah University of Science and Technology – www.knust.edu.gh

Kwame Nkrumah University of Science and Technology in Kumasi KNUST), Ghana, was established in 1951. KNUST and ITC have been cooperating since …. And are offering a double degree program in GIS and remote sensing for natural resources management. Under the College of Engineering there is a Department of Geomatic Engineering that is teaching a Bachelor as well as a Master in Geomatic Engineering and in GIS. Subjects taught include Photogrammetry and Remote Sensing, Land and Engineering Surveying, Geographic Information Systems (GIS), Cartography, Geodesy, Hydrography, Cadastral Surveying and Land Information Management. The option exists to choose a professional or a scientific orientation in the degree programs.

University of Cape Coast - https://ucc.edu.gh/

The University of Cape Coast is offering courses in geography and regional planning where subjects are included on GIS and remote sensing.

Ghana School of Surveying and Mapping - http://ghschoolofsurveyingandmapping.com/

The Ghana School of Surveying and Mapping (GSSM) is the training branch of the National Survey Department of Ghana. GSSM and ITC are jointly offering a Technical Diploma course in Geoinformatics which is equivalent to the GFM 4 course of ITC.

10. South Africa

University of Cape Town – www.uct.ac.za

Under the Faculty of Engineering and the Built environment there is a School of Architecture, Planning and Geomatics. This school offers a Bachelor program in Geomatics, with streams on surveying and geo-informatics. There is also a Master program and a PhD program in Geomatics Engineering (http://www.geomatics.uct.ac.za/).
Also in other Departments and programs there is attention for GIS and earth observation (a.o. at the Centre for Transport Studies)

University of Kwa-Zulu Natal – www.ukzn.ac.za

The Geomatics (Land Surveying) program at the Howard College Campus of the University of KwaZulu-Natal (http://landsurveying.ukzn.ac.za/Homepage.aspx) offers a Bachelor of Science degree in Land Surveying (BSc Sur). This is a professional degree recognized by the South African Geomatics Council, and provides access to registration as a Professional Land Surveyor enabling graduates to pursue a career in any of the sub-disciplines of the broader discipline of Geomatics. The modules offered are largely grouped in the following subject areas: Cadastral Surveying, Engineering Surveying, Photogrammetry and Remote Sensing, Hydrographic Surveying, Geodetic Surveying, Satellite Surveying, and Geographic Information Science.
The Land Surveying (Geomatics) Program at UKZN currently offers postgraduate studies only by research leading to MSc or PhD study in the following main areas: Cadastral Surveying, Photogrammetry and Remote Sensing, Engineering and Hydrographic Surveying, Geodetic and Satellite Surveying, and Geographic Information Science. Currently, the department has nine registered MSc research students and four PhD research students.

University of Pretoria – www.up.ac.za

The Department of Geography, Geoinformatics and Meteorology of the University of Pretoria (https://www.up.ac.za/geography-geoinformatics-and-meteorology) offers undergraduate and postgraduate programs on the living environment. These programs all contain elements on GIS and remote sensing. There is a Bachelor as well as a Master program on Geoinformatics. The Department has close links to ESRI South Africa.

North West University – www.nwu.ac.za
North West University (NWU) in Potchefstroom is home to the School of Geo and Spatial Sciences (http://natural-sciences.nwu.ac.za/geo-spatial-sciences/about-us). Elements of GIS and remote sensing are part of studies in Geology, Geography and Environmental Management and Urban and Regional Planning.
The Faculty of Business, Management and Social Studies (BMS) of the UT has close contact with NWU.

Cape Peninsula University of Technology – www.cput.ac.za
Within the Faculty of Engineering and the Built Environment courses at National Diploma, Bachelor and Master level are taught on geomatics, surveying and cartography. The programs are built around a program of full-time study and a period of work-integrated learning a paid internship period). CPUT is involved in regional collaboration with Botswana and Zambia, offering a joint program on geo-informatics.

Stellenbosch University – www.sun.ac.za
Stellenbosch University is home to a Department of Geography and Environmental Studies. The Department is offering Bachelor and Master programs in Geographic Information Systems, Geoinformatics, Geography and Environmental Studies, and Urban and Regional Planning. The programs are built around geographic research on the development or application of geographic information systems and remote sensing in spatial environmental problem solving. The Centre for Geographical Analysis (CGA) is a research institution seated in the Department of Geography & Environmental Studies. The CGA specializes in the application of satellite remote sensing, geographical information systems (GIS) and other geographical-analytical techniques for research and training purposes. More information can be found at: https://www0.sun.ac.za/geography/?option=com_content&view=article&id=43&Itemid=4

11. Zimbabwe

Midlands State University - https://ww5.msu.ac.zw/
Midlands State University (MSU) is home to the Faculties of Social Sciences and Faculty of Science and Technology. Both Faculties are offering programs that contain elements of GIS and remote sensing, where in the social sciences the programs have a focus on geography and environmental sciences, and in engineering there is a focus on surveying and geomatics.

University of Zimbabwe – www.uz.ac.zw
The Faculty of Engineering of the University of Zimbabwe (UZ) has a Department of Geoinformatics and Surveying that is offering a Bachelor program with the same title.

Great Zimbabwe University - www.gzu.ac.zw
School of Social Sciences, Department of Rural Development: Principles of GIS, Principles of Remote sensing as well as GIS and Remote Sensing applications modules in planning and development (Water Resources Management, Environmental Management, Urban Planning & Development as well as Rural Development).