INTRODUCTION

Education, Science and Cooperation for Sustainable Development and Biodiversity Conservation in Africa

The German Alumni Summer School 2018 on 'Education, science and cooperation between German Alumni for sustainable development and biodiversity conservation in Sub-Saharan Africa' was jointly organized by the Faculty of Geography-Department of Cartography, GIS and Remote Sensing, the Faculty of Biology and Psychology-Department of Conservation Biology, and the Karatina University, Kenya – School of Natural Resources and Environmental Studies. This summer school was funded by the German Academic Exchange Service (DAAD) and targeted to the German Alumni from Sub-Saharan Africa as well as scientist and experts from various discipline.

The European Union being confronted with mass migration from Sub-Saharan Africa is currently working on a new political and economic strategy for Africa. Moreover German Government initiated and proposed a new level of equal cooperation between Africa and western countries in areas such as education, trade, business development and energy. The main idea is to limit the effects of climate change and avoid climate refugees, to prevent mass migration and to help create a future for Africa's youth', and underscores the current status and efforts of German development policy towards African countries.

Sub-Saharan Africa comprises of 49 states with the highest population growth, and by the end of the 21st century the population is likely to triple. The average economic growth rate for Sub-Saharan Africa countries slowed down from 5.1% in 2010 to 1.4 % in 2016. Africa is still the world's poorest continent and widespread poverty is the primary cause of malnutrition and health problems. Catastrophes like famines and the recent hunger in Horn of Africa are additionally induced through climate change and land grabbing. Corruption, armed conflict, political and ethnic tension, terrorist activities, unstable state structures, national debt, dependence on global commodities markets, and inequitable world trade mechanisms are mainly responsible for this unstable and threatening situation. Biodiversity loss and diminishing of African wildlife due to habitat loss and poaching are as well the serious concern and calls for action.

It is a fundamental approach to encourage and mobilize the German Alumni in African countries to create significant contribution in sustainable development of this continent.

Higher education is recognised as a powerful tool in promoting sustainable development through integration of principles and practices of sustainable development into all aspects of education and learning. The role of higher education in societies in general and for local or ethnic communities in particular is necessary and crucial for the future of Africa. Implementation of the UNO 2030 Agenda and its 17 Sustainable Development Goals (SDG) for sustainable development involves creation of economic progress in harmony with social justice and in accordance with the earth's ecological limits. The education of African elites, collaborations between German and African Universities and creation of professional networking groups to promote sustainable development, and establishment of joint education and research programs are essential for realization of 2030 Agenda development goals. The Alumni Summer School provided a platform to researchers, academicians, practitioners and entrepreneurs in Sub Sahara African developing countries to share their knowledge and experiences from diverse disciplines ranging from natural and social sciences to humanities with the emphasis on the related-themes and topics of interdisciplinary approach.

The International Summer School aimed to set as a goal, the promotion of sustainable development through higher education, cooperation between Universities and the strengthening of both local and international professional links between the German Alumni. The actual topics dealing with assumptions and difficulties in the identification, categorization and implementation of sustainable development were on the priority agenda. Thereby the competences of alumni for solving socio-economically and environmentally relevant problems have been discussed and expanded.

Capacity building of Alumni were worked out to enhance and upgrade to the latest state of knowledge and expertise for supporting and realizing the UNO 2030 Agenda and its 17 Sustainable Development Goals (SDG). The expertise of the Alumni have been exercised to enable their capabilities for enacting an active role play in their respective home countries as multipliers for knowledge and skill transfer. This will additionally facilitate to restructure their respective universities' curricula and students training for sustainable development, thus may imply the creation of economic progress in harmony with social justice and in accordance with the essential earth's ecological limits which faced by the human beings to date.

With the objectives of discussing the impact of climate change and biodiversity loss on human livelihood, and seeking solutions for sustainable development, the following main areas were covered:

- Global climate change as the challenge for the future
- Challenges and prospects of environmental management and conservation
- Earth observation and Geographical Information Systems (GIS) for Sustainable development
- The role of science and education in nature conservation
- The Relationship between the green concept and global climate change
- Sustainable biodiversity conservation and the benefit to local communities
- Land use changes and impacts on ecosystem services.

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Earth Observation and Geographical Information Systems (GIS) for Sustainable Development

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Abstract

Earth Information nowadays is able to deliver key information and build up basic knowledge in the fields of Agriculture and Rural development; Water Resources management; Urban Development, Marine Resources, Risk management and Disaster Reduction; Forest Management; Ecosystem Services and Climate Resilience. Finally, Earth Observation delivers data that help to enable a more integrated view on our landscape or in short Remote Sensing and GIS are modern tools inside a more Landscape oriented Approach. The Landscape Approach is about balancing competing land use demands in a way that is best for human well-being and the environment. It means creating solutions that consider food and livelihoods, finance, rights, restoration and progress towards climate and development goals. The presentation is delivering case studies about EO-based information solutions to support targeted environmental problems. It summarizes the importance and applicability of geographic data for sustainable development and draws on experiences in African countries to examine how future sources and applications of geographic data could provide reliable support to decision-makers as they work towards sustainable development. The potential of new technologies, such as satellite remote-sensing systems and geographic information systems, that have revolutionized data collection and analysis over the last decade are explained with a focus on the new Copernicus initiative of the European Space Agency (ESA). EO4SD an ESA initiative to support the uptake of EO-derived information in sustainable development will be shortly presented.

Background information – Identification of national land use challenges Africa / Kenya

While much is known about Africa's biodiversity and nature's contributions to people, there are still significant scientific uncertainties that need to be addressed through national and regional research programmes. The major challenges of national land use problems in Kenia are the following topics:

1. Habitat fragmentation/loss of biodiversity
2. Forest degradation
3. Loss of soil fertility
4. Overgrazing / free grazing
5. Deforestation

6. Soil erosion
7. Siltation and sedimentation of waterbodies
8. Water stress (on water bodies and soils)
9. Flooding
10. Landslides
11. Climate change

All of these 11 topics can be analysed wih the help of GIS and Remote Sensing techniques. Additionally to these 11 topics we find a major thread by Africa's popoulation development. Africa's current population of 1.25 billion is likely to double by 2050, putting severe pressure on the continent's biodiversity and nature's contributions to people, unless appropriate policies and strategies are adopted and effectively implemented. Africa is also one of the most rapidly urbanizing continents. The major challenge for Africa is that the population of Africa surpassed one billion people in 2009 and is set to grow at 2.3 per cent every year during 2010–2015 (World Bank 2011). This means, 2.5 billion people will live in Africa by 2050. In Kenia, we find a 2.6% growth rate / year (2017), which means that Kenia belongs to the fastest growing countries in Africa.

Retrospective to Global Landscapes Forum Nairobi 2018 (UN compound in Nairobi)

The Global Landscapes Forum in Nairobi 2018 is led by the the Center of International Forestry Research (CIFOR) alongside founding partners UN Environment and the World Bank, with core funding provided by the German Government, the Global Landscapes Forum (GLF) accelerates action towards the creation of more resilient, equitable, profitable, productive and healthy landscapes and the achievement of the UNFCCC Paris Agreement and Sustainable Development Goals (Agenda 2030). It is a corner stone for future biodiversity protection. Concerning this important conference some key messages and facts can be summarized:

- Only one fifth of Africa's arable land is under cultivation. (IPBES report, 2018)
- Forests and woodlands make about 23% of Africa's land, while 27% is arable land (IPBES report, 2018)

- In East Africa, some pastoralists, increasingly confined to smaller areas, are forced to keep more animals on degrading pastures or enter conflict with other land users as they move their herds. (FAO, 2015)
- 14.7% of Africa's land is classified as protected. (IPBES report, 2018)
- Africa hosts eight of the world's 36 biodiversity hotpots. (IPBES report, 2018)
- Marine and coastal resources contribute in some African regions to more than 35% of GDP. (IPBES report, 2018)
- By 2100, agricultural gross domestic product (GDP) losses are expected to be greater in West and Central Africa than in North and Southern Africa (0.4%–1.3%). (African Transformation Report, 2017)
- In Africa only about 10 per cent of rural land is registered, with 90 per cent managed informally. (World Bank, 2013)
- Africa counts 369 wetlands of international importance (Ramsar sites), 142 UNESCO World Heritage Sites, 1,255 important bird and biodiversity areas and 158 Alliance for Zero Extinction sites. (IPBES report, 2018)

Finally, we can state that Africa is a biodiversity hotspot under hihg risk. In a short summary the trends / data and projections for Africa are listed (Africa by the numbers):

Trends / data:

- +/- 6.6 million: km2 of land is degraded due to factors such as deforestation, unsustainable agriculture, overgrazing, uncontrolled mining activities, invasive alien species and climate change, leading to soil erosion, salinization, pollution, and loss of vegetation or soil fertility
- +/- 62%: rural population directly dependent on wild nature and its services for survival (the most of any continent)
- +/- 2 million: km2 of land designated as protected (including 6% of biodiversity-rich tropical evergreen broadleaf forests and 2.5% of Africa's seas
- 25%: people having faced hunger and malnutrition (2011–2013) in Sub-Saharan Africa, the world's most food-deficient region

Projections:

- >50% of African bird and mammal species could be lost to climate change by 2100
- 20–30% expected decline in productivity of lakes by 2100
- billion predicted population increase of Africa in 2050 (double the current figure)
- 54%: Africans expected to live in urban and peri-urban areas by 2030 (up from 39% in 2003)

These trends, data and projections shows how much African's biodiversityx is under pressure and that new technologies are needed to sustain African's landscapes. From these trends and projections Africa (esp. Kenia) reacts and postulates certain restoration commitments for the future. A major task in restoration of African landscapes is reforestation. Up to 2018 the following commitments can be listed:

Restoration commitments (status 2018):

- Kenya's National Climate Change Response Strategy calls for growing 7.6 bn trees in the next 20 years. (afr100.org)
- The African Forest Landscape Restoration Initiative (AFR100) aims to restore 100 million hectares of deforested and degraded landscapes across Africa by 2030. (afr100.org)
- The Initiative on Sustainability, Stability and Security in Africa aims to create 2 million green jobs for vulnerable groups through restoration and sustainable land management by 2025. (UNCCD report, 2018, A Rising Africa in a fragile environment)
- Almost $1.5 billion: funds pledged for the AFR100. (afr100.org)
- The Great Green Wall for the Sahara and Sahel, aims to create the planet's larges living structure, stretching on 8,000 km across Africa. (UNCCD)
- The Great Green Wall Initiative aims to capture 250 million tonnes of carbon and create at least 350,000 rural jobs by 2030. (UNCCD)
- More than 8 billion dollars have been mobilized or pledged so far to support the Great Green Wall Initiative. (UNCCD)

An important report about the situation of African's biodiversity is given by the Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES). This

report is an important baseline about the current situation and delivers information such as the most endangered species and their xtinction risk (see Figure 1).

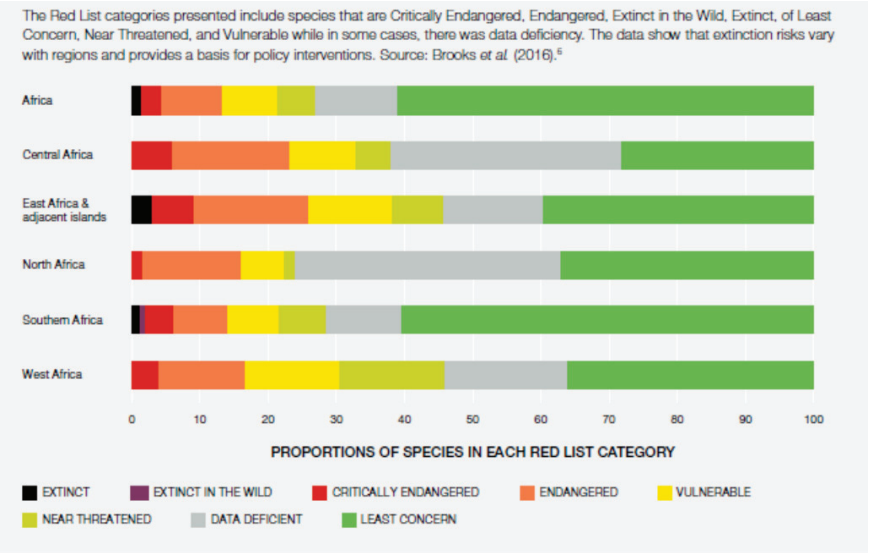

Figure 1. Extinction risk of species endemic to Africa and its subregions (IPBES, 2018)

Figure 1 shows that in East Africa and adjacent islands nearly more than 25% of the species are critically endangerd in the future. Another 10% is vulnerable. In Figrue 2, the key drivers of biodiversity change is shown for the different subregions. For East Africa, we can see that climat change and ilegal wildlife trade have a high impact on biodiversity. On the other side, most oft he protecteted areas of East Africa are under control and need monitoring and control (e.g. with the help of remote sensing technology). Two processes for regional environmental assessment are currently underway:

- the Global Environment Outlook (GEO) and
- Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES)

Both face constraints of data, time, capacity, and resources and are based on certain knowledge products. As a baseline, three global knowledge products according to their regions and subregions are available as follows:

- The IUCN Red List of Threatened Species,

- Key Biodiversity Areas (specifically Important Bird & Biodiversity Areas [IBAs],
- Protected Planet (Alliance for Zero Extinction [AZE] sites).

These main knowledge products about biodiversity are accompanied by diverse smaller and invidual products (see Figure 3). Another framework for the assessment of biodiversity over Africa is the report "The State of Biodiversity in Africa: A Mid-term Review of Progress towards the Aichi Biodiversity Targets" by United Nations Environment Programme (UNEP). The report identifies opportunities and challenges in implementing the Strategic Plan for Biodiversity 2011–2020 in Africa and looks ahead to actions which need to be taken by national governments and other decision makers to enhance and accelerate progress towards its attainment. Central initiative is the set up of the Aiche biodiversity targets.

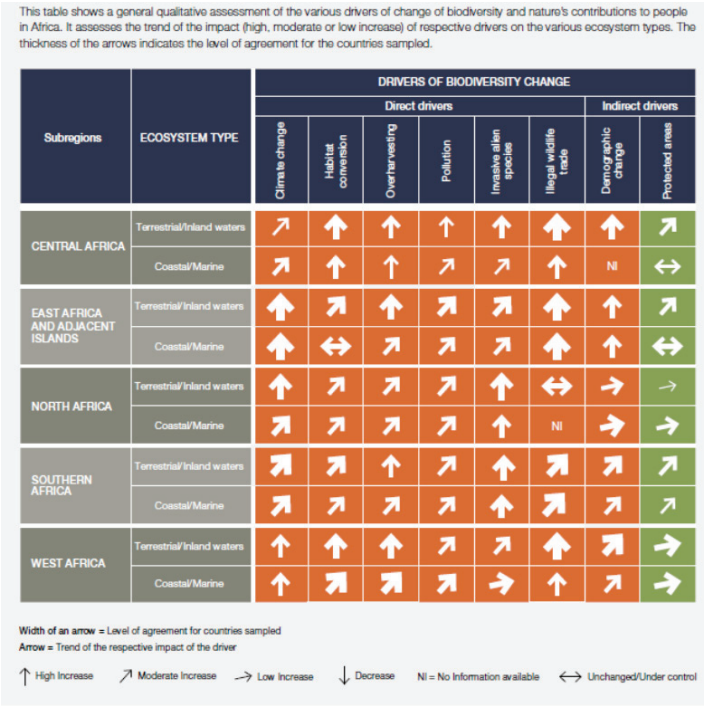

Figure 2. Key drivers of biodiversity change in Africa shown per subregion and ecosystem type (IPBES, 2018)