

## A brief overview of solutions to climate change related impacts across Sub-Saharan Africa

### Introduction

Globally, discussions on the cause and impact of a rapidly changing climate are taking on new directions. There is now a growing interest in solutions based on existing indigenous knowledge, greater awareness and the spread of innovation.

The Democratic Republic of Congo (DRC), one of the most resource-rich countries in Africa, is home to a seemingly endless variety of minerals, forests, savannahs, swamps, tropical plants and endangered wildlife. This article presents the work of the Centre d'Appui au Développement Integral/Mbankana (CADIM) in setting up a consultation framework on integrated water resource management, based on a study of the degradation of the Lukaya Watershed Forest Ecosystem in Kinshasa, DRC. The Lukaya Watershed is the main source of income for more than 50 per cent of local inhabitants, supporting agricultural activities and serving as a vital source of energy. CADIM used spatial data processing to assess satellite images and identify the extent of deforestation and rate of afforestation during the 1990s and 2000s. The results indicate a drastic deterioration of vegetation

cover from approximately 37 per cent in 1994 to 26 per cent in 2015.

Continuous cropping and poor soil management is a serious issue in northern Ghana. According to the Centre for Ecological Agricultural and Livelihoods (CEAL) formerly known as Zasilari Ecological Farms Project (ZEFP) combining farmers' experiences, local knowledge and indigenous practices with scientific knowledge is an effective way of managing soil fertility and increasing yields. However, field experiments, which largely exclude the experiences of local farmers, remain the preferred method of trialling new practices. CEAL promotes Integrated Soil Fertility Management (ISFM) to help farmers in the northern region of Ghana to overcome poor soil fertility, drought and poor yields. CEAL trains farmers from disadvantaged backgrounds (including school dropouts)

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on organic farming principles such as building compost and processing degradable waste materials with domestic animal droppings to maximize productivity. The training is an interim phase of the transition from conventional farming to organic farming, with the long-term aim of obtaining organic certification so that such farmers can acquire market premium for their agriculture produce. In this way, CEAL aims to fight poverty, disease and hunger by promoting education, agribusiness enterprises and other livelihood activities through smallholder farmer groups.

In South Africa, Champions of the Environment are promoting a holistic shift to sustainability through green tourism. Champions of the Environment raise and disburse funds for empowering women and youth in rural areas to promote green business

opportunities and advocate for lifestyle changes that foster sustainable production and consumption.

As one of the early enactors of a Climate Change Act, Kenya is quickly shifting from paper to action through innovative local initiatives to address climate change. The Kenya Climate Innovation Centre (KCIC) has documented the experiences of young people, highlighting efforts to turn agricultural waste known as chaff into organic fertilizer, the production of creative handmade stationery using water hyacinth, and the repurposing of plastic waste into eco-friendly building materials. Kenya has created a favourable policy and legislative environment for developing approaches to climate change and related impacts. More needs to be done in terms of implementation, which is impeded by limited resources

and bureaucratic procedures for accessing climate finance defined by UNFCCC as; local, national or transnational financing drawn from public, private and alternative sources of financing that seeks to support mitigation and adaptation actions that will address climate change.

Some of the climate change frameworks in Kenya include: the Climate Change Policy Framework, the Climate Change Bill, the National Climate Change Finance Policy and Budget Codes, and the National Climate Change Action Plan.

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# Promoting Green Tourism and Cultural Change in South Africa

By Stella Helwick- Champions of the Environment Foundation

The Green Climate Fund (GCF) is a Global Fund established under the UNFCCC to support the implementation of the Paris Agreement in developing countries. GCF makes use of accredited entities to develop funding proposals and oversee, supervise, manage and monitor their respective GCF-approved projects and programmes. In October 2016, the South African National Biodiversity Institute was accredited as a Direct Access Entity of the GCF.

The policy documents that regulate climate change activities in South Africa are still in draft form; these include the 'National Climate Change Response White Paper', first published in October 2011 and the 'National Adaptation Strategy', presented to the Department of Environmental Affairs and GIZ on 16 September 2016 and disseminated to a wider audience for comment. South Africa's 'aspirational goal' on adaptation is to build resilience and adaptive capacity to respond to climate change risk and vulnerability, while providing guidance on the integration of climate change responses into current and future development objectives, through optimizing policy, planning and implementation coherence of climate change adaptation actions.

South Africa is at present developing climate change adaptation strategies based on risk and vulnerability reduction, and seeks to share resources, technology and learning to coordinate a regional response. A key feature of adaptation responses is that they have a much stronger local context, and the benefits appear much faster and are often

more tangible – i.e. improved environmental quality and job creation, particularly 'green jobs'. Green tourism is an industry that has been identified to provide employment opportunities for youth and women living in rural areas. Adaptive measures to climate change include water harvesting, land use planning, changes in farming systems, crop breeding and improved climate forecasting and information, contributing significantly to sustainable development policies and disaster risk reduction in the short term. Green tourism has become something of a South African specialty; a kinder way of travelling, gentler on the pocket, and sensitive to community hosts and the natural environment – beyond simply being eco-friendly.

Champions of the Environment ('Champions') raise and disburse

funds to empower women and youth in rural areas, focusing on the 'Maputoland-Pondoland-Albany hotspot'. Champions are working to unlock economic, social and spiritual wealth over the next five years (2018-2023). Their aim is to develop centres of education and positive action through learning new ways of establishing and expanding businesses for local community members – both as employers (owners) and employees (job opportunities). This helps to stimulate respect for conservation and the rehabilitation of South Africa's rich cultural, historic, religious and natural/environmental heritage. The ripple effect of this will, in turn, encourage change in behaviour and attitudes to renewable energy, water and waste recycling, organic food supplies and service quality connecting people's environmental behavioural shifts to similar shifts within organizations. The ultimate aim is to promote sustainable socioeconomic transformation via the Green Economy and promote societies that are just and equal by reversing the 'urban bias' and by bringing the consumer to the community, thus retaining labour locally.



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Figure 1 : Xhosa Huts that promote green tourism (Credits: John Costello)

South Africa's rural population has declined from 42.7 per cent in 2006 to 34.7 per cent in 2016.<sup>1</sup> Between 2011 and 2016 approximately 326,171 people left the Eastern Cape to relocate to Gauteng and the Western Cape, seeking better living conditions and improved job prospects. In the Eastern Cape 40 per cent of the population live in poverty – the highest rates of poverty in South Africa. Only 69.8 per cent<sup>2</sup> live in formal housing and only 13 per cent of all homes use electricity for heating.<sup>3</sup>

Twelve traditional leaders in the Eastern Cape are working to promote sustainable economic empowerment, infrastructure development and healthy lifestyles in their communities. The Amakhonjwayo Traditional Communal Development Trust, headed by Nkosi Mpumalanga Gwadiso, incorporates twelve administrative areas: Gazini, Hamsini, Lucingweni, Lwandile,

Mamolweni, Mankosi, Mfundweni, Mgojweni, Mpoza, Nkanunu, Noxova and Ntsimbini. They are making 150 hectares of communal land available to 600 women skilled in plant propagation and organic food production, as part of efforts to support climate-smart agriculture. Each woman will own and manage her own business and will employ three youths, thereby generating 2,400 new job opportunities. This is partly to service green tourism and is aimed at the eco-adventure tourist market. The leaders are cultivating and investing in eco-trails to make optimum use of underused communal land, creating a sustainable eco-tourism destination to attract nature lovers who enjoy mountain biking, marathon running, hiking, pony trails and experiencing a variety of customs and foods. The aim is to bring the consumer to the community, thereby retaining labour locally – as opposed to labour migrating to

Twelve traditional leaders in the Eastern Cape are working to promote sustainable economic empowerment, infrastructure development and healthy lifestyles in their communities.

the consumer; thus promoting an influx of wealth and investment opportunities, while safeguarding the ecosystems. The initial development consists of approximately 76 km of track and 100 caravan parks/campsites constructed by local inhabitants, creating job opportunities and transferring skills to the community. The leadership is currently implementing practical initiatives to demonstrate food, water and energy security: a living blue-print of the Green Economy adapted for eco-tourism, consisting of 'off-grid' solutions using solar and biogas as preferred energy sources.

1 World Bank, 2016

2 Institute of Race Relations in South Africa, 2017

3 A survey of energy-related behaviour and perceptions in South Africa: The Residential Sector, 2012

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**Champions will promote green tourism and address environmental issues through education, empowering communities to make informed decisions on issues pertaining to the local business environment.**

Indigenous landscaped gardens will include grasses, plants and flowers, adding colour and biodiversity to the insect and bird population. The primary beneficiaries are isi-Xhosa-speaking women and youth who wish to be involved in green tourism and environmental sustainability projects. Although the contribution of biodiversity to our economic, social and spiritual well-being is difficult to measure, it is generally accepted that the benefits are significant and essential. Over the next five years (2020 – 2025) three thousand five hundred and sixty (3,560)

new jobs will increase sustainable revenue for Nyandeni, OR Tambo District – benefiting areas as far afield as East London, Mthatha, Port St John's and the Eastern Cape.

Champions will promote green tourism and address environmental issues through education, empowering communities to make informed decisions on issues pertaining to the local business environment. This is based on recognising the importance of environmental protection, conservation and rehabilitation with stringent reporting requirements and pressures to contain costs, our focus is skilled employable youth.

Youth have a greater interest in and aptitude for computing/information technology, presenting opportunities for training and to improve the flow of information and new ways of doing business. Stakeholders are increasingly under pressure to deliver real-time insights on all measures that contribute to their

organization's carbon footprint. Knowledge management, cloud computing and adaptation of new technologies will assist in measuring and containing costs of future carbon reporting, pricing and taxation scenarios. Digital media and data capturing will ensure that the portfolio of evidence is credible and accurate.

Women in South Africa, many of whom are farmers and resource managers, are primary actors in climate change mitigation and adaptation. New projects where women are awarded secure tenure will be able to show measurable social, environmental and economic benefits for their family and community from the start. That is improving organic farming methods and healthy eating patterns, creating carbon sinks by planting indigenous trees, multi-cropping reducing soil erosion and flooding and using natural composts thereby reducing the farmers dependency on herbicides and pesticides.

# Fighting Climate Change the Kenyan Way

Zachary O Mikwa – Kenya Climate Innovation Centre

Climate change is irrefutable. Indeed, it is perhaps the most pressing environmental challenge of our time. It affects ecosystems, water and food resources, and health, among others. Not only is it a local problem but also a global issue. In Kenya, climate change is now a reality. Its adverse effects on the Kenyan landscape, evident through changes in rainfall patterns, has become the norm, with floods and droughts causing damage to property and loss of life.

For instance, the 2018 floods in Naivasha resulted in 172 fatalities, displacing 283,290 people and leaving 84 people with severe injuries. In Tana River County alone, 150,000 people were displaced and 16 were killed by recent flooding. It is also estimated that 1,500 livestock were lost in Turkana County due to heavy rainfall. Flooding is also linked to food scarcity since floods destroy crops and fertile soil; over time, yields decrease and supply is not able to meet demand. In addition, droughts have resulted in a reduction in energy and water supplies to cities in Kenya, including Nairobi.

Agriculture, which supports 75 per cent of Kenya's population and contributes to 21 per cent of the country's GDP, has been negatively impacted by climate change. Given agriculture's high reliance on rainfall in Kenya, it is adversely impacted by drought. For instance, prolonged drought in 2016/2017 resulted in low agricultural productivity and a subsequent increase in food prices – by up to a third. Consequently, it was estimated that about 2 million people were in need of food aid. According to UNICEF's Annual Report of 2016, 175,000 children in Kenya are unable to attend preschool and primary school due to malnutrition.<sup>1</sup>

Energy supply is another area significantly affected by climate change. Kenya is heavily reliant on hydroelectric power. According to KENGEN, hydroelectric power accounts for approximately 50 per cent of all the electricity produced nationwide.<sup>2</sup> Other sources of renewable energy in the country include geothermal, wind and solar energy. Of all the renewable energy options available, hydroelectric power is the most vulnerable to impacts of climate change. Regular droughts and unreliable rainfall patterns have diminished the capacity of many dams in Kenya.

Tourism is also highly sensitive to climate change, which affects a wide range of environmental resources such as wildlife diversity and water levels. Firstly, changes in rainfall patterns cause fluctuations in grass abundance resulting in the migration of wildlife. High levels of water in the Mara River during the annual migration in 2011 killed about 15,000 animals – as opposed to the usual 1,000 or so. The increase in temperatures is also causing the melting of glaciers and snow caps on Mount Kenya – a major tourist attraction because of the presence of snow at the equator. In the near future, the snow may completely disappear if temperatures continue to rise.

## Climate change fuelling innovation in Kenya

In an effort to mitigate and adapt to climate change, Kenyans are adopting measures to safeguard future generations, through a combination of innovative ideas and strong entrepreneurial spirit.

Samuel Rigu, the founder of [Safi Organics](#), turns agricultural waste, known as chaff into organic fertilizer called Safi Sarvi. Mr Rigu purchases agricultural waste, such as rice husks and maize combs, for approximately \$30 per metric ton, which he then uses to make fertilizer. The fertilizer retails at \$15 per 50kg. Farmers who use it have seen their farm yields increase by up to 30 per cent and their income by up to 50 per cent in a single harvesting season. More importantly, for every acre of land that uses Safi Organics' fertilizer, the equivalent of 1.7 tons of CO<sub>2</sub> is sequestered from the



Figure 2 : Entrepreneur with Sifa Sarvi (Source: Sarvi website)

1 [https://www.unicef.org/about/annualreport/files/Kenya\\_2016\\_COAR.pdf](https://www.unicef.org/about/annualreport/files/Kenya_2016_COAR.pdf)

2 <https://www.kengen.co.ke/sites/default/files/financialreports/KenGen%20Annual%20Report%202017%20Final.pdf>



Figure 3: Plastic waste management a major issue in Nairobi  
(Credits: Hanns Seidel Foundation)

atmosphere – thereby helping to address climate and agricultural challenges simultaneously.

**Takawiri Craft Enterprises** is a social enterprise that produces handmade stationery and craft items, made mainly from water hyacinth, harvested from the shores of Lake Victoria in Kisumu. Their products include bookmarks, notebooks, gift boxes, files, folders, paper lamp shades, greeting cards, name tags, business cards, envelopes and letterheads, among others. Takawiri seeks both local and foreign clients. In the local market, they are targeting expatriates and tourists who want to take home unique souvenirs, while in local markets they are targeting customers in the household and gift sector who either want to redesign their homes with handmade items or who are looking for fair trade products.

**COREC** (Continental Renewable Energy Co.) uses plastic waste to make eco-friendly building materials; addressing the plastic waste menace which is a growing problem in Nairobi. Approximately 2,650 metric tons of waste is generated in Nairobi, of which 20 per cent is plastic; 70 per cent of the waste (majority which consist of plastic) is

irresponsibly disposed, clogging sewers and littering streets. The eco-friendly building material is sold to developers looking for cheaper materials, providing an affordable and durable alternative for construction products. These eco-friendly building materials made from recycled plastics are ideal for fencing for farms, homes, national parks, forest reserves and commercial units. COREC's innovative approach to plastic waste has significantly reduced the accumulation of plastics in the environment and has probably reduced the accumulation of CO<sub>2</sub> in the Indian Ocean.<sup>3</sup>

Kenya has also experienced an increase in the use of solar energy. In Garissa County, a solar energy system worth \$135.7 million has been established and is now the largest solar

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project in East and Central Africa. The multimillion-dollar project is estimated to generate 55 megawatts of electricity and power for 625,000 homes. The production of renewable energy is an important factor in enhancing access to energy, especially for rural households, via government initiatives such as rural electrification programmes.

### Way forward

Kenya is developing vital climate change policies and legislation, such as the Climate Change Policy Framework, the Climate Change Bill, the National Climate Change Finance Policy and Budget Codes, and the National Climate Change Action Plan. As the Government seeks to effectively implement these policies, funding has proved to be a major obstacle. The Kenyan Government therefore needs to develop effective frameworks that will enable Kenya to attract climate finance.

Funding interventions are being used to mitigate and adapt to climate change. The Green Climate Fund (GCF), established by the UNFCCC in 2009, allocates resources and supports governments to effectively finance climate-related projects and programmes that help countries reduce their environmental footprint. To localize the fight against climate change, local governments can follow the example set by the Kitui County Government and establish a County Climate Change Fund. Impact funds such as the Kenya Climate Innovation Centre also help incubate, fund and support small- and medium-sized enterprises (SMEs) that have developed innovative ideas for tackling climate change.

<sup>3</sup> <https://www.unenvironment.org/news-and-stories/story/double-trouble-plastics-found-emit-potent-greenhouse-gases>

# Study of the Degradation of the Lukaya Watershed Forest Ecosystems in the Democratic Republic of Congo

By Martin Ndongo, A.Nkoba and Prof. Kalulu Taba – Centre d'Appui au Développement Integral/Mbankana (CADIM)

Central Africa has the second largest area of tropical rainforest in the world covering an area of nearly 2 million km<sup>2</sup>. This humid tropical forest is uninterrupted, stretching from the Gulf of Guinea to the Albertine Rift (OFAC, 2010).<sup>1</sup> The tropical forest is also subject to very high pressures that could ultimately lead to severe degradation and increase poverty of the riparian population dependent on forest resources. Tropical deforestation is responsible for 15 per cent to 20 per cent of all greenhouse gas emissions (Bellassen, 2008).<sup>2</sup>

The Congo Basin, located in Central Africa and covering Cameroon, the Central African Republic, the Democratic Republic

of Congo, the Republic of Congo, Equatorial Guinea and Gabon, is one of the major forest areas in the tropics. It covers nearly 70%

of forest and nearly two-thirds of it is in the Democratic Republic of Congo, 10% in Cameroon and 9.61% in Congo (Tchatchou *et al.*, 2015).<sup>3</sup>

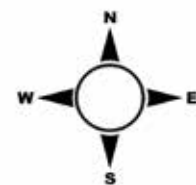
Lukaya Watershed is located between 4°27' and 4°41' south and 15°10' and 15°20' east, and straddles two provinces: Kinshasa and Kongo Central. The Lukaya River has its source in the rural village of Ntampa in Kongo Central and joins the Ndjili river (2,000 km<sup>2</sup> watershed), a tributary of the Congo River, at

1 OFAC, 2010. Etat des Foret, les forets du bassin du Congo, 274pp

2 Bellassen V., Crassous R., Dietzsch L., Schwartzman S., 2008. Réduction des émissions dues à la déforestation et à la dégradation des forets : quelle contribution de la part des marches du carbone? 44p.

3 Tchatchou B., Sonwa D., Ifo S., Tiani A. M., 2015. Déforestation et dégradation des forêts dans le Bassin du Congo, État des lieux, causes actuelles et perspectives. ISBN 978-602-1504-69-70.

## IMAGE GOOGLE EARTH



### Légende

 Bassin versant de la Lukaya

5 0 5 10 15 20 km




Figure 4. Location of the Lukaya River Watershed (Credits: Martin Ndongo and Professor Taba Kalulu)



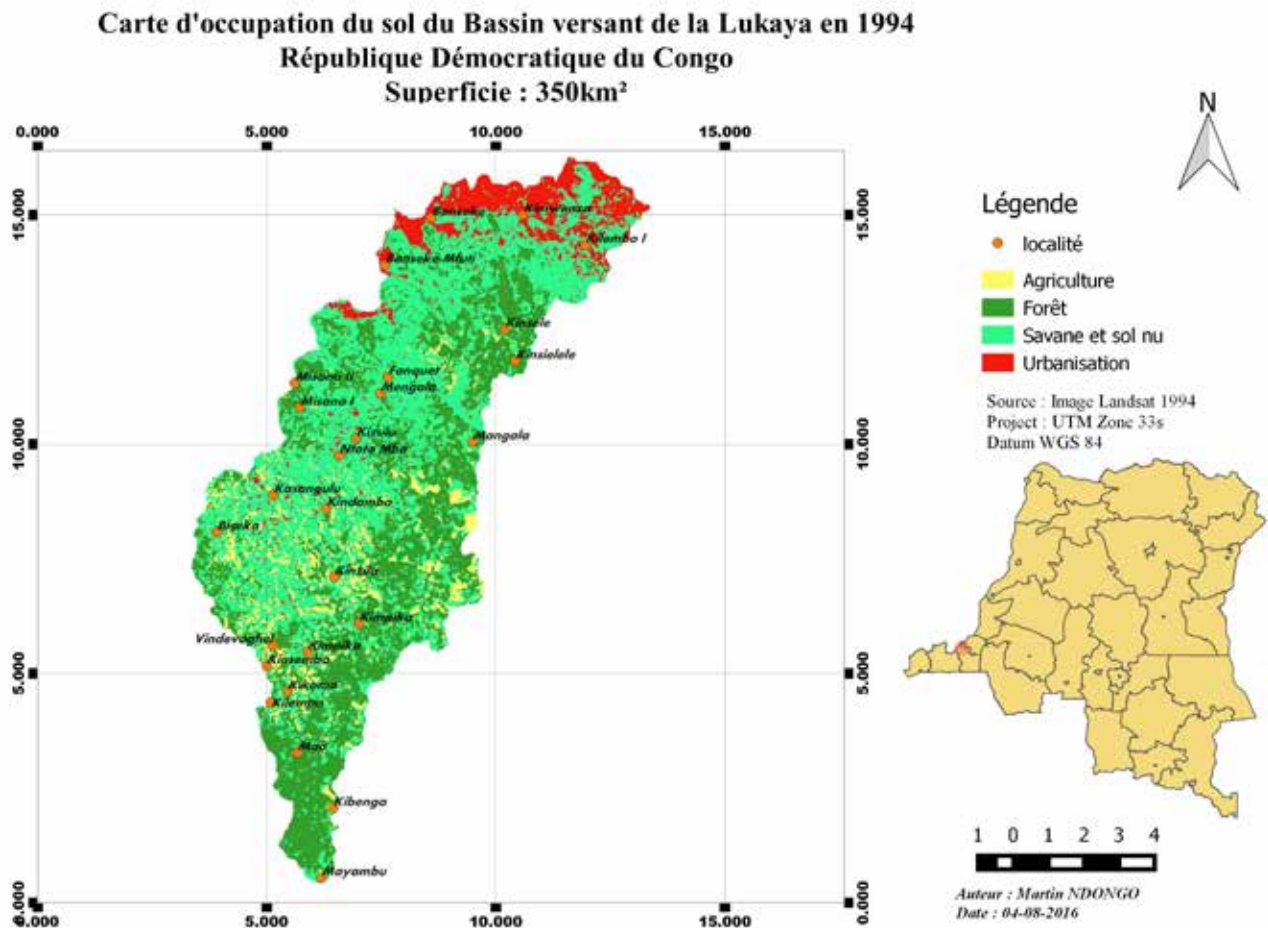


Figure 5 : Watershed Land Use Map, 1994 (Credits: Martin Ndonggo and Professor Taba Kalulu)

Ndjili-Kilambu on the outskirts of Kinshasa. This 50-km river has a variable profile and contains many effluents. The Lukaya catchment area covers an area of 350 km<sup>2</sup>, has a 13 km perimeter and a drainage capacity of 993.46 m<sup>3</sup>/km<sup>2</sup> (Jacmain, 2010<sup>4</sup>). Figure 4 shows the administrative and geographical boundaries of the Lukaya Watershed.

Over the last few decades, the impacts of the unsustainable use of natural resources in the watershed, and rapid and anarchic urbanization have become more and more visible. There has also been an increase in the deforestation of the last remaining patches of natural forest, more bush fires in the

dry season and an increase in erosion, resulting in the silting up of rivers. This, in turn worsens the effects of flooding, the pollution of watercourses and springs, the degradation of biodiversity and changes to cropping seasons. As a result of these adverse impacts, there is a growing awareness among some communities in the Lukaya River Watershed of environmental issues and the links with community well-being. Inspired by examples of positive experiences of integrated water resource management in other countries, communities in this area came up with the idea of setting up an organisation of users to apply these best practices.

## Discussion of mapping results

The purpose of the mapping, based on the analysis of satellite images over time, is to answer the following questions: What is the current extent of forest degradation in the area? Is there any evidence of afforestation? What are the spatial changes in the watershed? Are the changes that occurred in the 1990s and 2000s observable?

The study allows us to think about the use of supervised or unsupervised classification methods to produce thematic maps based on nomenclatures of predefined classes.

4 Jacmain C., 2010. Adaptabilité des contrats de rivières au bassin versant de la lukaya en République Démocratique du Congo. Mémoire master Université de liège, Belgique, 77p.

**Carte d'occupation du sol du bassin versant de la Lukaya en 2015**  
**République Démocratique du Congo**  
**Superficie : 350km<sup>2</sup>**

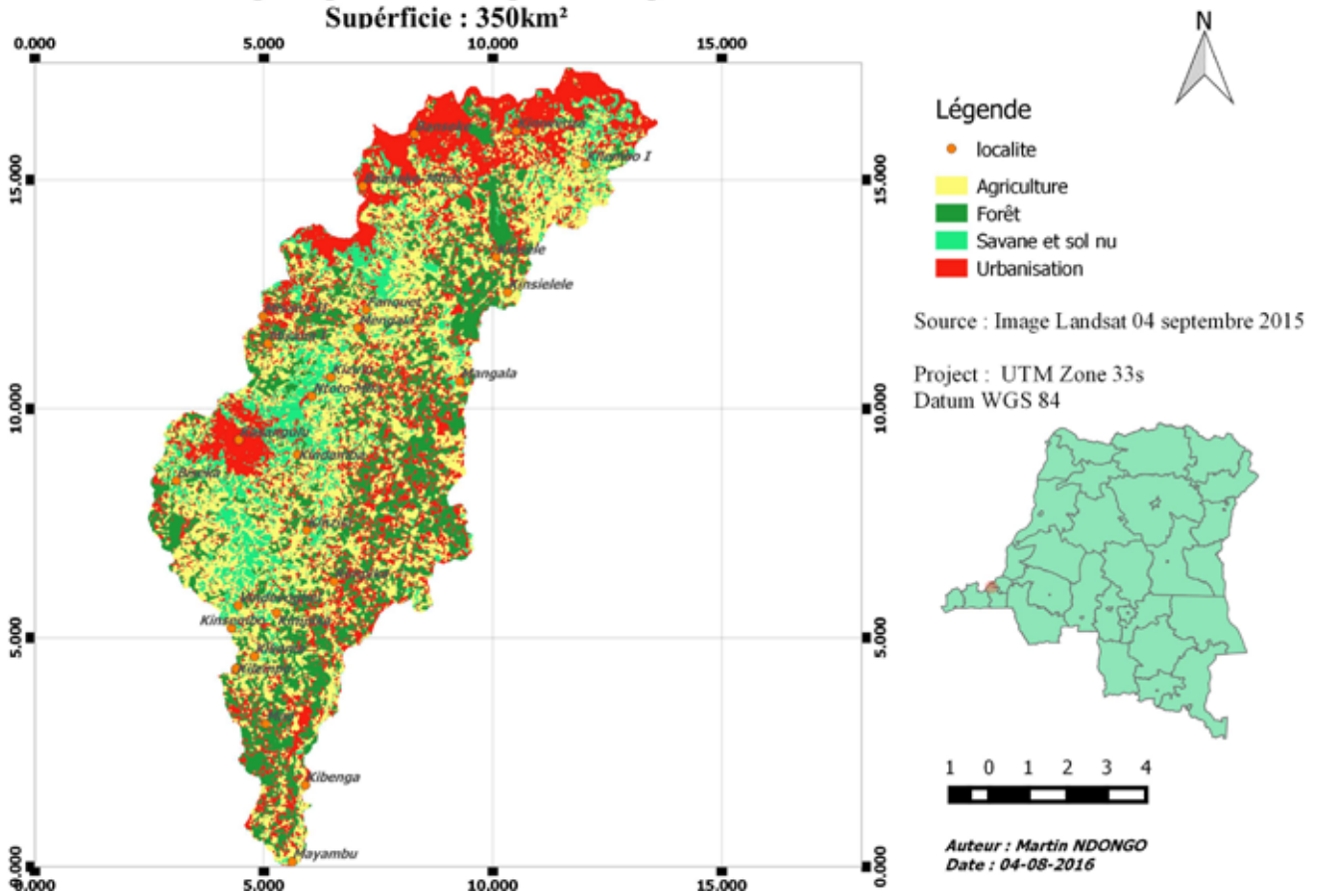


Figure 6 : Watershed Land Use Map, 2015



Figure 7 : Lukaya Watershed (Credits: Martin Ndongo and Professor Taba Kalulu)



Figure 8 : Lukaya Watershed (Credits: Martin Ndongo and Professor Taba Kalulu)

QGIS 2.14. software was used to process the spatial data and map the area, as well as support the use of various tools for this purpose.

Cartographic development started first by analyzing Landsat data in order to make the studied area clear. The results of the classification show that the studied area is in the forest zone; however, there is practically no forest in and around Kinshasa and inside the studied area.

The Lukaya Watershed land use maps show that the area covered by vegetation decreased from 12,844.62 ha (36.86 per cent coverage) in 1994 to 9,089.55 ha (26.10 per cent coverage) in 2015 (Figures 5 and 6). This implies that between 1994 and 2015, the total loss of vegetation

cover was 3,755.07 ha – a loss of 178.8 ha/year (at a rate of 0.016 per cent per year). These results indicate that the watershed is under severe threat from anthropic pressures.

If we look at the general rate of deforestation of catchments, it is relatively low compared to the 0.6 per cent/year found in Kongo Central Province and 0.20 per cent/year for the whole country; however, it is a large area that is deforested each year (OFAC, 2010).

It is also possible, by simple extrapolation, to estimate the areas which might be deforested during the coming years. It is likely that the rate of deforestation will increase because of important demographic growth in the region,

rural exodus and rapid peri-urbanization. The area covered by forest could shrink to 5,185.5 ha by 2050 (Ndongo, 2016).<sup>5</sup>

In spite of the magnitude of deforestation in the Lukaya Watershed, the area offers a range of socioeconomic activities, predominantly in agriculture and wood energy exploitation. These constitute the main sources of income for more than 50 per cent of the households and are, among other things, the main activities that have a negative impact on the natural resources of the watershed. It is important therefore, that sustainable agricultural practices such as agroforestry be introduced in the area.

<sup>5</sup> Ndongo M., 2016. Contribution à l'étude de la dégradation des écosystèmes forestiers du bassin versant de la rivière Lukaya en RD Congo. Mémoire, Université de Liège (ULG)/Belgique.

# Adoption of Conservation Agriculture Technology in Northern Ghana

By Issifu Jobila Sulemana

Sustainable soil management has become a global concern for policymakers, scientists, extension officers, NGOs and farmers. Sustainable soil management is particularly relevant in the northern part of Ghana: the Guinea Savannah (GS) zone.<sup>1</sup> Issaka *et al.* (2012) reported on the low level of soil nutrients in the GS, as a result of continuous cropping and poor/inadequate soil management practices.<sup>2</sup>

However, efforts to improve soil productive capacity often involve field experiments, which tend to ignore farmers' experiences, local knowledge and indigenous practices. There is, therefore, a need to adopt a soil management approach that includes relevant stakeholders and takes into account their methods of managing soil fertility for increased production. Farmers experience, local knowledge and indigenous practices can be combined with scientific knowledge to adequately manage soil fertility and increase yield.

Omari *et al.* (2018) identified soil nutrient management practices among farmers in the GS, which include the use of inorganic fertilizers (IF)/chemical fertilizers, organic fertilizers, combinations of the two (integrated soil fertility management – ISFM) and no fertilization. ISFM is basically a combination of agronomic practices relating to crops, mineral fertilizers, organic inputs and other

additions, which are used to meet the needs of different cropping systems, levels of soil fertility and socioeconomic conditions. These practices are usually used to increase the productivity of smallholder farmers, and a number of ISFM practices have been extended to other areas (Roobroeck, *et al.*, 2016).<sup>3</sup>

Of these options, IF application was rated the highest in terms of soil nutrition management because of the high crop response and its wide availability. A significant percentage of respondents in the Omari *et al.* (2018) study – 48.3 per cent of men and 14.9 per cent of women – practised inorganic fertilization; 14.0 per cent combined organic and inorganic fertilizers, while 7.9% of respondents (males only) used only organic fertilizers. More specifically, the smallholder farmers in the study used nitrogen (N), phosphorous (p) and potassium (K) as a base

application. Omari *et al.* (2008) also reported the different reasons for the application of IF: 36.8 % of the respondents used IF because it produced the greatest yields; 22.4 % used it because it was a common practice in their locality; 15.8 % used it because of the limited availability of organic fertilizers; 13.2 % of respondents used it because of its availability; and 3.9 % used IF to minimize the negative effects of *striga hermonthica* – known to local farmers as *witch weed*, very detrimental to staple food crops such as maize, sorghum, rice and millet.

Furthermore, Omari *et al.* (2018) found that the problem of declining yields and low levels of soil nutrients in the GS was not solved when IF was the only fertilizer applied. This finding suggests the need for the integration of both IF and organic fertilization practices. Over a decade of research on soil fertility, crop nutrition and the socioeconomic conditions of smallholder farmers suggests that the integration of IF and organic fertilization practices is an effective approach for increasing soil fertility and crop yield (Roobroeck *et al.*, 2016). ISFM refers to a set of practices that includes the use of IF, organic fertilizers and improved germplasm, in combination

1 Ansong Omari, R., Bellingrath-Kimura, S. D., Sarkodee Addo, E., Oikawa, Y., & Fujii, Y. (2018). Exploring Farmers' Indigenous Knowledge of Soil Quality and Fertility Management Practices in Selected Farming Communities of the Guinea Savannah Agro-Ecological Zone of Ghana. *Sustainability*, 10(4), 1034.

2 Issaka, N.R.; Mohammed, M.; Tobita, S.; Nakamura, S.; Owusu- Adjei, E. Indigenous fertilizing materials to enhance soil productivity in Ghana. In *Soil Fertility Improvement and Integrated Nutrient Management- A Global Perspective*; Whalen, K.J., Ed.; InTech: Rijeka, Croatia, 2012; pp. 119-13

3 Roobroeck, D.; Asten, P.V.; Jama, B.; Harawa, R.; Vaniauwe, B (2016). *Integrated Soil Fertility Management: Contribution of Framework and Practices to Climate Smart Agriculture*

with the knowledge required to adapt these practices to suit the local conditions of smallholder farmers. As part of climate-smart agricultural technology transfer, CEAL has adopted an ISFM approach to help farmers overcome poor soil fertility, droughts and poor yields in the West Mamprusi Municipality in the northern region of Ghana.

### CEAL approach and results

CEAL is a local Ghanaian NGO set up to support vulnerable communities in northern Ghana to overcome poverty, disease and hunger through education, agribusiness enterprises and other livelihood initiatives. Using proven eco-friendly technologies, CEAL supports smallholder farmer groups to increase crop and livestock yields. The organization focuses on agricultural conservation initiatives and other forms of climate-smart agricultural technology transfers as a means of achieving food security, sustained income-generation and poverty reduction among smallholder farmers in northern Ghana.

CEAL uses an ISFM approach to train farmers to adopt organic farming principles, with low conventional agricultural inputs to maximize productivity. Under the CEAL approach, farmers were trained on how to create compost and process household degradable waste materials together with domestic animal droppings – in place of nitrogen, phosphorus and potassium (NPK) chemical fertilizers. Farmers are then trained to top dress soils with organic fertilizers, using either urea chemical fertilizers or household urine to boost yields. The trained farmers then used this approach to improve yields of vegetables, maize and rice. The approach enables farmers to transition from conventional to more organic practices and then prepares them for obtaining organic certification in the future so that such farmers can acquire market premium for their agriculture produce. In Kata Banawa, a village 4km from

The organization focuses on agricultural conservation initiatives and other forms of climate-smart agricultural technology transfers as a means of achieving food security, sustained income-generation and poverty reduction among smallholder farmers in northern Ghana.

Walewale in the West Mamprusi Municipality in the northern region of Ghana, CEAL trained a group of 50 farmers from different disadvantaged backgrounds. The trainees included single mothers, school dropouts, and people who have been forced to migrate from one place to another because of depleted soil conditions, poor annual crop yields and the impacts of climate change. As an adaptation strategy, the farmers were grouped together, trained and supported to adopt ISFM practices. Each farmer received training in compost building, household waste processing skills, the planting of improved seed varieties and urea deep placement fertilizer application technology. The practice is very affordable in terms of monetary costs, and well suited to northern Ghana, which has the country's highest rates of poverty and food insecurity. For example, 50kg of NPK costs Gh¢ 110-approximately US\$25 without a government subsidy, compared to a 50kg of compost prepared by the farmer which costs approximately Gh¢ 40-45 or \$10. CEAL farmers who applied organic fertilizers increased crop yield. The practice increased maize yields from 1-3 bags (110kg/bag) to 7-11 bags (110kg/bag) within the first year of application. This is expected to increase in the coming years as farmers continue to apply the new practices.

Additionally, the composting, household waste processing and the application of home-made fertilizer has reduced the use of conventional agriculture inputs (chemical fertilizers) for both

men and women. CEAL deemed the practice to be climate-smart as well as soil fertility enhancing; it improves water retention in soils and reduces the pollution of water bodies, thereby enhancing the health of soils and other ecosystems.

### Implementation challenges

Despite the success of the CEAL approach, farmers and the CEAL team still face challenges in transitioning to low IF input applications. Some of the biggest challenges include low/untimely rainfall, the limited availability and high cost of climate-smart certified seeds, the limited availability of agro-dealers (the nearest are almost 10km away), limited access to credit, a lack of knowledge about the relative benefits of organic and inorganic fertilizers, the lack of soil tests and the blanket application of fertilizers.

Based on the practical experiences of working with farmers and local communities, CEAL provides the following policy recommendations:

- Civil society should advocate for the enforcement of policy on certified seed production and marketing.
- Civil society should partner with the Ministry of Food and Agriculture to introduce seed vans to remote areas and sell seeds at affordable prices.
- Stakeholders should partner with technical universities to introduce labour-saving technology for preparing and applying organic fertilizers.
- Government budgetary allocations and international partners should provide grants to reduce risks and introduce new appropriate technologies.
- The Government should increase the ratio of Agriculture Extension Officers to smallholders from 1:1,500 to 1:200.
- Stakeholders should provide production credit with low interest rates to farmers.

## Conclusion

It is evident from the exemplary experiences shared by the different countries in this report that conservation efforts have triggered important discussions at the community level.

Organizations such as CEAL and Champions of the Environment are adopting integrated approaches to promote discourse, and fight poverty, the spread of disease and hunger, as part of their efforts in promoting environmental conservation. Working with

community-led groups in driving conservation efforts has presented opportunities for further discussions on the ways that communities can organize themselves. To support the localization of adaptation practices, there is an urgent need for national governments to actively push for supportive policy and legislative environments. Fast-tracking this process enables countries to better position themselves to access resources for pro-actively addressing climate change and its related impacts.

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