

CLIMATE SMART AGRICULTURE

Successes in AFRICA





Authors: Xiaoyue Hou, Xenia Zia Morales, Grace Anyango Obuya, Dasan Bobo, and Ademola Braimoh

“ For African governments, promoting climate-smart agriculture is a priority. There is a range of agricultural management solutions, which can improve crop productivity, enhance resilience to climate shocks and reduce carbon emissions. Delivering this triple win is essential to addressing Africa's food security agenda. ”

*Makhtar Diop
Vice President, Africa Region
The World Bank*

“ Agriculture is a victim of climate change but also a major part of the climate problem. With climate change and dwindling natural resources, sustainability of the food system is important. That's why the World Bank promotes climate-smart agriculture, which aims to secure a triple-win of increased productivity, greater resilience and a lower environmental footprint. ”

*Juergen Voegelé
Senior Director, Agriculture Global Practice
The World Bank*

The African Challenge

Africa is home to more than 225 million undernourished people. Farm families in Africa and other parts of the world are already overrepresented among the poor. Climate change will strongly reduce their chances of escaping poverty.

Climate variability is already reducing productivity. Research indicates that decreases of about 5 percent in crop productivity are expected for every degree of warming above historical levels. Without actions to improve the resilience of agriculture, a rise in average temperatures of 2°C by the middle of the century might reduce yields by up to 20 percent. Additional temperature increases would cause exponentially more harm. More irregular rainfall amplifies temperature risks, and the consequent droughts may trigger famines.

Falling yields in many African countries occur at a time when population growth and increasing incomes will require

Africa agricultural systems to almost triple overall production. Doing so in a business-as-usual manner would triple agriculture and land use-related emissions, catapulting Africa to near the top of international agricultural emission contributors and making it impossible for the global community to meet its COP 21 commitment of keeping temperature change well under 2°C.

Agriculture and agriculture-driven land use produce 25 percent of global greenhouse gas emissions (GHG), making it a big part of the climate problem. But agriculture can also become a part of the solution.

Unless we change our approach to planning and investment for agricultural growth and development, there is a profound risk of misallocating financial resources, generating agricultural systems incapable of supporting food security, increasing land degradation and vulnerability of the poor, and contributing to increasing climate change.

The Climate-Smart Approach

Climate-smart agriculture (CSA) is an approach for transforming agriculture and meeting the world's food security needs under the new realities of climate change. CSA aims to secure a triple win of increased productivity, greater resilience and reduced GHG emissions.

CSA is an alternative approach to managing land sustainably while increasing agricultural productivity. CSA can reverse the trends of land degradation and agriculture's negative ecological footprint, sustain food production, enhance resilience, reduce GHG emissions, sequester carbon, and improve other ecosystem services.

In order to scale up CSA, urgent action from public, private and civil society stakeholders at the international to local levels is required in four important areas: 1) Coordinated policy making; 2) Strengthened institutions; 3) Evidenced-based planning and decision-making; and 4) Dedicated financing and measuring its effectiveness (Lipper et al.).

CSA interventions should be considered and chosen for their benefits towards the overall farming system/landscape. CSA interventions are most successful if they complement the project-site situation.

Successful CSA projects are often composed of a number of action-oriented solutions backed by enabling policies and environments.

This publication highlights successful CSA projects in Africa. These projects are implemented by the World Bank and partner organizations. The World Bank is working to scale up adoption of CSA technologies and practices in Africa through the Africa Climate Business Plan.



81%
of families
experience hunger in
Nyando valley, Kenya

Malnutrition affects
45%
of children under the
age of 5

CSA
provides better
options, improved
productivity and
nutrition, increased
income, resilience and
reduced GHG
emissions

Climate-Smart Villages in Kenya:

Building resilient farming systems

Kenya's Nyando valley is carved with deep gullies caused by soil erosion. In the villages of Nyando, 81 percent of families experience 1-2 hunger months - or periods when they are unable to produce food from their own farms - in a year. To cope with these challenges, many farmers have started practicing CSA, including using climate-smart species and cultivars, and climate information services. They also benefit from local development and adaptation plans and supportive institutions and policies.

After getting trained, farmers decide on what climate-smart techniques to implement in an inclusive process that empowers women and other groups. Drawing from their training, farmers have been able to transform their land into productive and high-yielding farms.

Many farmers now practice water conservation techniques; better livestock management through the introduction of

more resilient livestock varieties, veterinary services and manure management; and agroforestry.

Farmers are no longer just "crop farmers" or "tree farmers". They understand that diversifying their activities will make their farms more resilient to climate change and lower their carbon footprint, while increasing productivity and improving the overall quality of their soils.

Inclusiveness is a strength of the climate-smart villages approach. Farmers from different communities, researchers from different disciplines, non-governmental organizations and other partners, come together to test a range of options in an integrated way. The climate-smart villages have improved food security and resilience, and given smallholders options for adapting their agriculture.

This project is supported by the CGIAR-Research program on Climate Change, Agriculture and Food Security (CAAFS).



Honey production has increased by over **131%** while incomes have grown by nearly **356%**



The Bee-siness of Agriculture:

Developing commodity value chains through Public-Private Partnerships

The Mau Forest's Ogiek people have practiced beekeeping for generations. But their experience hasn't spared them the challenges that come with running a business: low production levels, lack of organized marketing structures, low prices due to low quality harvests, wasted hive products, and lack of skills in improved beekeeping technologies.

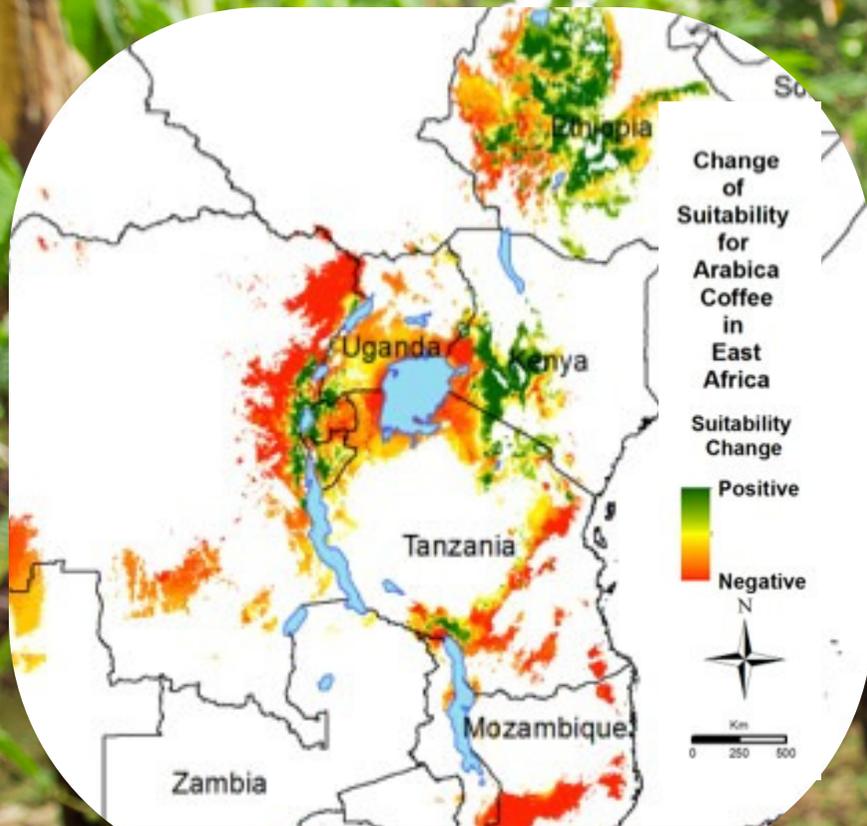
With technical support, beekeeping has improved. Honey production has increased from 2-10 kilograms to 15-20 kilograms. Unlike traditional farming practices, beekeeping is not resource-intensive. Once the hives are built and the apiary is correctly placed, farmers can start harvesting after 6 months.

Ogiek beekeepers sell honey to their cooperative which processes, refines, bottles, markets, and sells the finished

product. Efforts to improve the quality of honey, especially in post-harvest handling, have improved marketability, as has certification by the Kenya Bureau of Standards (KEB), bar coding and development of the Ogiek brand. A market outlet in Mariashoni sells directly to customers.

Environmental and forest conservation has become more important as beekeeping has expanded. Beekeepers are encouraged to plant trees in their apiaries. These trees not only rejuvenate the forest and act as a carbon sink, but also produce flowers that attract bees.

Capacity building efforts and investments from stakeholders such as the Kenya Forestry Service, Kenya Commercial Bank, Baraka Agricultural College, and the World Bank have improved livelihoods, enhanced sustainability and proven that traditional practices can become a profitable business.



Suitability maps like the one above produced by IITA shows that areas that are suitable for Arabica coffee will drastically decrease as average global temperatures continue to rise.

Intercropping can change the micro-climate in coffee growing areas and reduce temperatures by 2-5°C

Inaction could result in estimated losses of **US\$100m/yr** to the coffee industry

Coffee Farming in Uganda:

Where science and the private sector meet

Coffee is Uganda's largest export product. It generates 20 percent of foreign exchange earnings. However, climate change could negatively affect coffee production and dampen the economy. To address this challenge, research institutions are working throughout the value chain to grow the coffee industry and empower smallholder farmers.

Adaptation is a must and by adding shade to coffee, it can change the micro-climate and reduce the temperature in coffee growing areas by 2-5°C. These shade trees, like banana, can generate 50 percent additional income for farmers, while also absorbing carbon in the soils and reducing temperatures and drought problems.

In addition to CSA techniques such as intercropping, mulching and the use of shade trees, researchers used International Panel on Climate Change (IPCC) climate models to develop maps showing where Arabica and Robusta coffee varieties can be grown in Uganda.

The maps show that if current coffee production systems are maintained, then current Arabica growing areas may not be suitable for the coffee variety going forward. Estimated losses may exceed US\$100 million per year.

With this information, farmers and the private sector are able to better plan their investments for a sustainable future. Farmers will become more climate resilient by choosing the right type of crop. Meanwhile, with a clearer idea of the future impacts of climate change, the private sector can better plan for their business.

This project is supported by the International Institute of Tropical Agriculture (IITA).



228,000

farmers adopted
improved farming
techniques

Rice production has
increased by nearly

30%

Irrigating the Future of Tanzania:

Raising productivity through irrigation investments

Agriculture dominates Tanzania's economy, accounting for 46 percent of GDP. Economic growth relies heavily on the performance of the sector. Improvements in agricultural performance can have a direct impact on the incomes of the poor.

Growth in the agricultural sector is determined largely by factors that lead to increased productivity, including access to agricultural inputs (mainly improved seeds and fertilizers), research and extension, irrigation, and mechanization. Facilitating factors such as access to output markets, access to credit, and infrastructure such as rural roads also have an impact on growth in the agricultural sector. Irrigation provides reliable access to water, which protects farmers from periodic shocks caused by climatic variability.

The Agricultural Sector Development Project (ASDP) supports small-scale irrigation investments to raise productivity and insulate producers from shocks caused by

climate change. The ultimate goal of ASDP is to enhance agricultural productivity, farm incomes and food security, contributing to the achievement of the Second Poverty Reduction Strategy (MKUKUTA II) and the Comprehensive African Agriculture Development Program's (CAADP) goals to promote agricultural growth and achieve food and nutrition security.

The project has directly benefited 228,000 farmers, 25 percent of whom are female. The total area under irrigation has increased by over 80 percent. This has led to an increase in rice productivity from 4.5 metric tons to 5.8 metric tons. In addition, to improve the policy environment for private sector investment, initiatives like the Southern Agricultural Growth Corridor for Tanzania (SAGCOT) have been put in place to foster inclusive, commercially successful agribusinesses that will benefit the region's small-scale farmers, and in doing so improve food security, reduce rural poverty and environmental sustainability.



Soil analysis and mapping has been conducted in over

60%

of districts across Ethiopia

Distributing appropriate fertilizer blends through 5 plants in 4 regions has improved crop productivity

Mapping out Ethiopia's Soil Health:

A path to a green economy

Ethiopia is committed to becoming a resilient and low-carbon economy by 2030. To meet this goal, soils from different woredas (districts) are being surveyed and analyzed. The result of these analyses are translated into soil maps and documented in the national soil inventory database.

Ethiopia has 18 soil classes and it is estimated that 80 percent of the country is covered by nine major soil types. A wide range of topographic and climatic factors causes the extreme spatial variability of the soils. Inadequate information on soil fertility status can often lead to erroneous application of fertilizers, further damaging soil health and productivity.

Soil analyses show that Ethiopian soils are deficient in one or more essential nutrients - namely nitrogen, phosphorous, potassium, sulfur, boron, zinc, iron and copper.

These findings have helped to revise fertilizer recommendations at the woreda and kebele (neighborhood) levels, as well as to identify highly acidic soils that should be rehabilitated with the use of lime. These not only improve farming practices but also reduce the use of greenhouse gas emitting urea and nitrogen.

To meet the increasing demands of appropriate blended fertilizers, five fertilizer blending plants were established in the four regions with the largest agricultural production. Additional fertilizer blending plants are planned for other regions in Ethiopia.

Farmers are already reaping the benefits of sound soil advice. By applying the appropriate fertilizer and composting techniques, farmers are able to increase productivity while reducing fertilizer expenses. This is not only good for the farmer but also for overall soil health in Ethiopia, putting Ethiopia on track to become a green economy.



87,000

farmers trained and practicing CSA interventions

Annual household income grew over

260%

1 million ha

set aside as community conservation areas

Incentivizing Agriculture in Zambia:

Conservation through sustainable agriculture practices

Recent years haven't been easy for smallholder farmers in Luangwa Valley, Zambia. Traditional farm practices, as well as lack of access to improved production technologies and affordable inputs, have resulted in crop shortfalls. Farmers have pursued unsustainable agricultural practices to help them cope, which have spurred soil degradation, deforestation and biodiversity loss.

The Community Markets for Conservation (COMACO) is a model for rural development that uses inputs, technologies and markets to help smallholders achieve food security and boost incomes while conserving the natural resources they rely on. COMACO's premise is that with the right incentives and training, smallholders will favor sustainable agriculture practices over more destructive ones, especially if basic food and income needs are met. COMACO offers above market prices for goods that are produced in compliance with sustainable soil, farming and conservation agriculture practices.

To date, 87,000 farmers - 52 percent of whom are women - have benefited from formal training in climate-smart, sustainable agriculture. They now practice low-tillage farming, mulching, and composting, in addition to beekeeping, dry season gardening and poultry husbandry. These practices have enhanced productivity and reduced the need for inorganic fertilizers, thereby reducing nitrous oxide emissions.

Over 10 million cassava cuttings have been planted to serve as a drought-resistant food reserve. This also reduces the risk of rainfall run-off and can help increase the storage of water in the soil profile. Deforestation and bush fires have decreased. Participating farmers' incomes have risen by at least US\$200, compared to before the program.

This initiative shows that CSA is a win-win for everyone - it's both good for the environment, as well as farmers' incomes.



Livestock sector
contributes to

39%
of rural incomes

253,000

livestock farmers have
adopted improved
husbandry practices

19.6%

of Zambia's GHG
emissions is from the
livestock sector

Improving Livestock Productivity in Zambia:

Investing in animal health

In Shesheke, western Zambia, cattle rearing is more than just a livelihood. It is a culture that can be threatened by the spread of animal diseases. As cattle share watering holes with buffalo, particularly during dry season, herds are especially at risk for contracting Foot and Mouth Disease (FMD). To prevent an outbreak of FMD and other animal diseases in the country, the Department of Veterinary Services in the Ministry of Fisheries and Livestock (MFL) has set up vaccination centers throughout the province.

The livestock sector contributes approximately 39 percent of rural incomes in Zambia, making control of FMD and other diseases and their vectors a critical priority. The country is already faced with the challenge of low productivity in the livestock sector due to underinvestment, poor animal husbandry and poor animal nutrition.

Bringing animal diseases under control is a prerequisite for productivity improvements. The Livestock Development and Animal Health project (LDAHP) has allocated US\$25.7 million to strengthen veterinary services including

surveillance, laboratory diagnostic capacity, control of animal diseases and institutional support to the livestock and agriculture ministry. LDAHP is also supporting capacity strengthening of key public institutions in the livestock sector, with the specific objective of improving delivery of advisory and technical services to enhance the adoption of good husbandry practices and innovative technologies. LDAHP promotes the sustainable development of the livestock sector by increasing food production while at the same time reducing GHG emissions.

Zambia's long term livestock sector strategy is to establish a Disease Free Zone with the objective of accessing international markets for livestock and meat products. In the short to medium term, the proposed LDAHP would underpin this strategy and contribute to improving veterinary and livestock services, food safety and productivity of the smallholder production systems. Since the project's creation, contagious bovine pleuropneumonia has been verifiably cleared from 11 of the targeted 18 districts, and 253,000 livestock farmers have benefited.



Drip irrigation saves

25%

of water use in
irrigated areas

Tree crops provide
higher returns and are
better adapted to
drought and climate
change than cereal
crops in rainfed
areas

Combating Drought in Morocco:

Supporting smallholder farmers in a changing climate

Morocco is prone to drought, and climate change is already resulting in higher temperatures and lower and more unpredictable rainfall. This has implications for the agricultural sector, which is critical to the country's demographic and socio-economic situation, generating 40 percent of jobs nationwide, mostly in rural areas where the majority of the poor live. The sector is largely composed of small subsistence farmers, but it also includes dynamic and well performing large farmers, who use state-of-the-art technologies and are well integrated into the national and international markets.

In 2008, Morocco launched the Plan Maroc Vert (PMV), a long-term agricultural strategy aiming to double the value-added of the sector and create 1.5 million jobs by 2020, thus transforming the agri-food sector into a stable source of growth, competitiveness, and broad-based economic development in rural areas. The PMV gives targeted attention to small farmers, aiming to facilitate their

access to technologies and services and promoting their integration into the market. The PMV acknowledges that support to small farmers is even more crucial under climate change, as they have limited technical and financial means to buffer increasing climate unpredictability.

Water management is key under drought conditions and climate change. In irrigated areas, the PMV and the related National Irrigation Water Saving Program (PNEEI) promotes improved water service and adoption of more efficient irrigation technologies. As a result, water is provided when it is best for crop needs, and can be used by small farmers more effectively and efficiently. In rainfed areas, the PMV promotes - among others - the transition from cereals to tree crops: olive trees are well adapted to drought, provide higher return to small farmers, and are less at risk of year-to-year fluctuations than annual crops especially when practices like rainwater harvesting are put in place.



A Sustainable Food System in West Africa: Building an integrated , research driven approach

Agriculture plays a major role in West African economies, contributing more than 40 percent to its GDP and employing around 70 percent of the region's population.

The World Bank-Funded West Africa Agricultural Productivity Program (WAAPP) is making agriculture more climate-smart across 13 West African countries to ensure that the agriculture sector remains sustainable for future generations.

WAAPP's support to a new generation of local scientists and "national centers of specialization" - or research centers focused on commodities that are a country's competitive advantage - has helped develop climate-smart varieties of staple crops such as rice (Mali), banana plantain (Cote d'Ivoire) and maize (Benin). Collaboration with a network of cooperatives and extension workers is helping deliver these new varieties to farmers across West Africa.

WAAPP has developed and distributed 160 climate-smart crop varieties, provided climate-smart technologies such as post harvest and food processing technologies, and trained farmers on climate-smart practices such as composting and agroforestry.

Farmers are also getting access to technologies like more efficient water harvesting systems. WAAPP assistance has helped over 7 million farmers and more than 4 million hectares of land be more productive, resilient, and lower greenhouse gas emissions.

Productivity has increased by up to 150 percent. Food production has increased by more than 3 million tons, beneficiary incomes have grown by an average of 34 percent, the hunger period has been reduced by half, and staple food availability and nutrition standards have increased throughout West Africa.

A woman wearing a red sleeveless top, a patterned skirt, and a headscarf is working in a field. She is holding a wooden hoe and looking towards the right. The field is filled with young green plants, and there are trees in the background.

Benefits of a regional approach:

1. Reduces duplication by allowing a single regional research institute to undertake work that otherwise would be done in parallel by multiple institutions;
2. Helps capture economies of scale by concentrating resources, where they can achieve critical mass;
3. Increases payoffs to research by facilitating dissemination of improved technologies across national borders and increasing number of beneficiaries; and
4. Mitigates isolation and silos by creating effective mechanisms for facilitating knowledge exchange and technology transfer.

Regional Integration in Southern Africa: Fulfilling agricultural potential through R&D

In recent years, agricultural productivity has increased throughout sub-Saharan Africa (SSA) and within southern Africa in particular. But most of the growth has come from bringing previously uncultivated land into production, rather than from intensification made possible by technical change (increased input efficiency). Comparisons of total factor productivity growth have shown that during the past decade, technical change accounted for a larger share of agricultural productivity growth in Asia and Latin America, compared to Africa.

To fulfill agriculture's potential in southern Africa, investments in agricultural research and development (R&D) are needed. Despite the confirmed returns to investments in agricultural R&D, agricultural research in Africa is particularly underfunded.

Regional integration has proven to be an effective strategy that can allow groups of countries facing common research challenges to increase the efficiency of their investments in

agricultural R&D. In southern Africa where groups of countries share similar agro-ecological zones and farming systems, there is a potential for finding shared solutions to common problems. Technology spillover is already occurring within the sub-region, and a number of high-yielding crop varieties and improved crop and livestock management practices have been successfully disseminated across borders.

The Agricultural Productivity Program for Southern Africa (APPSA) brings together participating countries in southern Africa to improve technology generation and dissemination through capacity building within national R&D systems and enhancing regional collaboration.

Since the launch of APPSA, Malawi, Mozambique and Zambia have joined, 42 technologies have been made available to farmers and other end users, 48 collaborative research/extension sub-projects are under implementation, and 8,225 farmers have been reached.

End Notes

Food and Agriculture Organization of the United Nations. FAOSTAT Statistics Database. [Rome]: FAO, 1998.

Jassogne, Laurence, Peter Lderach, and Piet Van Asten. "The Impact of Climate Change on Coffee in Uganda: Lessons from a case study in the Rwenzori Mountains." *Oxfam Policy and Practice: Climate Change and Resilience* 9.1 (2013): 51-66.

Lipper, Leslie, et al. "Climate-smart agriculture for food security." *Nature Climate Change* 4.12 (2014): 1068-1072.



Right photo: Dasan Bobo/World Bank

Back cover left: Xiaoyue Hou/World Bank

Back cover middle: Grace Anyango Obuya/World Bank

Back cover right: Amadou Ba/World Bank

Above photo: Xenia Zia Morales/World Bank





© November 2016 World Bank Group

1818 H Street, NW

Washington, DC 20433 USA

Telephone: 202-473-1000

Internet: www.worldbank.org/agriculture

www.worldbank.org/foodsecurity

Twitter: @WBG_Agriculture