

Climate Smart Agriculture (CSA): Climate Smart Agroforestry

Climate Smart Agriculture addresses the challenges which climate change (CC) poses to agricultural production. It is a pathway towards sustainable development and food security and is built on three pillars:

- Increasing agricultural productivity (crops, livestock and fisheries) and income
- Enhancing resilience or adaptation of livelihoods and ecosystems towards climate extremes
- Reducing and removing GHG emissions from the atmosphere (FAO 2016)

An agricultural technique or practice that contributes to the achievement of these pillars can be considered climate smart. But often, different techniques perform differently over the three pillars, and therefore have to be combined in an integrated CSA approach to complement each other and maximize their benefits (Worldbank 2015, FAO 2015).



Climate-smartness Categories

In the 15 climate-smart villages established by CGIAR in Western Kenya for example, a farm is only counted as climate smart if it applies practices that are strong in all climate-smartness categories:

- Soil and water conservation structures
- Integrate perennial and annual crops
- Improved livestock enterprises
- Diversification of enterprises
- Readiness of a farm plan

Sometimes it is difficult to assess how climate smart a specific agricultural technology is in a certain context. Climate-smartness indicators, divided in three categories, try to indicate this and thereby support implementation.

- CSA-Technology indicators evaluate beforehand how well technologies will achieve CSA goals.
- CSA-Policy indicators assess to which extent the enabling environment (e.g. policies) support the implementation of CSA.
- CSA-Result indicators monitor the short term impacts of CSA interventions (Rawlins 2015).

How do you implement CSA?

CSA requires site-specific assessments to identify suitable agricultural production technologies and practices (FAO 2015).

The World Bank in collaboration with international partners has developed three indicator sets to support CSA implementation at the national and sub-national levels. The indicators will guide CSA investment decisions, and assist national governments, agricultural specialists and natural resource managers in evaluating the productivity and climate benefits of sustainable land management operations.

For Kenya adapted practices include:

- Soil and Water conservation measures increase ground cover and use little water.
- Manure and compost can decrease use of chemical fertilizers and adequate manure management for biogas production can reduce methane release.
- In agroforestry systems trees and crops coexist and benefit from each other.

Activities that amplify Climate Change effects include:

- Inadequate tillage practices that expose the soil release carbon stored in the soil.
- Indiscriminate use and wrong timing of agrochemicals harm the ecosystem.
- Clearing land and burning plant biomass for farming releases carbon stored in the soil.

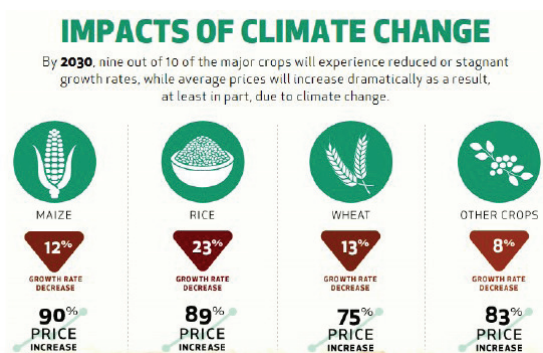
Why CSA?

Therefore CSA is a basket of agricultural practices and techniques that not only aims at increasing profits and resilience for farmers but does so without harming, often even bettering, environmental parameters. It improves input efficiency, soil quality and benefit-cost returns for farmers while limiting the expected negative effects of climate change on Kenyan agriculture for producers and consumers (Worldbank 2015, FAO 2016).

What is climate change?

Climate change (CC) is the long-term or permanent shift of average climatic conditions (FAO 2015). They result in changes of weather patterns and directly affect agricultural production. Kenya is highly vulnerable to the impacts of climate change. Some of the most visible changes are:

- Increase in mean temperature;
- Shifts in the onset and end of the rainy seasons;
- Changes in duration, amounts and intensity of rainfall;
- Higher frequency of droughts and floods;
- Changing strength and direction of winds;
- Higher temperatures and stronger solar radiation;
- Occurrence of more and new pests and diseases (FAO 2015, Worldbank 2015).



Kenya's agriculture is especially vulnerable to climate changes¹ because of its large dependence (98%) on rainfed agriculture (Worldbank 2015). Depletion of water and pasture resources are expected consequences under which mainly smallholder farmers will suffer. They might lose income and livelihoods through crop failure and livestock losses. A 30% drop is expected for the productivity of crops, livestock, forestry, fisheries and aquaculture, endangering Kenya's food security and rural livelihoods (FAO 2015).

Mankind is, however, not only negatively affected by CC, they also contribute to it by emitting greenhouse gas (GHG) emissions to the atmosphere. Agricultural production is next to industry and transportation a key contributor to CC. Several activities, such as clearing land, burning of biomass or wood, some tillage practices or indiscriminate use of agro-chemicals all amplify the effects of CC by releasing GHG (FAO 2015, Worldbank 2015). On the other hand, agriculture has the potential to contribute to reducing GHG emissions. A variety of adapted agricultural practices, summed up under the term "climate smart agriculture", minimize harmful effects or even reduce emission or absorb GHG.

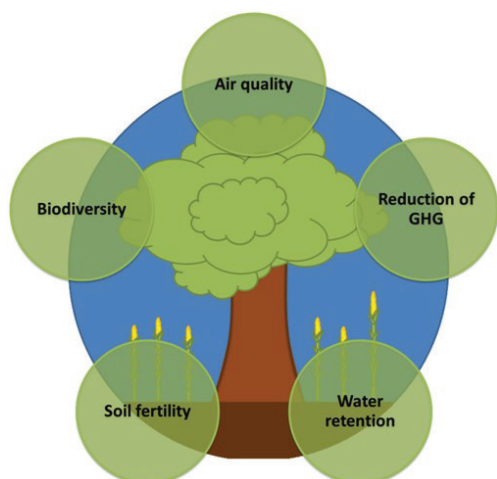
¹ However, more positively, such climate change projections suggest that, in some places, opportunities for crop diversification and intensification may emerge, including options for expanding into places where cultivation is not currently possible.

Climate Smart Agroforestry

Agroforestry (AF) is the integration of trees along with annual or perennial crops or livestock on the same land, usually at the same time. There are lots of possible combinations of food products including crops and fruits, fodder, mulch/green manure and timber. There is a variety of tree species to use and many possibilities to arrange them on your farm. Trees may, for example, be planted around homesteads (home garden), along fences, on the farm boundaries or on crop- or pasture land. The introduction of trees or shrubs will create a more diverse, productive and ecologically sound land use and environment. Social, economic and environmental benefits can for example be better food security, increased income and enhanced soil fertility.

Why Climate Smart Agroforestry?

The establishment of an agroforestry system can enrich your livelihood through many possible benefits (social, economic, environmental). Trees can either work as wind breaker, provider of shade or “nutrition pump”. The roots of most trees grow deeper into the soil than the roots of other crops. This means that they can recover nutrients and water from lower soil layers. Leguminous trees can even help to fix atmospheric nitrogen and can therefore enrich the soil with much-needed nitrogen. Especially with the ability to fixate carbon and nitrogen and the diversification of the farm production system, agroforestry qualifies for adapting to and to mitigate climate change.



- Biodiversity: more habitats for many species of plants, animals and other organisms
- GHG emissions: trees bind carbon in their biomass (above and below ground); decaying biomass contributes to carbon storage in the soil
- Improves air quality: trees work as wind-breaker and help to reduce soil erosion; this reduces dust and other particles in the air
- Soil fertility: decaying biomass protects soil surface through litter and more carbon is stored in the soil
- Water retention: trees slow the flow of water due to their above and below ground biomass

Productivity	Adaptation	Mitigation
<ul style="list-style-type: none"> • Depending on the system, crop yields can increase under AF. A case in Malawi reported increases of maize yields by 110-190%¹. • AF produces additional outputs such as fruits, fodder, green manure, timber and fuel woods, which together can also compensate for any crop losses. 	<p>AF systems increase resilience to:</p> <ul style="list-style-type: none"> • extreme dry conditions • variable rainfall • extreme rain and wind • rising temperatures and evaporation rates <p>AF also reduces the risk of production failure by diversifying enterprises and income sources.</p>	<ul style="list-style-type: none"> • AF systems have high potential for CC mitigation via carbon sequestration in the soil and biomass. • The potential for carbon sequestration from AF in smallholder farming in Western Kenya lies at 0.22-0.35 t carbon per acre per year, which sums up to 4.4-7 t carbon per acre over 20 years.²

¹ WOCAT 2011: SLM in Practice - Guidelines and Best Practices for Sub-Saharan Africa;

² Henry et al. (2009) Biodiversity, carbon stocks and sequestration potential in above-ground biomass in smallholder farming systems of western Kenya. *Agric. Ecosyst. Environ.* 129:238–252

How to establish a climate smart agroforestry system?

To implement agroforestry on your farm, there are several steps you have to take before and while you plant your trees. If you follow these steps as described below, you can soon profit from your own agroforestry system.

Step 1: Choose a suitable species

According to

- Preferred agroforestry system/practice
- Site conditions (e.g. slope, soil type)
- Region and environmental conditions of your farm

Step 2: Prepare your farm

Mark the area and spots where you want to plant trees

- Dig holes, depending on the soil conditions
 - Soft soil: Round holes 8 inches width; 1 foot depth
 - Hard soil: Square holes 1.5 feet width and depth

Step3: Prepare the soil and manure

- Make a fine mix from top-and subsoil (2:1)
- Mix the soil-mix with manure (2:1)
- Fill the holes and leave it for 1-3 days

Step 4: Plant the seedlings

- Start planting 1-7 days before rain is coming
- Use 20 l in each spot for slow watering in preparation of planting
- Open up a hole for the seedling
- Place the seedlings half down the stem in the watered soil-manure mixture
- Cover with soil and flatten
- Water again until the soil is saturated

Step 5: Maintain and manage your trees

- Provide the trees with compost/manure
- Use dry residues as mulch
- Protect the growing tree from too much sun
- Irrigate the young tree daily when rain is absent
- Weed the plant regularly and prune when necessary
- Use ash to protect the tree from ants and termites



Main sources:

Eastern Africa Climate-Smart Agriculture Scoping Study: Ethiopia, Kenya and Uganda. By Njeru, E., Grey, S. and Kila-we, E., Addis Ababa, Ethiopia, FAO 2016

Climate Smart Agriculture. Training Manual for Extension Agents in Kenya. FAO, Ministry of Agriculture, Livestock and Fisheries - State Department of Agriculture. FAO Kenya, 2015

Climate-smart agriculture in Kenya. CSA Country Profiles for Africa, Asia, and Latin America and the Caribbean Series. CIAT, World Bank, The World Bank Group, Washington D.C., 2015

Rawlin, Maurice, Abstract: http://csa2015.cirad.fr/layout/set/resume/submission/l2_1_developing_and_evaluating_climate_smart_practices/developing_indicators_for_climate_smart_agriculture_csa

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Diagrams:

Page 1: CSA Pillars, CalCAN 2010; <http://calclimateag.org/what-is-climate-smart-agriculture/>

Page 2: Projected impacts of climate change on main crops in Kenya by 2030, Tegemeo Institute 2010

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