Climate Smart Agriculture (CSA): Conservation Agriculture (CA)

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 asses 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).

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.

How do you implement CSA?

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

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.
- Indiscriminative use and wrong timing of agrochemicals harm the ecosystem.
- Clearing land and burning plant biomass for farming releases carbon stored in the soil.

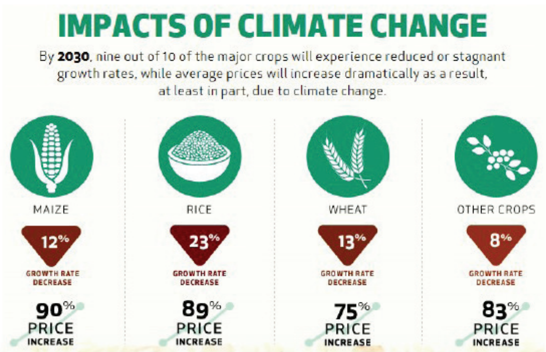
Why CSA?

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 changes[1] 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 foodsecurity 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.

What is Conservation Agriculture (CA)?

Conservation agriculture is a farming approach that can sustainably increase yields from cereals, legumes, fodder, and cash crops. The various practices counted to conservation agriculture are characterized by reducing production costs while following the 4 key principles:

1. Minimal soil disturbance;
2. Permanent ground cover - maintenance of carbon-rich organic matter covering and feeding the soil (e.g. straw and/or other crop residues including cover crops);
3. Crop rotation or sequences and associations of crops and nitrogen-fixing legumes;
4. Balanced application of chemical inputs (FAO 2015, FAO 2016).

Why CA?

CA practices include soil and water conservation mechanisms such as:

Name	Benefits
Zero or minimum land tillage techniques like: ripping, subsoiling, planting basins or strong rooted cover crops or trees 	Protective tillage mechanisms not only prepare the soil perfectly for planting while minimizing carbon dioxide losses but even correct compaction and hardpans. They also support the increase of organic soil matter.
Conservation Agriculture with Trees (CAWT) 	Trees as a part of CA: • Control pests and weeds thereby ensuring good harvests and reducing post-harvest losses; • Serve as vegetative barriers to fight soil loss and facilitate water percolation; • Provide fodder, fuel, construction materials, etc.; • Fixate atmospheric nitrogen enriching the soil with nitrates.
Crop rotation (changing of crop sequences) and association (intercropping with leguminous crops) 	Crop rotation and association decrease the occurrence of pests, diseases and weeds and protect the soil from leaching. By hosting nitrogen-fixing bacteria, leguminous crops also contribute to good plant growth without (high)fertilizer use.
Permanent soil cover (cover cropping) with mulch or live cover crops (either non-legumes – like sweet potato, etc. or legumes, that fix nitrogen like Cowpeas, Pigeon peas and Desmodium.	Permanent soil cover shields the soil surface from heat, wind and rain, keeps it cooler and reduces moisture losses by evaporation. Mulch layers also improve water and nutrients in the soil and contribute to net increase of soil organic matter.

Name	Benefits
Pest and disease management using knapsack sprayer, shallow weeder, contact applicator (zam wipe) and cover crop    	CA pest and disease management techniques avoid disturbance of deeper soil layers and field ecosystems thereby protecting beneficial organisms such as bees and avoiding the evaporation of soil-water (FAO 2015).

How does CA contribute to CSA?

Conservation Agriculture practices' contribution to the three pillars of climate change differ significantly:

1. Increasing agricultural productivity and income: Conservation Agriculture ensures optimum plant growth without increased fertilizer use by carefully protecting soil quality and nutrients. This way soils stay productive and income earned does not need to be spent on extra fertilizers.

2. Enhancing resilience or adaptation of livelihoods and ecosystems towards climate extremes CA needs less water and helps to stabilize yields in years of extreme weather, pests, and diseases. It does so by protecting the soil, its surrounding ecosystems and wisely combining crops, legumes and trees.

3. Reducing and removing GHG emissions from the atmosphere CA practices such as minimum tillage mechanisms have great potential to mitigate GHG emissions of nitrogen and CO_2 and even help sequestrating them in the soil (Worldbank 2015, FAO 2015, FAO 2016).

Main sources:

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Diagrams:

Page 1: CSA Pillars, Source: 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

Page 3: Climate Smart Agriculture. Training Manual for Extension Agents in Kenya. FAO, Ministry of Agriculture, Livestock and Fisheries - State Department of Agriculture. FAO Kenya, 2015, pp. 12, 24, 25, 27

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