Climate-Smart Agriculture in Mali

Climate-smart agriculture (CSA) considerations

A P — Mali is a Sahelian, landlocked country, where two thirds of the total land area is covered by desert and semi-desert areas unsuitable for agriculture. In a context of increased annual temperatures and decreased precipitation, sustainable management of fragile lands and water resources remain critical for the development and growth of the sector, which is predominantly small-scale and highly reliant on rainfall.

A P — Declining crop productivity as a consequence of highly variable rainfall patterns, drought spells and shortening of the growing season is limiting achievement of food and nutrition security in the country. Projected changes in precipitation and temperature are expected to impact significantly crop yields in both drier and wetter regions of the country. Model simulations predict a decrease in yield of the major food crops produced in the country, namely millet, sorghum, maize and rice, as well as a reduction in the availability and quality of fodder and water resources, particularly affecting pastoralists.

A P — New cultivars adapted to a changing climate may increase yields and boost economic growth, while increasing farmers' resilience to climatic and environmental stresses. However, these are tied to farmer knowledge of good agricultural practices and adequate management of the farm and its resources.

A P M — Knowledge-intensive practices, such as organic manure, urea deep placement, and sustainable rice intensification need further investments in capacity building of extension workers and farmers, in order to increase adoption rates and maximize the potential of such investments to reduce GHG emissions and improve agricultural productivity.

A P M — While there is consensus over changing rainfall patterns across the country over the past years, information on subnational and intra-seasonal variations remains insufficient for understanding local impacts and potential opportunities that climate change - particularly trends in precipitation - can bring to agriculture production. Improved data systems and cropland suitability analyses could serve as powerful support tools for agricultural decision-making, including the scale-out of existing CSA practices.

A P M I — Increased adoption of CSA practices requires wider socio-economic, gender-targeted interventions that help curtail challenges related to access to basic needs and services, education, and ownership of productive assets of the most vulnerable groups, including women, youth, and nomadic populations. While Malian women are more likely to engage in income-generating activities compared to men, only a fifth of them have access to extension services and output markets and slightly more than a half of the economically active women can access agricultural inputs and loans.

I — The agro-meteorological advisory system was proven a successful and accessible model for integrating big data in daily farm decision-making, empowering farmers to collect, interpret and use information as a tool for building resilience to a variable and changing climate. With the high penetration of mobile phones, digital-led solutions can boost widespread access and use of these climate services.

I $ — CSA has been high on the public agenda in the past years in the country. The Mali Climate Fund (MCF) constitutes an important opportunity to mobilize and anchor bilateral, multilateral, public and private financing for CSA and align these to the national climate change strategy. Therefore, more efforts need to be directed towards increasing human and technical capacity to manage and sustain the funds to ensure improved targeting and coordination of investments.

A Adaptation M Mitigation P Productivity I Institutions $ Finance

The climate-smart agriculture (CSA) concept reflects an ambition to improve the integration of agriculture development and climate responsiveness. It aims to achieve food security and broader development goals under a changing climate and increasing food demand. CSA initiatives sustainably increase productivity, enhance resilience, and reduce/remove greenhouse gases (GHGs), and require planning to address trade-offs and synergies between these three pillars: productivity, adaptation, and mitigation [1].

The priorities of different countries and stakeholders are reflected to achieve more efficient, effective, and equitable food systems that address challenges in environmental, social, and economic dimensions across productive landscapes. While the concept is new, and still evolving, many context-specific practices that make up CSA already exist worldwide and are used by farmers to cope with various production risks [2]. Mainstreaming CSA requires critical stocktaking of ongoing and promising practices for the future, and of institutional and financial enablers for CSA adoption. This country profile provides a snapshot of a developing baseline created to initiate discussions, both within countries and globally, about entry points for investing in CSA at scale.

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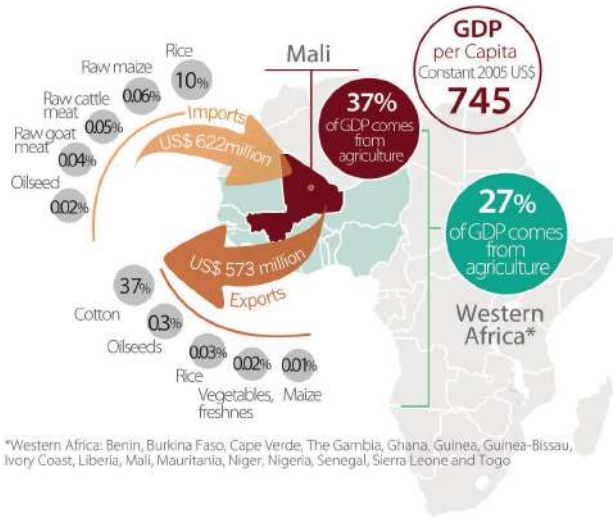
National context

Economic relevance of agriculture

Located in Sub-Saharan Africa, the Republic of Mali covers an area of 1,241,238 km² [3]. Agriculture represents the backbone of social and economic development, contributing approximately 37 percent to the national GDP and employing almost two thirds of the economically active population [3]. In rural areas, more than 80 percent of the population depends on the production of staple crops (maize, rice, millet, sorghum and cowpea), vegetables, and fishing. National agricultural exports are mainly composed of cotton, groundnuts, rice, vegetable and maize which account for 38 percent of total exports with cotton as major export crop (37 percent). The country imports significant quantities of rice, maize, cattle, goat, and oilseed [4].

Economic relevance of agriculture in Mali [3,4]

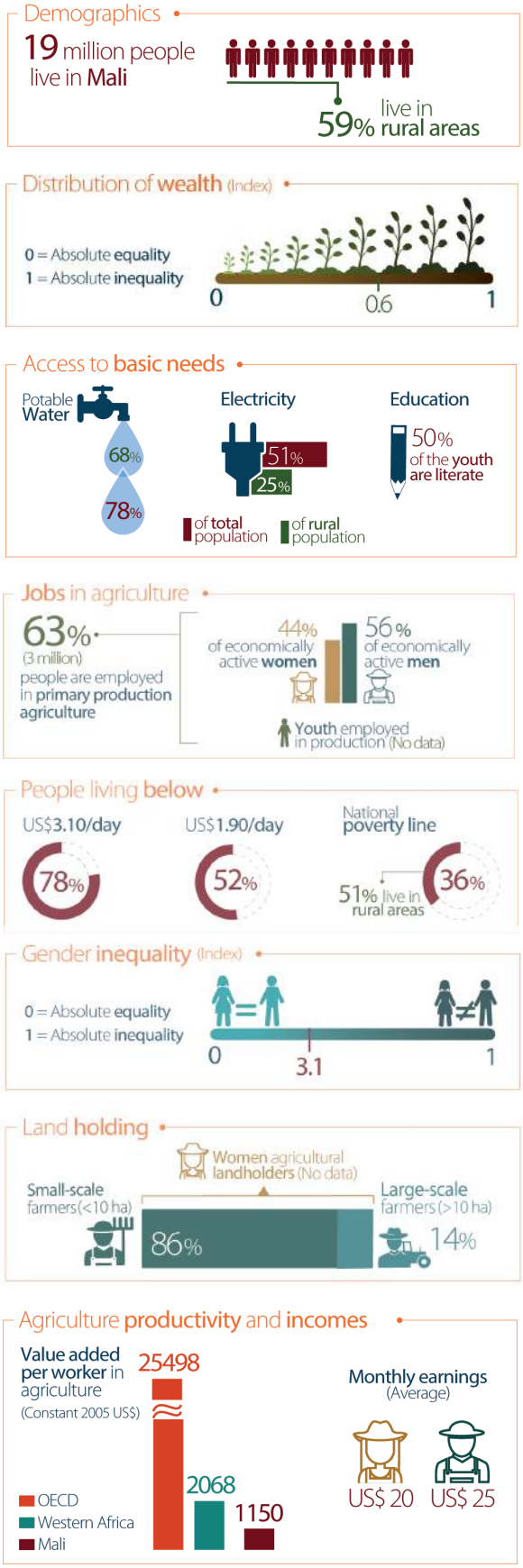


People, Agriculture, Livelihoods

Mali has one of the highest population growth rates in the world at almost 3 percent per annum, with a population that has more than doubled in number over the past two decades [3]. Around 10 percent of the population is considered nomadic. Most farmers in the country practice subsistence agriculture on small parcels of land (less than 1.5 ha) [5; 6]. Rain-fed crop farming mixed with livestock keeping is usually practiced as an income diversification strategy. Crops production hardly covers households' needs throughout the year.

Poultry farming and market gardening are the main sources of income for women and young farmers; contributing equally to food security and livelihoods. Studies have shown that women are more likely to engage in income-generating activities compared to men, including processing of food and non-timber forest products (shea nuts, baobab leaves) and street commercialization. However, women have less control

People, agriculture and livelihoods in Mali [3, 4, 7, 8, 9, 11, 12, 13, 14]



over household and agricultural assets. Only 57 percent of the women engaged in agricultural activities have access to agricultural credit and 51 percent to merchant equipment [7].

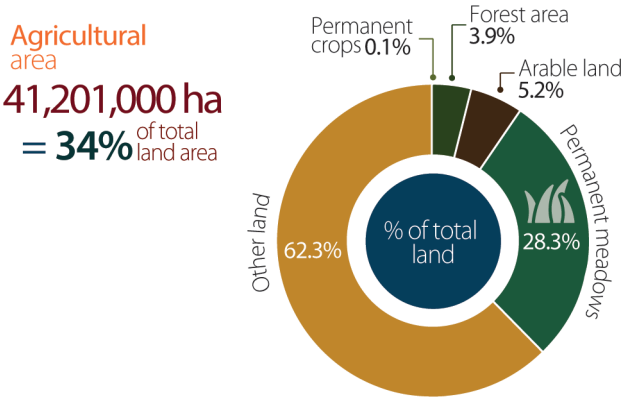
The incidence of poverty remains high throughout the country, with more than two fifths of the national population and half of the rural population living below the national poverty line [3]. The Human Development Index is also low, with a 0.42 score (0-1 rating) and a gender inequality index of 0.68 [8]. These hinder significantly farmers' ability to invest in agricultural development (inputs, technologies) and also limit access to credit and markets. Around 78 percent of the population and 68 percent of rural population have access to potable water sources [9].

Land use

Mali is a Sahelian, landlocked country, with almost two-thirds of the total land area being covered by desert and semi-desert areas, unsuitable for agriculture. Agricultural land represents just 33.7 percent of the country's total land area. Arable land, which constitutes 5.3 percent of total land, is dedicated to the annual cultivation of rice, maize, millet, sorghum, cowpea and groundnut, mostly under rainfed agricultural production. Permanent meadows and pasture represent 28.4 percent of the total land area and contribute to the production of sheep, goats and cattle. Mali is regarded as a low forest cover country, with forests occupying just 4percent of the country's land area [10], largely in the Guinean and Sudanian regions in the south of the country. The low level of forest cover means that Mali needs to import most of its wood to meet the population's needs. Land not occupied by crops is generally dedicated to sylvo-pastoral activities, representing around 49 million ha. Livestock is mainly based on the exploitation of farm residues and natural resources. Poor management of land and natural resources, combined with harsh climate conditions (drought) have caused decreases in grazing land area, further inducing migration and even livestock losses.

The Niger and Senegal Rivers are key enablers for fisheries production as well as for irrigation of vegetables and for watering livestock (cattle, sheep and goats).

Land use in Mali [10]



Agricultural production systems

Four agro-ecological zones (AEZs) can be identified in Mali along a north-south gradient, namely:

- ***The Saharan zone,*** which encompasses 51% of the country's total area, is covered by desert. Caravan trade, nomadic stock raising and the gathering of wild fonio are main activities of the people in this area. Few households cultivate sorghum around ponds.
- ***The Sahelian zone,*** which is subdivided into the Sahelian-Saharan area in the North and Sahelian-Soudanian area in the South, covers 285,000 km² and occupies 23 percent of the country's land area. Yearly precipitation averages 200 mm and the main grown crops here include rice and sorghum. Nomadic and transhumant livestock rearing is also common, the main species reared in these zones being camels, cattle, goats, and sheep.
- ***The Soudanian zone,*** which covers 17 percent of the country, receives between 600 and 800 mm of rainfall per year. The main crops produced in this zone are millet, sorghum, maize and cowpea. Groundnut and sesame are major cash crops in this zone. In addition to these, most of the farm households (largely smallholders) practice sedentary livestock rearing. Due to the rich fodder resources, the area is equally valued by transhumant herders particularly during drought years.
- ***The Soudan-Guinean zone*** covers only 75,000 km² of the country's land area. The rainy season lasts for 5-6 months and yearly precipitation varies between 800 and 1300 mm. Livelihoods in this region are based on maize, sorghum, cowpea, fruits and groundnut. Groundnut and maize are produced both for household consumption and for cash generation. Tubers and vegetables (cabbages, okra, tomato, onion) are also grown for income diversification, in addition to the gathering of wild fruits (shea, tamarind, nere). The majority of farm households in this zone also practice sedentary stock rising. Main species raised are cattle, sheep and goat. During the dry season, fields and pastures are exploited by transhumant herders from northern regions.

The Niger and Senegal River systems also play an important role in the agroecology of Mali. The Inner Niger Delta ecosystem constitutes a unique ecological area sheltering numerous wetlands that have been designated as Ramsar sites, very key to agriculture and food security. The main crop produced here is fluvial rice, both for household consumption and income. During the dry season, it is also home to the largest pastures in Western Africa. The Inner Delta is also the main production zone for fish, with the fishing sector in Mali being the third most important economic activity in the country and contributing (directly and indirectly) to the employment of about 500,000 people. The added value of the fishing sector to the Malian GDP averages XOF 80 billion (US$ 144 million), representing 1.5 percent in 2014 [15]. Fish catch however, varies with water levels and rainfall variability [16].

Overall, food crop production represents 45 percent of the total agricultural production, while cattle and fisheries account for 28 percent and 14 percent respectively. Maize, millet and sorghum are produced for local consumption and

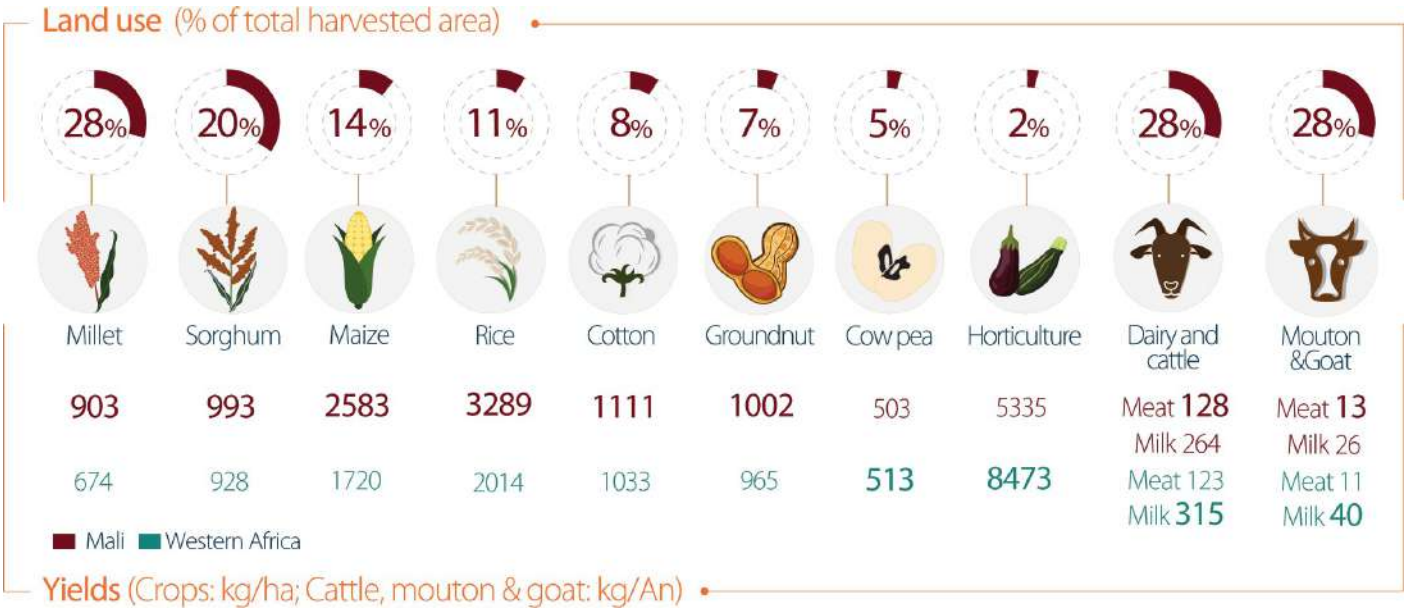
provide around 35 percent of the daily calorie intake [5]. Livestock remains a key economic sector both at national and household level. The livestock sector accounts for 30 percent of Mali's agricultural GDP and more than 80 percent of agricultural households own some ruminants [17].

Crop production activities are carried out for approximately five months a year in the South, three months in the North and two months in the Sahara, depending on the length of the rainy season [16]. Off-season farming is common among one-third of the households and includes market gardening (around 26 percent of the households), cultivation of flood recession crops (9 percent) and irrigated cereal agriculture (9 percent) [18].

Subsistence farming (especially of food crops) is characterized by use of fallow, as well as limited utilization of organic input and chemical fertilizers [5]. As only 5 percent of the land is currently irrigated, food production is oftentimes constrained by crop failure due to erratic rainfall and other climatic stresses. With the exception of rice, crop yields have remained unchanged for the past 50 years, indicating that agricultural innovations have been insufficient and ineffective in responding to increasing demand for food crops [19]. To boost agriculture production and food security goals, the Malian government has considerably invested in fertilizer subsidies and promotion of irrigation, especially in rice production, through the management of flood pains and small irrigation schemes [5, 16], yet policy focus on other staple crops has been only marginal.

The following infographic shows a selection of agriculture production systems key for Mali's food security. The importance is based on the system's contribution to economic, productivity and nutrition quality indicators. For more information on the methodology for the production system selection, consult Annex 1.

Production systems key to food security in Mali [20, 21]



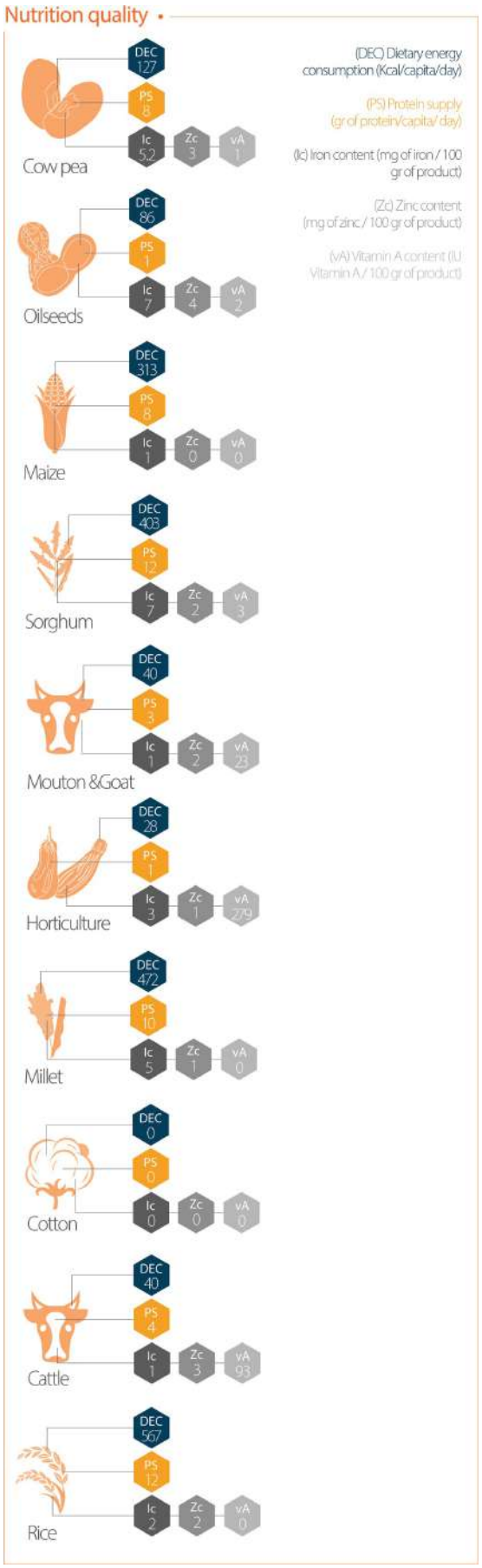
Economic relevance and nutrition quality of key crops in Mali

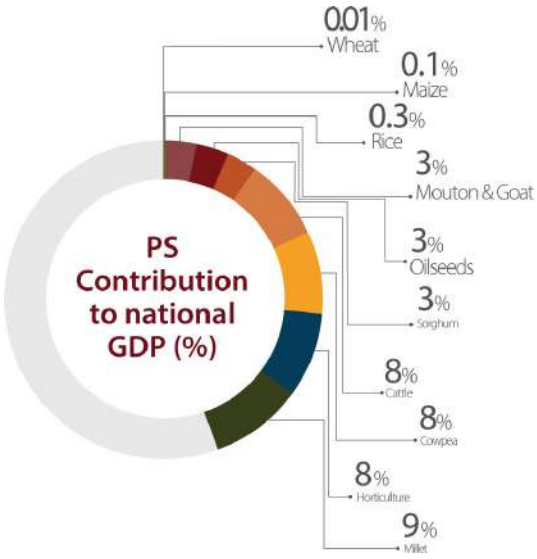
The International Network of Food Data Systems (INFOODS), Food Composition databases of the Food and Agriculture Organization of the United Nations [22][1] provide a first glance at long-term trends and patterns of the per capita availability of food, food groups, main food items, and macronutrients at the national level. Agriculture plays a vital role in Mali's economy. It also provides the primary source of income and nutrition in farming communities, contributes to national food security, and hence reduces, and often eliminates, the need for food imports. Among major crops and livestock, paddy rice, cattle, horticulture and cotton are considered to contribute at 5.3 percent, 4.0 percent 3.4 percent and 3.1 percent respectively to GDP of Mali [3].

Mali's per capita availability of food expressed on the basis of dietary energy in calories has continuously improved between 2012 and 2016. Rice, millet, sorghum, maize and cowpeas mostly supply high level of kcal/capita/day, with 567, 472, 403, 313 and 127 respectively.

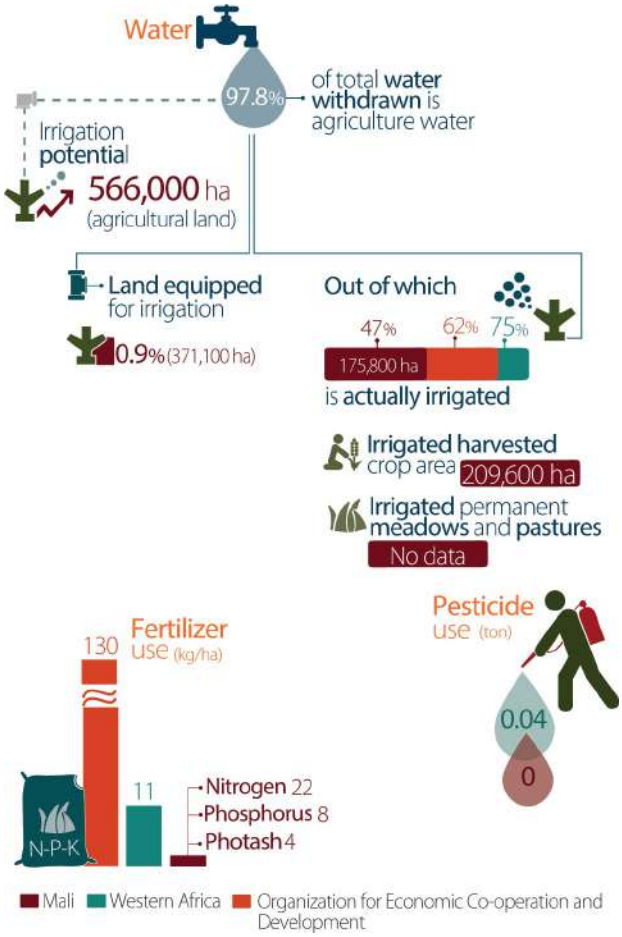
1 The FAO/INFOODS 2019 database contains nutrient composition of foods and per capita food supply in a country available for human consumption.

Nutrition Quality [3, 22]





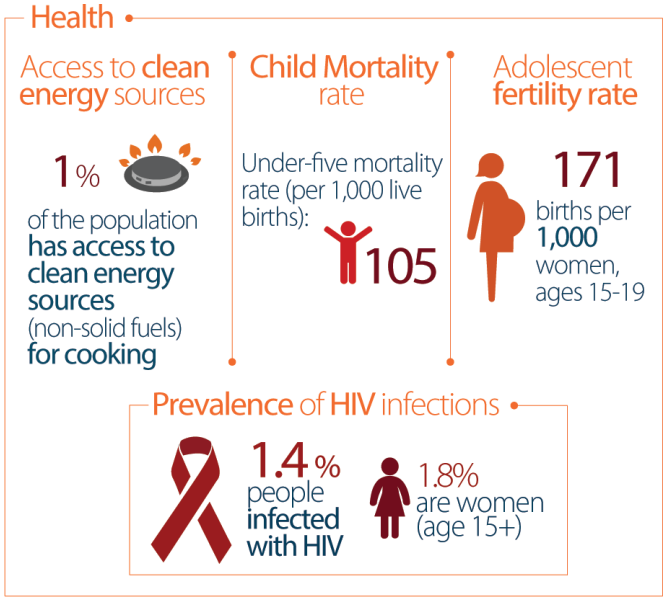
Agricultural input use in Mali [23, 24, 25, 26]



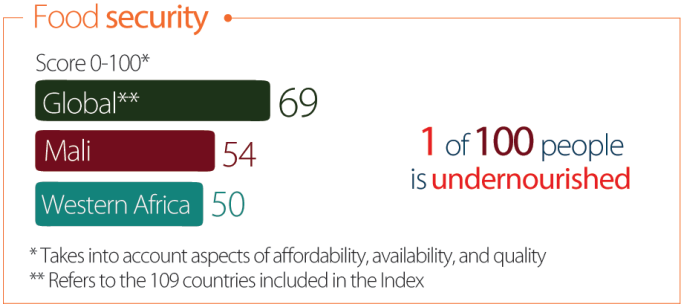
Food Security, Nutrition, Health

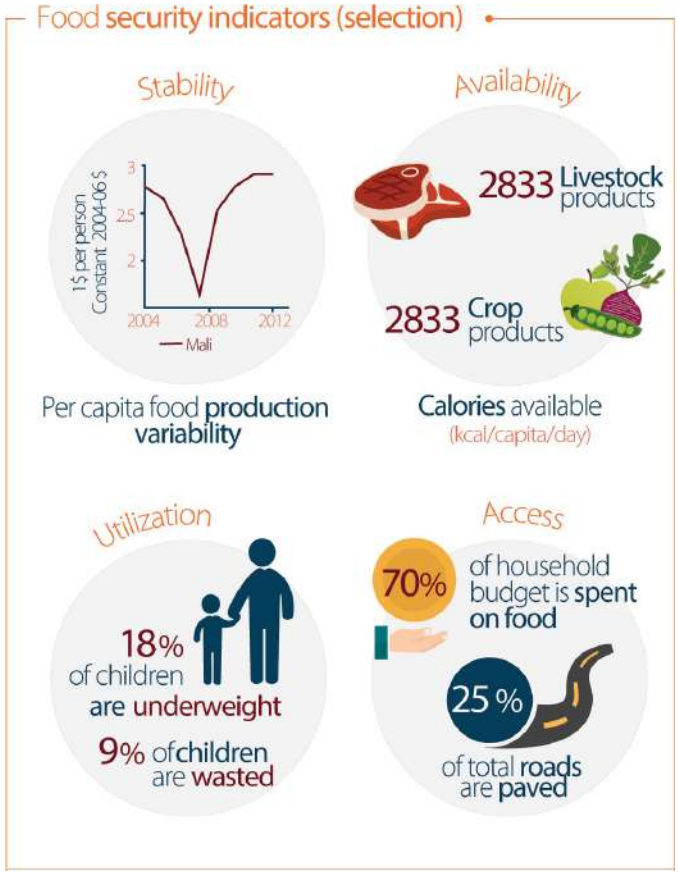
Mali scores 54.4 (on a 0 to 100 scale) in the Global Food Security Index, a relatively higher score compared to the average in West African countries, currently at 50. In 2016, Mali was recognized among the few African countries to have achieved both the Millennium Development Goal (MDG 1.C) and the World Food Summit (WFS) targets of, respectively, halving the proportion and the number of hungry people by 2015 [23]. This was attributed largely to the improvements in the policy environment and legal framework for food security and nutrition, management of water resources, and support to vulnerable groups. Despite the relatively stable food crop yields over the past years, food insecurity prevails in a quarter of the households and is rather structural and chronic, particularly in rural areas and among nomad and transhumant pastoralist groups. These conditions are exacerbated in the lean season [18]. Political instability (notably in the North, poverty and low adaptive capacity, frequent food crisis caused by climatic shocks such as droughts and floods, constrain food access and affordability. In 2015, two-thirds of the households were indebted to informal structures (local shops, families, and friends) for buying mainly food products, indicating high vulnerability of the population but also low access to formal credit facilities.

The diet is becoming less diversified in households with low, irregular incomes (mostly from fishing activities, market gardening, donations) in the northern (Kidal region) western (Kayes region), and southern (Tombouctou region) areas [18]. The prevalence of child stunting was 18.6 percent in 2018, while the wasting rate among children under five years of age was at 9.0percent in 2018 [3].



Food security, nutrition and health in Mali [3, 24, 27, 28, 29, 30, 31, 32]





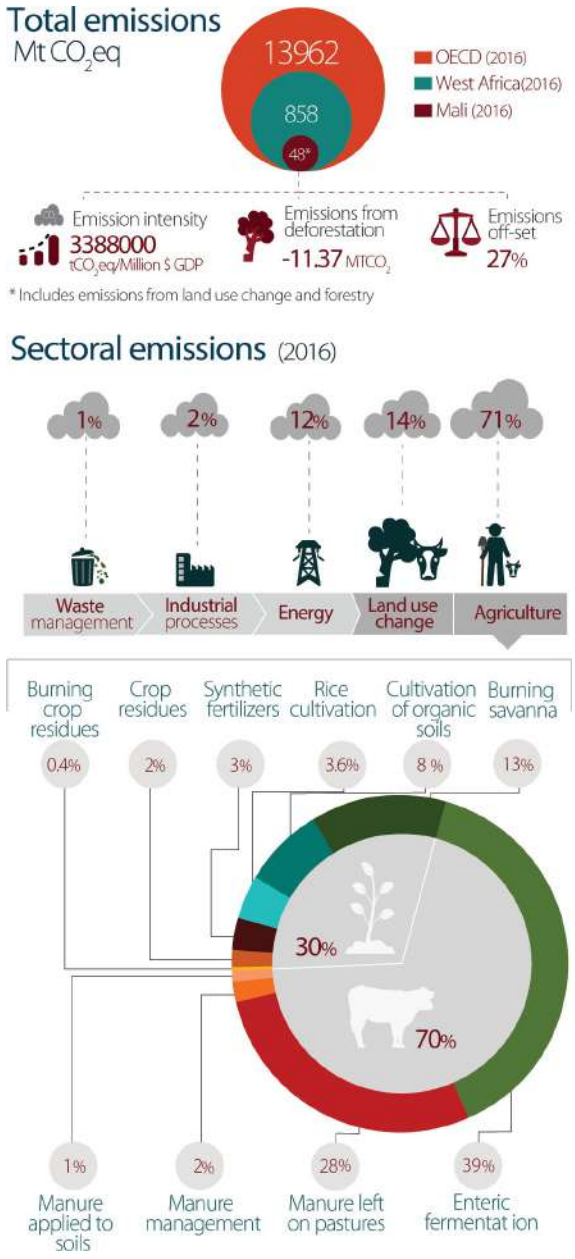
Governmental programs and food aid donations have helped keep food insecurity and malnutrition rates relatively stable over the past years. The Nutrition Cluster was formed in 2012 to coordinate nutrition humanitarian response among various donor institutions and governmental actors. The National Policy of Nutrition was developed in 2013 with the aim to guide the implementation and coordination of efforts around food security in the country, under the leadership of the Ministry of Health and Public Hygiene. Under the Scaling Up Nutrition (SUN) movement, various campaigns to build institutional capacity and mainstream nutrition in policies, programs and projects have been organized by governmental and non-governmental actors in Mali. Other efforts to curb malnutrition in the country include the USAID-funded Integrated Rural Program to Improve Nutrition and Hygiene in Mali, implemented by CARE and Save the Children (2013-2018); the strengthening Community-Based Acute Malnutrition Prevention and Treatment project in the Koulikoro and Sikasso regions (USAID/Mali and the Office of U.S. Foreign Disaster Assistance [OFDA]); and the Nutrition WASH "Damu Ni Wassa" project (USAID/Mali).

Agricultural greenhouse gas emissions

The agricultural sector contributes around 71 percent to the total greenhouses gases (GHG) emitted in the country, mostly through rice production and livestock rearing. This generally high percentage is largely due to the low emissions from energy production (12percent of national emissions), which is largely through the use of hydropower. Of these emissions, crop production contributes 31 percent of total agricultural emissions and livestock production contributes 69 percent. Cultivation of organic soils are major GHG contributors, with savannah burning attributed with 21 percent of agricultural emissions. Within the livestock sub-sector, enteric fermentation is a major emissions source (39 percent of agricultural emissions), while manure left on pastures follows closely behind (28 percent of agricultural emissions). Nitrogen emissions are mostly induced by fertilization and the conversion of forest areas, [16]. The conversion of forest areas into farms, the increasing demand of urban centers for charcoal and wood to satisfy household energy needs are speeding the degradation of soils, natural resources and increasing emissions trends [16, 33].

To enable growth and sustainably boost its agricultural potential, the government has committed to the reduction in agricultural, energy and land use and forest emissions, as outlined in the (Intended) National Determined Contributions ((I)NDC)) submitted to the United Nations Framework Convention on Climate Change (UNFCCC). The GHG reduction ambition level of the mitigation scenario compared to the baseline scenario is 29 percent for agriculture, 31 percent for energy and 21 percent for land use change and forestry [34]. As result, emissions off-set target is 27 percent by 2030. To achieve these targets, the government committed to the promotion of CSA strategies related to irrigated rice farming (through improved irrigation in order to avoid permanent flooding of rice-producing land and use of the System of Rice Intensification (SRI)); improved animal husbandry; and the management of fertilizer use (through substitution of high-nitrogen urea for organic fertilizer production, micro-dosing). Forest plantations, natural assisted regeneration of forests and management of protected areas are strategies for decreasing emissions from the forestry and LUC sector [33]. The total costs of the measures outlined in the INDC are estimated at US$ 34.68 billion, with most of the budget being required for activities in the agricultural sector (US$ 20.6 billion).

Greenhouse gas emissions in Mali [34, 35]



Challenges in the Agricultural Sector

The agriculture sector in Mali is faced by a number of challenges which include low productivity, post-harvest crop losses, under-developed markets, and vulnerability to climate change. Low productivity and underperformance of the agricultural sector in Mali is largely induced, either directly or indirectly, by factors such as:

- ***The heavy reliance on rainfed cropping and livestock production.*** Rainfall has become increasingly variable and unpredictable, impacting water availability and quality for crop and animal production, but also bringing about invasions of locusts. This is coupled with the inadequate management of water resources, which are vital to agricultural activities and food security in the country. Losses from inappropriate management of water resources in the Inner Niger Delta are estimated at 30,000 billion cubic meters. Silt deposits in rivers and lakes average 30 million tons per year [16].
- ***The degradation of natural resources,*** induced by demographic growth and increased pressure on agricultural land. Every year, the country is estimated to lose more than 100,000 ha of forest areas, due to deforestation [16]. The demand for charcoal and wood for household energy needs were assessed to be 5 million tons and likely to reach 7 million tons in the next years, which would correspond to the regeneration capacity of forest resources in Mali [16, 19]. Soil loss due to continuous cultivation and erosion varies between 1 and 10 tons/ha/year [16]. Reduced fallow, continuous cultivation of low fertile soils and deforestation are expected to contribute further to loss of topsoils and degradation of pastures. Natural resources degradation has become a major factor for desertification in a country already primarily covered by desert and with a relatively small portion of agriculturally suitable land.
- ***There is limited access of farmers*** in rural areas to training, improved seeds, fertilizers, adequate equipment and finance opportunities; which hinder development efforts and growth of the agriculture sector [35]. This is compounded by limited access to niche markets, due to farmers' low capacity to add value to their products. Agriculture products are usually sold at low prices due to the lack of value addition and inefficiencies within the value chain, bringing most benefits to the wholesalers (especially in the case of the cereal value chain) [5].
- ***Gender inequity*** and unequal distribution of resources (especially land), encouraged by existing customary laws that limit women and youth's access to productive resources in rural areas and their representation in decision-making spheres. Unclear land use and ownership rights, as well as reduced availability of land for cultivation or grazing, drive conflicts between farmers and herders over the access to and use of natural resources including pasture, water and forest resources. Such conflicts are particularly frequent in the Niger River Delta.
- ***Insecurity,*** prevailing in the Northern and central areas of the country where livestock production is predominant, reduces human mobility and intra-regional exchanges; therefore, affecting food security for the country as a whole. Conflict and insecurity affect the availability of farm labour and agricultural marketing, and increase the transaction costs associated with access to these services [37]. Furthermore, population displacements (along with the high population growth rate) aggravate pressure on land and water resources.

Agriculture and Climate Change

Mali is characterized by a Sahelian climate with high inter- and intra-annual variability of temperature and rainfall, often resulting in a great difficulty in the analysis of trends of these two key parameters. The agriculture sector is particularly sensitive to climatic stresses such as droughts and floods, with recurrent droughts having led to major food shortages in 2005, 2007, 2010 and 2012 respectively [5]. Drought in 2004, seriously affected pastoralist movements, forcing them to remain near permanent water sources and leading to considerable overgrazing [38]. Droughts have become more frequent and more severe since the 1970s, contributing to significant North-South migration of the population in search of improved livelihoods. Historic climate and weather analyses revealed that since 1950, precipitation has reduced at various rates throughout the country, between 150 mm in the Western areas and 10 mm in the remaining parts of the country. The length of the rainy season has also reduced. Additionally, temperatures have increased by more than 0.8°C since 1960 (0.2°C per decade), with the rate of increase being more pronounced in the hot-dry season from April to June [38]. Moreover, the number of hot days and nights have increased in all seasons except winter, and dry spells are more frequent and longer [16, 19, 39]. In addition, 80 percent of Mali's electricity is generated from hydropower, with energy production reducing by as much as 20 percent in dry years. On the other hand, floods also occur due to periods of intense rainfall, particularly along the Niger River flood plains. The combination of droughts and floods can have a devastating effect. For example, in 2000 in Mopti and Gao (both along the Niger River) dry spells led to late planting of the area's rice crops, however floods followed shortly after planting resulting in loss of the seeds prior to emergence [38]. Poor land management, overgrazing and encroachment of agriculture onto otherwise unsuitable land have resulted in siltation and erosion, which have increased vulnerability to floods and droughts.

Climate projections for Mali generally indicate [16, 19, 39]:

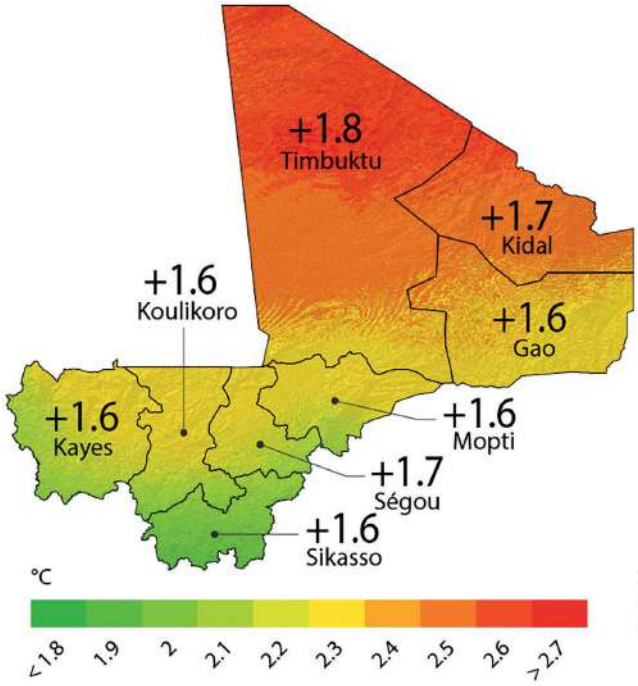
- An increase in annual temperatures by 1.5°C by 2030, 1.7°C by 2050 and 3°C by 2100 in all regions and during all seasons;
- Increased evapotranspiration rate, degrading soils and land surface;
- An uncertain and unpredictable distribution of rains, increased inter-annual rainfall variability and shortening of growing period [16, 19, 39];

- An average decrease in rainfall by 5-8 percent by 2030, 5-10 percent by 2050, and 22 percent by 2100 in the entire country [33] and a displacement of isohyets towards the South. Most significant decreases in rainfall are expected to be registered in the northern areas of the country, while the South will likely experience more frequent heavy storm events [19].
- Increases in the frequency and the severity of extreme climatic events (droughts, storms, and floods especially along the Niger and Senegal River). Drought hotspots are mostly located in the grazing land areas.

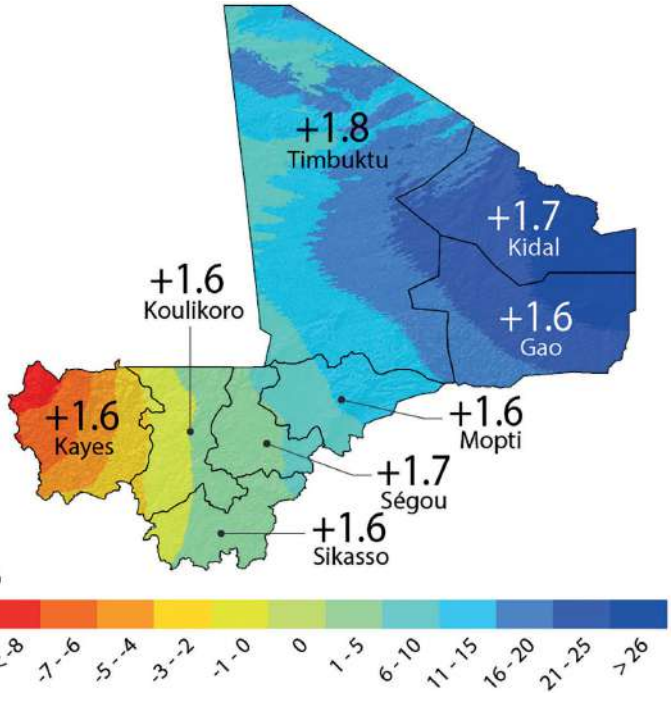
Projected changes in precipitation and temperature are expected to significantly impact crop yields in both the drier and wetter regions of the country. Model simulations predict a decrease in yield of the major food crops produced in the country, namely millet, sorghum, maize and rice [5, 16, 19, 40]. Climate change is also expected to impact pastoralists negatively, reducing the availability and quality of fodder and water resources. Increased heat waves are expected to contribute to higher spreading of diseases like rift valley fever [16].

Projected changes in temperature and precipitation in Mali by 2050 [41, 42, 43]

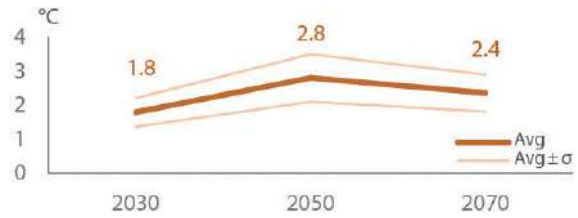
Changes in annual temperature (°C)



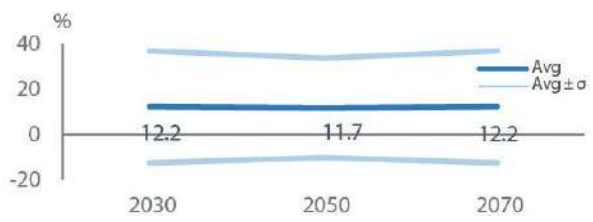
Changes in total precipitation (%)



Average temperature (˚C)



Average precipitation (%)



Potential economic impacts of climate change

The International Model for Policy Analysis of Agricultural Commodities and Trade (IMPACT) developed by IFPRI [44] enables the assessment of future changes in yields, cropped area (or livestock numbers), and net trade under scenarios with and without climate change (CC and No-CC scenarios, respectively).

Production systems such as rice, maize, millet, sorghum, horticulture, groundnuts, cowpea and cotton are projected to experience yield increase while surface areas will decrease. The impact of climate change on crop yield is consistently negative showing relative decreases for every commodity, the most severe of which are for maize and horticulture. For instance, by 2050, the yield will decrease by 20 percent and 11 percent coupled with an area decrease of 0.2 percent and 5.6 percent, for maize and horticulture respectively. The cultivation area for groundnut, millet, sorghum and cowpea is expected to increase by 4 percent, 1.1 percent, 0.9 percent and 0.5 percent respectively by 2050 (See Annex 2).

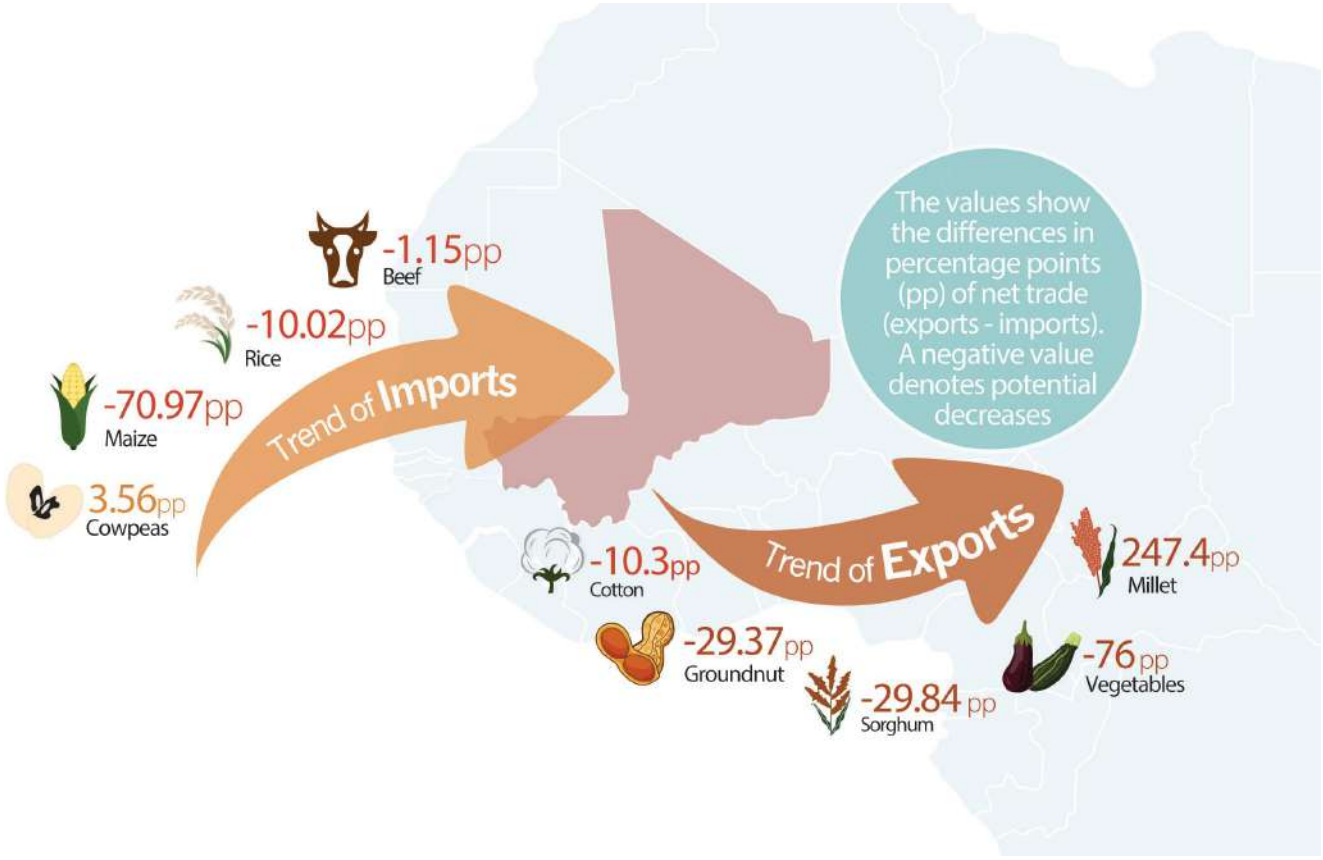
The expansion of area under cultivation while with yield decreases shows that land suitability may be severely impacted by climate change. There is a need to understand how cultivated area will shift and the role that intensification plays in avoiding loss of biodiversity or other important land uses. Indeed, yield and area show slightly different aspects of the food system. Yield can increase using the same amount of land because intensification techniques are most likely fully in use.

Climate change impacts on international trade are represented as the gaps between production and local demand for each production system. This is calculated as the difference between the country's net trade growth with and without climate change. Under the climate change scenario, we observe a reduction in all commodities imports, mainly maize and rice imports by 84.7 percentage points (pp) and 15.9 pp, respectively.

Additional entry points can be drawn from the model projections about the future of food security, food sovereignty and the role that climate change plays:

- Crop yield is consistently negatively affected by climate change and requires proactive investment in technologies and practices that can mitigate the predicted decline in yield.
- Crop area shows heterogeneous impacts from climate change which is likely due to changes in land suitability for certain crops. Further investigation is required into how each crop may respond to changes in land suitability so that farmers may transition to crop systems better suited to their region.

The impact of climate change on net trade in Mali (2020–2050) [44]



- Livestock yield and production are minimally affected by climate change by 2050. Cattle and Mutton &Sheep may be essential to maintaining food security in the region. Agricultural policies and programs should consider pastoralists as key players.
- Several crops and livestock show a trend of importation by 2050, indicating that local production will fall short of local demand. Crops such as maize and rice are core to food security. The trend of importation of these core crops may threaten food sovereignty in the region if farmers' and citizens' needs are not central in agricultural systems.
- While cotton is a cash crop, it remains vital in supporting livelihoods and shows a trend towards exporting by 2050 under both climate change and non-climate change.

CSA Technologies and Practices

Farmers use a number of strategies to cushion themselves from the adverse effects of climate change. These adaptation strategies have existed and have been adopted for many years, and their climate-smartness depends on the context of the country and/or region [2, 44]. In Mali, a number of climate-smart practices have been prioritized [46; 47]. For crop production, the use of improved varieties that are drought tolerant and fast growing, composting, micro-dosing, urea deep placement, soil and water conservation are among the key practices.

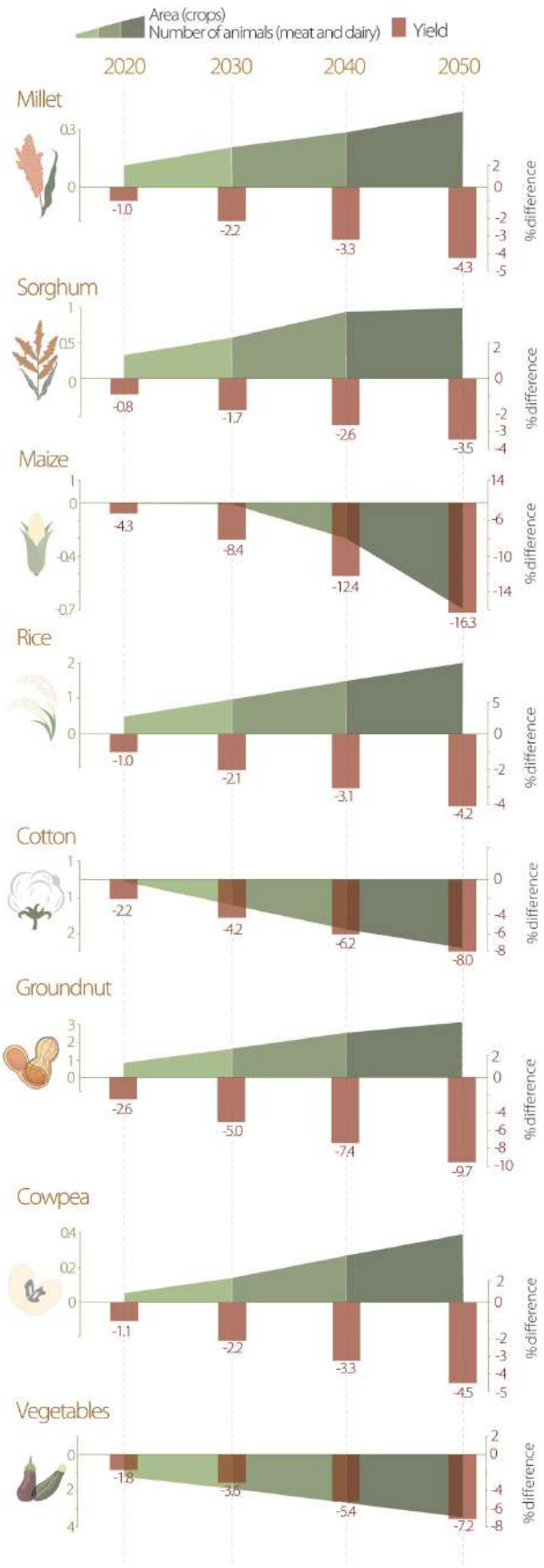
For livestock, fodder production, feed supplementation and herd mobility are among the main CSA-related practices used by agro-pastoralists. Cattle fattening, through stall feeding and animal housing has also been promoted in the country [48], and has potential to increase livestock productivity, farmer incomes and resilience to climate hazards, while also allowing for capture of manure for use in biogas digesters or in crop and vegetable fields. Such practices could contribute to productivity and resilience in agriculture in Mali, as well as to agricultural mitigation.

Farmer managed natural regeneration, particularly in the context of reducing desertification, has become increasingly common. More generally, forestry and agroforestry have also been promoted, with Acacia Senegal being commonly planted due to the extraction of Gum Arabic, a highly desired food additive used in a wide variety of products produced across the world including soft drinks.

Off-farm CSA related practices are largely focused on the development of hydrometeorological information systems, particularly for hazard early warning but also for informing seasonal agricultural activities. For example, through the National Meteorological Agency (Mali Meteo) is providing agro-meteorological assistance to rural communities, delivering accurate, timely and locally-adapted weather forecasts on various aspects, including beginning of the rainy season, length of the growing season, daily weather information, among other parameters (see case study).

However, the rapidly changing environment, climate and even socio-economic context render some of the practices insufficient in cushioning the farmers from the risks of

Climate change impacts on yield, crop area, and livestock numbers in Mali [44]



climate variability and change. Many of these adaptation strategies respond to short-term immediate needs, as long-term sustainability has not been a priority for farmers. For instance, in the region of Segou, there are significant differences in the observed and potential adoption rates of the most used CSA technologies and practices (drought tolerant crop varieties, micro-dosing, organic manure, intercropping, contour farming, farmer managed natural regeneration, agroforestry and climate information service) [49]. The most adopted technology is the organic manure (89 percent) while the least adopted is the intercropping (21 percent). The observed adoption rate varies from 39 percent to 77 percent according to the CSA options while the potential adoption rates of the technologies and practices ranged from 55 percent to 81 percent. This implies an adoption gap of 2 percent to 16 percent certainly due to the incomplete diffusion (lack of awareness) of CSA technologies and practices which must be addressed by carrying out more actions to disseminate these technologies in the different regions of Mali.

Some of the challenges contributing to the low adoption include among others lack of relevant knowledge about the practices, poor organization of the value chains and low financial capacity. Adaptation options such as seed priming and fertilization that require minimal initial cost and less skills are most preferred by farmers. Land tenure is also an important factor that influences adoption of some practices such as agroforestry, irrigation and investment in infrastructure [50]. This is more significant in the Sahelian and Sudanese regions that experience frequent conflicts between livestock and non-livestock keepers.

For these strategies to work efficiently, different climate change related services have been promoted in the country. These include among others agricultural insurance (crop area-yield index insurance, weather-indexed insurance, and remotely sensed indexes-vegetation index and water index among others), and agro-meteorology advisory services. The latter has been implemented in Mali, an initiative that brings together different actors including the Mali's National Meteorology Agency (Mali Meteo), and the Swiss Agency for Development and Cooperation (SDC) as the donor. The sole objective of the initiative was to provide climate information to enable farmers better manage climate risks. An assessment of the impact of the programme shows that timely weather information plays a major positive role in influencing farmers to adopt climate smart strategies [51]. However, the major impediment to this initiative has been lack of capacity of the meteorological department to effectively communicate critical weather and climate information to the rural farmers in goo time. At present Mali has placed great focus on improving hydro-meteorological services to meet the needs of farmers, with the country currently implementing a Green Climate Fund on

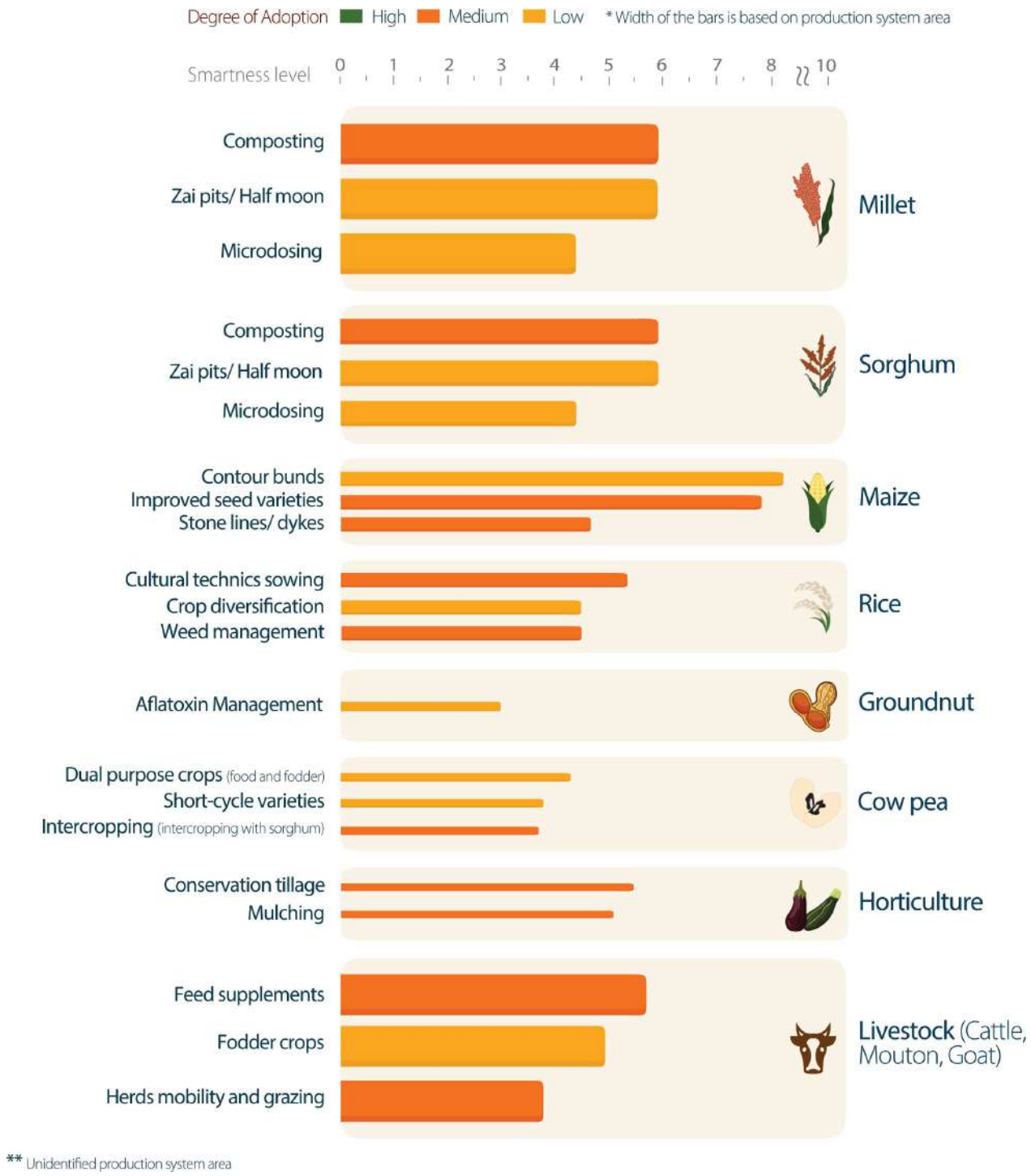
Though information demonstrating the novelty of the climate-smart practices exists elsewhere, there is missing evidence to inform and guide the adoption of different practices in Mali. This is with the exception of a few cases such as [46] which shows that rational management of land, drip irrigation and zai pits have great impact across all the three CSA pillars, while the system of rice intensification (SRI) has trade-offs between adaptation and mitigation; with evidence from a study by Africare showing that SRI increased rice yields in the country by 34 percent [52]. In some cases, studies that involve controlled field trials do not fully represent the conditions that surround the farmers, hence the gap that always exists in realizing the potential of the technologies at farm level. In addition, Mali is among the countries with a small number of crop varieties commercialized in the AGRA's Africa's Seed System [36]; making access to these technologies difficult. There is also a weak link between using indigenous knowledge (IK) and integrating it into building farmer's resilience. Evidence shows that IK is a strong component in building adaptive capacity. Zaï pits, one of the traditional adaptation strategies in Mali for instance, have proven very effective in soil and water conservation [36].

Within the framework of the West Africa Agricultural Productivity Program (2007-2013)[2], the government has engaged in efforts to improve productivity and incomes of Malian farmers, by promoting CSA practices and technologies that yield better results for the smallholders, such as improved varieties of rice, stress-resistant tomato varieties (allowing production in the rainy season), seed drills for efficient planting, siloed maize production for fodder, among others. Approximately 175,000 farmers who used such technologies experienced average increases in yields and incomes by 30% and 34%, respectively [53].

The following graphics present a selection of CSA practices with high climate-smartness scores according to expert evaluations. The average climate-smartness score is calculated based on the individual scores of each practice on eight climate-smartness dimensions that relate to the CSA pillars: yield (productivity); income, water, soil, risks/ information (adaptation); energy, carbon, and nutrients (mitigation). A practice can have a negative/ positive/ zero impact on a selected CSA indicator, with 10 (+/-) indicating a 100% change (positive/ negative), and 0 indicating no change. Practices in the graphic have been selected for each production system key for food security, as identified in the study. A detailed explanation of the methodology can be found in Annex 5.

2 The WAAPP is a mechanism to disseminate agricultural innovations among eligible ECOWAS countries, with the aim to support regional cooperation in agriculture and guarantee competitive prices for agricultural products. The WAAPP is funded under the Adaptable Programmatic Loan (APL) of the World Bank - International Development Association (IDA) for a 10-year period. Each country contributes one third of its IDA allocation, while the Bank puts the remaining two-thirds from the IDA regional desk. The beneficiary countries also contribute a part of their funding to the West and Central African Council for Agricultural Research and Development (WECARD) to ensure regional coordination. The second phase of the WAAPP is on-going (2012-2018) and is primarily targeting agricultural extension and research.

Selected CSA practices and technologies for production systems key for food security in Mali



** Unidentified production system area

Detailed smartness assessment for top ongoing CSA practices by production system as implemented in Mali

CSA practice	Region and adoption rate (%) <30 30-60 60>	Predominant farm scale S: small scale M: medium scale L: large scale	Climate smartness	Impact on CSA pillars
Rice (12.20% of harvested area)				
Cultural sowing technics	Guinean, Soudanian, Sahelian	M		**Productivity** Increases productivity. **Adaptation** Enhances rational use of soil water.
Crop diversification	Guinean, Soudanian, Sahelienne <30%	S		**Productivity** Increases productivity. **Adaptation** Improves water use efficiency.
Livestock (83.84% of total harvested area)				
Fodder crops	Guinean, Soudanian, Sahelian	S M		**Productivity** Increases productivity. **Adaptation** Diversifies farm incomes, enhances availability of livestock feeds.
Feed supplements	Guineenne, Soudanienne, Sahelienne	S M L		**Productivity** Increases productivity. **Adaptation** Reduces pressure on resources, protects livestock from diseases. **Mitigation** It can contribute to emissions depending on the absorption and digestibility of the supplements.

Yield Income Water Soil Risk/Information Energy Carbon Nutrient

CSA practice	Region and adoption rate (%) <30 30-60 60>	Predominant farm scale S: small scale M: medium scale L: large scale	Climate smartness	Impact on CSA pillars
Maize (12.63% of harvested area)				
Improved seed varieties	Guineenne, Soudanienne 30-60%			**Productivity** Increases yields. **Adaptation** Enhances crop resistance to diseases. **Mitigation** Reduces emissions due to reduced use of pesticides.
Contour bunds	Guineenne, Soudanienne >60%			**Productivity** Increases yields. **Adaptation** Reduces soil erosion and manage soil water to cope with changing weather. **Mitigation** Land management prevents further worsening of soil quality and increase tree's vegetation cover.
Millet (36.12% of harvested area)				
Zai pits	Soudanienne, Sahelienne	S M		**Productivity** Increases yields. **Adaptation** Reduces soil erosion and enhances water infiltration to cope with changing weather. **Mitigation** Land management prevents further worsening of soil quality and increase tree's vegetation cover.
Composting	Soudanienne, Sahelienne	S M		**Productivity** Increases yields. **Adaptation** Reduces erosion and enhances water infiltration to cope with changing weather. **Mitigation** Builds up soil carbon over time and improves soil fertility.

Yield Income Water Soil Risk/Information Energy Carbon Nutrient

CSA practice	Region and adoption rate (%)	Predominant farm scale S: small scale M: medium scale L: large scale	Climate smartness	Impact on CSA pillars
Sorghum (26.35% of harvested area)				
Zai pits/half moon	Soudanienne, Sahelienne	S M		**Productivity** Increases yields. **Adaptation** Reduces erosion and enhances infiltration. **Mitigation** Reduces emissions since it conserves water and reduces soil disturbance.
Composting	Soudanienne, Sahelienne 30-60%			**Productivity** Increases yields. **Adaptation** Reduces erosion and enhances infiltration. **Mitigation** Reduces emissions since it conserves water and reduces soil disturbance.
Groundnuts (7.16% of total harvested area)				
Aflatoxin management	Soudanienne, Sahelienne			**Productivity** Reduces yield losses. **Adaptation** Diversifies incomes and reduces diseases. **Mitigation** No significant effect.
Cow pea (5.42% of harvested area)				
Short cycle varieties	Soudanienne, Sahelienne	S M L		**Productivity** Increases productivity. **Adaptation** Reduces erosion and enhances infiltration. **Mitigation** Reduces utilization of chemical Nitrogen fertilizers, hence reduces emissions.
Dual purpose crops (food and fodder)	Soudanienne, Sahelienne	S M L		**Productivity** Increases productivity. **Adaptation** Reduces erosion and enhances infiltration. **Mitigation** Reduces utilization of chemical Nitrogen fertilizers hence reduces emissions.

Yield Income Water Soil Risk/Information Energy Carbon Nutrient

CSA Case Study: Meteorological Assistance to Rural Communities in Mali

In Mali, 70% of the population and 80% of rural farmers depend on rain fed agriculture. While it represents the backbone of the national economy, the sector is highly affected by rainfall variability and extreme climate events (drought, flood), which are characteristics of the Sahelian climate. These have brought about significant yield losses for major food crops, such as millet/sorghum, rice and maize, affecting farmers' food security, incomes and capacity to respond to adverse climatic stresses.

In response to these challenges, the government, through the National Meteorological Agency (Mali Meteo) is providing agro-meteorological assistance to rural communities, delivering accurate, timely and locally-adapted seasonal weather forecasts on various aspects, including beginning of the rainy season, length of the growing season, daily weather information, 10-day forecast, among other parameters. A multidisciplinary task force composed of government agencies' representatives working on agriculture, livestock husbandry, social protection and rural development topics was set up, leading initial consultations with beneficiaries and participatory data collection, to increase local ownership, relevance, and sustainability of the project. Rainfall data collected by farmers and extension workers are sent to Mali Meteo, which analyses the information and provides recommendation and advisory. Additionally, Regional and Local Meteorological Assistance involving Mali Meteo, extension workers, local radio and representative of Medias are setup at both regional, district and communal level, to make sure that meteorological advisory are adapted to local needs. The national radio and local private radios (FM) disseminate meteorological information across the country.

The initiative started in 1984 with external financing from the Swiss Agency for Cooperation and Development (SDC) and support from the World Meteorological Organization (WMO) and has been scaled out through the country ever since, becoming entirely funded by the government, extension agencies and farmer groups. It was the first initiative of agro-meteorological assistance in Africa to reach farmers directly, enabling them to measure and use climate information in farm decision. To date more than 500 extension workers across the country have been trained and a network of 1600 rain gauges has been installed across the country. Additionally, 1600 farmers/observers have been trained on weather data collection, using forms translated in local languages.

Photo: Bioversity International

Enabling institutions and policies for CSA

The lead institutional actor for climate change work in the country is the Ministry of the Environment, Sanitation, and Sustainable Development (MEADD), which also acts as the Global Environment Fund (GEF) and Green Climate Fund (GCF) focal points. The National Climate Change Committee (CNCCM, French acronym) has a consultative role, also mobilizing resources and actors for climate-related initiatives in the country. The Agency for Environment and Sustainable Development (AEDD, French acronym), created in 2010, is mandated by the MEADD to coordinate climate mitigation and adaptation actions and serves as the secretariat for CNCCM.

The Institute for Rural Economy (IER, French acronym) leads the research on innovation and climate-smart technologies, contributing to the development of improved cultivars adapted to local conditions and participating in the capacity building of farmers and agricultural extension workers. IER collaborates closely with other international research institutes as the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), the Agricultural Research Centre for International Development (CIRAD, French acronym), the World Vegetable Center AVRDC, the International Livestock Research Institute (ILRI), and the World Agroforestry Centre (ICRAF). An example of a collaborative research project is the CGIAR Research Programme on Climate Change, Agriculture and Food Security's Climate-Smart Village programme which is being implemented in the Segou Region of Mali. In these climate-smart villages, farmers work with researchers and other local partners to test a portfolio of climate-smart technologies and practices in order to generate evidence on their effectiveness as well as the lessons learnt on mechanisms for their scaling.

The National Meteorological Agency (Mali-Meteo) provides daily and seasonal weather forecasts translated in local languages and disseminated through national and private radios.

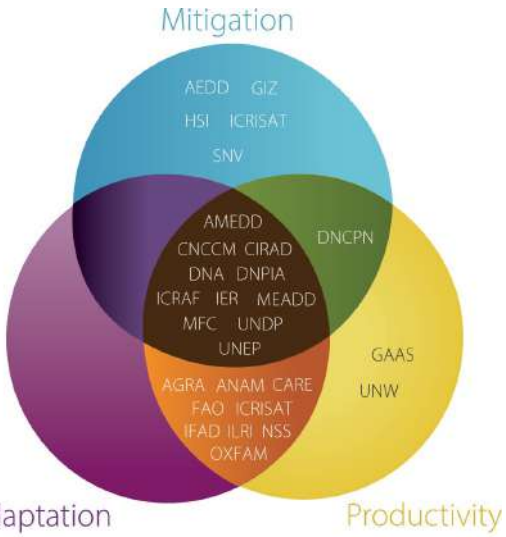
The national science-policy dialogue platform for climate change and food security, known as the CCASA Platform, is established to facilitate dialogue between experts and decision-makers for creating a common vision for agriculture and food security in the context of climate change. Under the chairmanship of the Direction de l'Agriculture (DNA), the coordination of AEDD and the facilitation by the Malian Association of Awakening to Sustainable Development (AMEDD, French acronym), CCASA is now active in regional and international fora related to CSA, such as ECOWAS, NEPAD, UNFCCC and GACSA. The platform was set up in 2012 with support from the CGIAR Climate Change, Agriculture, and Food Security research program (CCAFS). CCAFS has also supported country-wide science-policy dialogues on climate-smart agriculture.

External actors have been actively supporting the government and farmers directly in the promotion and scale out of CSA-related activities at various levels [54]. Together with national and international partners, FAO has been promoting integrated pest management for improved yields through the Integrated Production and Pest Management Programme (IPPMP), with projects that focus on rice and cotton production, reduced use of agro-chemicals, improved farmers' resilience through capacity building (farmers field schools) and livelihoods diversification, as well as mainstreaming of national adaptation priorities in local development plans.

A partnership between USAID, the German Development Bank (KfW), the European Union, the Canadian Government and Malian institutions (the Ministry of Rural Development [MDR], and the National Directorate for Rural Infrastructure [DNGR]) is assisting the implementation of the National Program for Small-Scale Irrigation 2012-2021 (PNIP, French acronym) through small-scale irrigation projects in the Sikasso region in the South. The initiative involves the installation of micro-dams to trap rainfall water in small ponds and supplement water needs for agriculture, livestock and fisheries in times of scarcity [55]. The African Development Fund (ADF) also supports irrigation infrastructure work in the country, particularly the rehabilitation of existing irrigated land and development of value chains for growth-oriented crop sectors (capacity building and technical innovations) (the "Food Security Consolidation through Development of Irrigation Farming (PRESA/DCI)" Project).

The following graphic highlights key institutions whose main activities relate to one, two or three CSA pillars (adaptation, productivity and mitigation).

Institutions for CSA in Mali



AEDD Environment and Sustainable Development Agency **AGRA** Alliance for a Green Revolution in Africa **AMEDD** Malian Association of Awakening to Sustainable Development **ANAM** Mali National Meteorological Agency **CIRAD** Agricultural Research Centre for International Development **CNCCM** Mali National Climate Change Committee **DNA** National Directorate of Agriculture **DNCPN** National Directorate for Conservation and Protection of Nature **DNPIA** National Directorate of Animal Production and Industries **FAO** Food and Agriculture Orgnaization of the United Nations **GAAS** Groupe d'Animation Action au Sahel **GIZ** German Agency for International Cooperation **HSI** Helvetas Swiss Intercooperation **ICRAF** World Agroforestry Centre **ICRISAT** International Crops Research Institute for the Semi -Arid Tropics **IER** Institute for Rural Economy **IFAD** International Fund for Agricultural Development **ILRI** International Livestock Research Institute **MEADD** Ministry of the Environment, Sanitation, and Sustainable Development **NSS** National Seeds Service **SNV** Netherlands Development Organisation **UNDP** United Nations Development Programme **UNEP** United Nations Environment Programme **UNW** UN Women

To confront future food security challenges exacerbated by climate change and to boost economic performances, the Malian government has defined key strategies and interventions to promote CSA objectives. The country ratified the UNFCCC Convention in 1994, the UN Convention on Biological Diversity (CBD) in 1995, the Kyoto Protocol in 1999 and submitted the First, Second and Third National Communications to the UNFCCC [16]. The National Adaptation Programme of Action (NAPA) developed in 2007 identified agriculture and health as priority sectors for investments, highlighting several key areas of intervention, among which: adoption of crop varieties and livestock and tree species adapted to climate change, cereal banks, income diversification through access to loan, gardening, stock rearing and aquaculture, irrigation infrastructure (micro-dams) and agro-meteorological advisory systems.

Mali's NDC specifically mentions the use of "climate-smart and resilient agriculture" practices as well as highlighting forestry, energy and agriculture among the key focus areas for both adaptation and mitigation. FMNR is particularly highlighted as key agroforestry practice. Within agriculture key practices highlighted included, water harvesting and storage, and promotion of resilient pastoralism. The NDC highlights the need for technology transfer and capacity building on issues such as agrometeorology, fodder production, agrometeorology, water harvesting, and improved breeds and varieties.

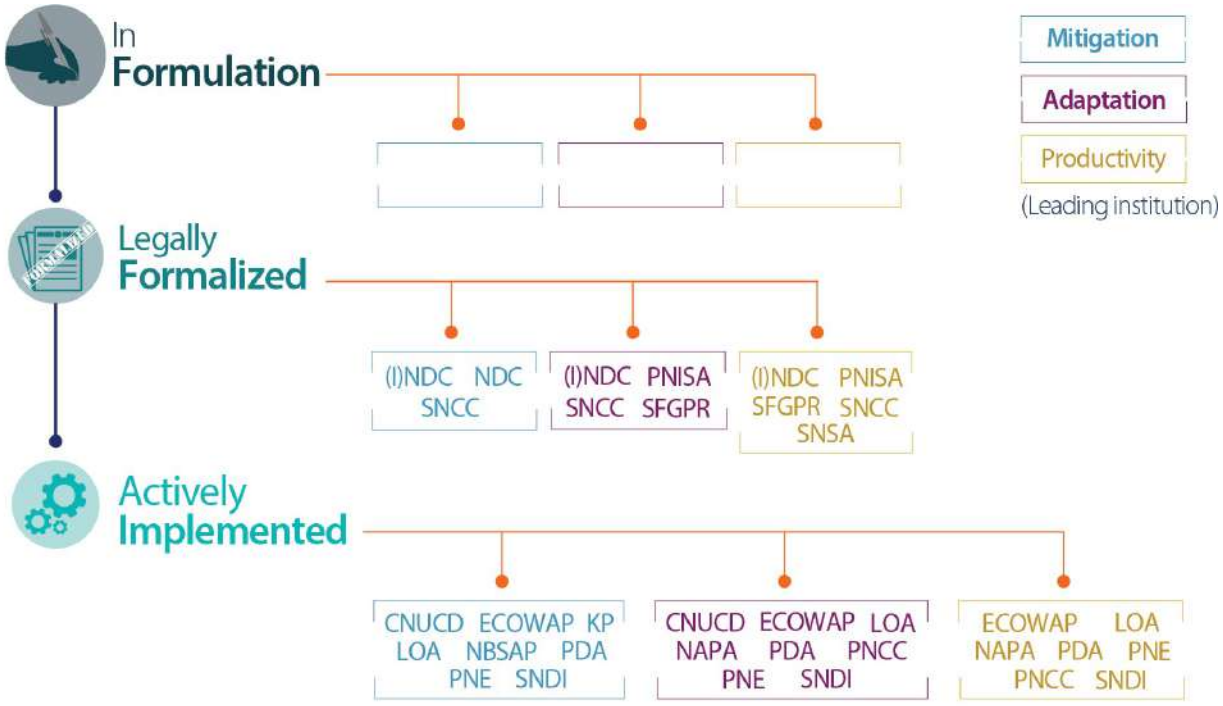
Climate change is also formally mainstreamed into national planning and programming, as evident in several policies and strategies related to agriculture and the environment and aligned to the Strategic Framework for Growth and Poverty Reduction (SFGPR). These include: the National Policy for the Protection of the Environment which focuses on desertification, sustainable natural resource management and food security; the National Agricultural Policy; the National Policy for Land Use Planning; the National Water Policy, which pursue one key objective on the use of water for agricultural adaptation and productivity; the Mali National Agricultural Investment Plan; the National Food Security Plan; and the National Strategy for the Prevention and Management of Disaster Risk (SNPGRC, French acronym), among others. Since 2011, the National Climate Change Policy (PNCC) and the National Climate Change Strategy (SNCC) constitute the framework documents that guide climate action, setting the institutional infrastructure for planning, implementing and coordinating efforts across sectors and stakeholder groups. The SNCC is comprised of eight strategic pillars which include mainstreaming climate change into sectoral policies, capacity building, finance for climate change and engagement of the private sector in the fight against climate change. Within these pillars various actions have been identified and relating to adaptation and mitigation in water, agriculture and forestry such as the reforestation; setting up a research programme on agriculture and climate change; improving weather and climate information systems and promoting their use in agriculture; and climate proofing of the agriculture and forestry sectors; agricultural diversification; sustainable land management; and livestock intensification among others [56].

The National Agricultural Sector Investment Plan (PNISA), is focused around five priority programmes, which include natural resource management and agricultural mechanization, with programmes already having been implemented in areas such as agricultural diversification. Mali's agricultural development strategy is also centered on the "agropoles" concept which emphasizes regional development of agriculture similar to agro-processing zones, and could provide an opportunity for climate-smart value chains and climate-smart agropoles.

The country, with support from the World Bank, has developed a climate-smart agriculture investment plan (CSAIP), in line with the Agriculture Adaptation in Africa initiative (AAA). The CSAIP identifies specific interventions that define on-the-ground action that are consistent with Mali's NDC and national agricultural strategy, which can be funded by public and private sector partners. CSA interventions are designed to increase agricultural productivity, to help farmers, livestock keepers and fisher-people adapt and build resilience to climate risks, and, where appropriate, to reduce greenhouse gas emissions that cause climate change. This plan includes a set of 12 key CSA investments for Mali that were developed with strong stakeholder engagement, expert input and scientific evidence. This plan is not intended to be comprehensive but can further include additional projects when more funds will be available. The plan presents a situation analysis of Mali's national policies, plans and programs in relation to key climate risks, which form the context for key prioritized interventions. Designed project concepts are developed for each of these key investments, including the main project objectives, components and implementation arrangements. These provide a tangible set of project concepts for potential investors and donors to consider for funding [58].

The graphic shows a selection of policies, strategies and programs that relate to agriculture and climate change topics and are considered key enablers of CSA in the country. The policy cycle classification aims to show gaps and opportunities in policy-making, referring to the three main stages: policy formulation (referring to a policy that is in an initial formulation stage/consultation process), policy formalization (to indicate the presence of mechanisms for the policy to process at national level) and policy in active implementation (to indicate visible progress/outcomes toward achieving larger policy goals, through concrete strategies and action plans).

Policies for CSA in Mali



CNUCD United Nations Convention to Combat Desertification (1994) (MEADD) **ECOWAP** ECOWAS Agricultural Policy (2009) (MA) **KP** Kyoto Protocol (1999) (MEADD) **(I)NDC** (Intended) Nationally Determined Contribution (2015) (AEDD) **LOA** Agriculture Orientation Law (2006) (MA) **NAPA** National Adaptation Programme of Action (2007) (AEDD) **NBSAP** National Biodiversity Strategy and Action Plan (2014) (MEADD) **PDA** Agriculture Development Policy (2013) (MA) **PNCC** National Climate Change Policy (2011) (AEDD) **PNE** National Water Policy (2001) (MEE) **PNISA** National Agriculture Sector Investment Plan (2014) (MA) **SFGPR** Strategic Framework for Growth and Poverty Reduction (2013) (MEF) **SNCC** National Strategy on Climate Change (2011) (MEADD) **SNDI** National Irrigation Development Strategy (1999) (MA) **SNSA** National Food Security Strategy (2002) (MEADD)

Financing CSA

Current finance

Costs for implementing the National Climate Change Strategy (SNCC) over the period 2012-2017 amount to US$ 250 million [58], while adaptation and mitigation activities in the agricultural sector - as outlined in the country's INDC - expected to cost another US$ 20.6 billion by 2030, indicating a need to tap into new public and private financing opportunities to help achieve the desired targets [33].

Major funders of climate-smart agriculture related work in Mali include the GEF, for which the country has accessed funds for projects related to improved hydrometeorological information and integration of climate change adaptation into the agricultural sector (US$2.2 million project implemented by FAO); reversing deforestation through reforestation (The Great Green Wall for the Sahara and The Sahel project, also supported by the World Bank and the European Union), supporting agroforestry and sustainable land management among others[3]. Mali's first project to the GCF focuses on putting in place a hydro-meteorological (hydromet) system to improve food security, protect livelihoods and inform infrastructure development[4]. The project has a budget of US$27.3 million with the GCF providing $22.8 million of this and the World Bank and the Government of Mali providing US$2.5 million and US$2 million respectively. Key challenges noted for scaling up the implementation of activities indicated in Mali's NDC include the availability of long-term large-scale finance as well as availability of technologies.

Bilateral donors such as the United States Agency for International Development (USAID), have also contributed to various food security and resilience related projects.

Climate finance is channeled through the Mali Climate Fund (MCF), a mechanism set up in 2012 to mobilize and anchor bilateral, multilateral, public and private financing and

3 https://www.thegef.org/projects?f[]=field_country:102

4 https://www.greenclimate.fund/-/gcf-spotlight-on-mali

align these to the SNCC. The MCF is expected to improve coordination of budgets and technical interventions on the field, incentivizing innovative partnerships and investments in key areas: improved research capacity to assess vulnerability to climate change, improved water supply for multiple uses, enhanced food production and promotion of CSA practices, livelihoods diversification and promotion of renewable energy. UNDP acts as the administrator and distributor of the funds, while the secretariat is ensured by AEDD. A Steering Committee formed of representatives of the stakeholder groups (government, donors, civil society) takes decisions over resource allocation and re-distribution [58].

Up to 2015, the MCF had mobilized US$ 7.29 million from the Governments of Norway and Sweden, targeted towards agriculture, livestock and fisheries (US$ 1.6 million[5], with a 39 percent execution rate) and water management. Political instability, heavy bureaucracy and insufficient human resources for managing fund-related processes have stalled significantly the functioning of the MCF [59].

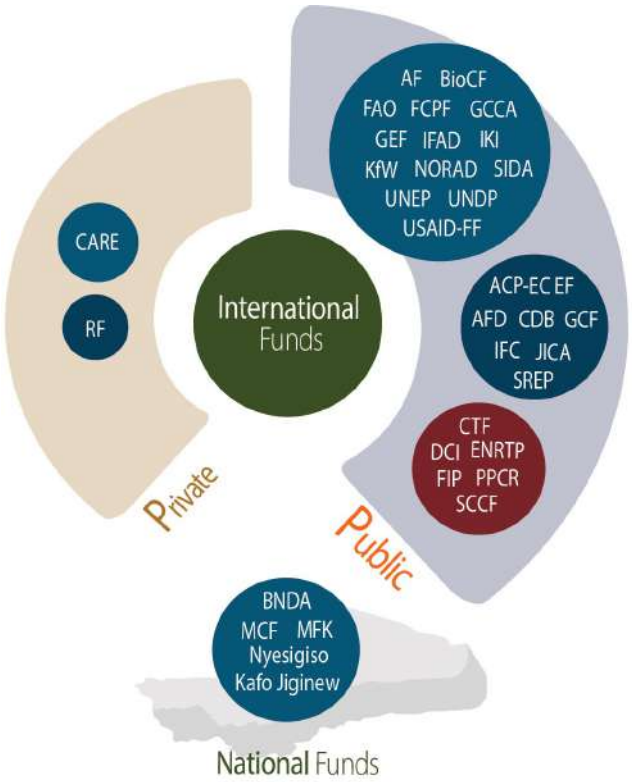
Potential finance

Microfinance for smallholder investment in climate-smart practices is limited. It has been estimated that for 70 percent cases, farmers in Mali are refused an agricultural loan on the ground, the reason being that such investments are too risky, given unpredictable weather, irregular planting seasons, low yields, unclear land tenure regimes, insufficient knowledge to apply for credit, and risk related to repayment of loans [60]. Greater focus could be placed on microfinance and private sector finance for agricultural adaptation and mitigation in the country.

Between 2004 and 2010, Mali was one of the few African countries that consistently allocated more than 10 percent of national budget to the agriculture sector[6], as per the Maputo declaration and CAADP recommendations. However, from 2010 public expenditure on agriculture dropped significantly reaching as low as 5% in 2015. The NDC has a renewed call for the Government to commit 15 percent of its budget towards agriculture, while the Mali National Agricultural Investment Plans (NAIP) calls for a target of 20 percent by 2020. This ambitious target will be important in complementing the international climate finance being accessed by the country and helping to catalyze national and private sector investments in the agriculture sector.

The graphic highlights existing and potential financing opportunities for CSA in Mali. The methodology and a more detailed list of funds can be found in Annex 2.

Financing opportunities for CSA in Mali



ACP-EC EF African, Caribbean and Pacific - European Commission Energy Facility **AFD** French Development Agency **AF** Adaptation Fund **BioCF** BioCarbon Fund **BNDA** National Agriculture Development Bank **CARE** Cooperative for Assistance and Relief Everywhere **CDB** China Development Bank **CTF** Clean Technology Fund **DCI** Development Cooperation Instrument **ENRTP** Environment and Sustainable Management of Natural Resources Thematic Programme **FAO** Food and Agriculture Organization of the United Nations **FCPF** Forest Carbon Partnership Facility **FIP** Forest Investment Program **GCCA** Global Climate Change Alliance **GCF** Green Climate Fund **GEF** Global Environment Facility **IFC** International Finance Corporation **IFAD** International Fund for Agricultural Development **IKI** International Climate Initiative **JICA** Japan International Cooperation Agency **KfW** German Development Bank International Climate Initiative **MCF** Mali Climate Fund **MFK** Mali Folk Center Nyetaa **NORAD** Norwegian Agency for Development Cooperation **RF** The Rockefeller Foundation **PPCR** Pilot Program for Climate Resilience **SCCF** Special Climate Change Fund **SIDA** Swedish International Development Cooperation Agency **SREP** Scaling up Renewable Energy Program **UNDP** United Nations Development Programme **UNEP** United Nations Environmental Programme **USAID-FF** United States Agency for International Development – Feed the Future

5 The sum was allocated to 2 projects: Support Program for Sustainable Agriculture and Resilience to Climate Change in Yanfolila (PAADRCY) and Land Reclamation and Agricultural Productivity Program (RTA) - "Land, Our Future"

6 https://agra.org/wp-content/uploads/2017/12/agra-mali-final.pdf

Outlook

Mali is making great progress in creating the enabling policy environment for agricultural development as well as the integration of climate change adaptation and mitigation into agricultural plans and policies. This includes the development of the PANA, the SNCC and the NDC, all of which mention the importance of agricultural adaptation and mitigation, and even specifically mentioning the need for climate-smart practices. Every effort must be made to ensure resources are availed and directed towards these CSA-related policies, and to support the capacity of the various institutions operating and aiming to implement CSA in the country. The CSAIP with its 12 investment project ideas is a key tool that can support the deployment of concrete projects in the ground.

The Mali Climate Fund also presents a huge opportunity for aggregating climate finance from various sources and directing it to agricultural practices deemed to be most climate-smart. Private sector engagement in climate finance for agriculture needs to be enhanced and a detailed CSA private sector engagement strategy could be of use.

Given that Mali's agricultural development strategy is centered on the "agropoles" concept there is need to ensure that investments in these growth poles integrate climate-smart practices to support long term resilience and productivity as well as low emissions development in the agriculture sector. A detailed assessment of the climate-smartness of planned agropole investments could assist in this regard.

Mali has a highly variable rainfall regime, that results in difficulty of measuring trends over time. However, projected changes in precipitation and temperature are expected to impact significantly crop yields in both drier and wetter regions of the country. Model simulations predict a decrease in yield of the major food crops produced in the country, namely millet/sorghum, maize and rice, as well as a reduction in the availability and quality of fodder and water resources, affecting particularly pastoralists.

Mali is still largely a dry and semi-arid country that is threatened by desertification. CSA related efforts need to take advantage of the need to reverse desertification and land degradation, by focusing efforts on integrated landscape and rangeland management that incorporates issues of agroforestry, pasture and rangeland management, water availability for both crops and livestock and early warning.

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