Food and Agriculture Organization of the United Nations

Climate resilient practices

Typology and guiding material for climate risk screening

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Typology and guiding material for climate risk screening

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Contents

Introduction 1

1 Cropping systems 2-9

2 Livestock systems 10-12

3 Forest systems 13-15

4 Fisheries, aquaculture and international waters 16-17

5 Biodiversity 18-19

6 Climate resilient practices along food value chains 20-25

7 Governance on climate change mitigation and adaptation 26-28

Bibliography 29-30

Introduction

A key element required for sustainable and transformational development in agriculture is ensuring that investments are informed by robust evidence about past and future climate risks. Climate resilience is a fundamental concept of climate risk management. In this context, resilience refers to the ability of an agricultural system to anticipate and prepare for, as well as adapt to, absorb and recover from the impacts of changes in climate and extreme weather. Resilience can be enhanced by implementing short and long-term climate mitigation and adaptation strategies, as well as ensuring transparent and inclusive participation of multiple actors and stakeholders in decision-making and management processes. Some hydro-meteorological hazards are slow in their onset, such as changes in temperature and precipitation resulting in long-term altered temperature, rainfall patterns and agricultural droughts. On the other hand, some occur much more suddenly, such as tropical storms and floods. Both require robust risk preparedness informed by the assessment of climate risk.

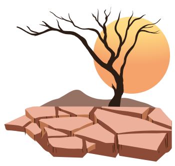
The objective of this publication is to support the climate risk screening of agricultural investment projects. Climate risk is based on the exposure, main climate hazards, vulnerabilities and the adaptive capacity of the agricultural, social, and ecological systems targeted by a given project. The climate risk screening includes recommendations and climate resilient measures to address the risks identified at the earliest stages of the investment project cycle.

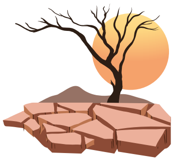
A compendium of climate resilient practices is presented to assist project developers and relevant stakeholders to consider enhanced climate resilient measures and address the hazards identified in the climate risk screening. This manual is intended to be a first reference point to guide climate resilient, technical practices and governance strategies and to inform multi-risk analysis and local level consultations. During project design, the identified practices are matched to context-specific environmental and climatic conditions, considering agricultural, social, and economic assets, while also acknowledging the potential technical, economic barriers and limitations of each measure. References with further details on specific practices are also provided in this guidance document.

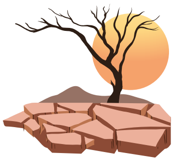
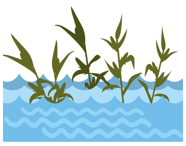
The practices outlined are organized by agricultural sub-sectors and focal areas, as follows: crops, livestock, forestry, fisheries and aquaculture, biodiversity, value chains and governance. The most suitable climate resilient practices will depend on the hazard risk, exposure and vulnerability observed during the climate risk screening process. While the measures provide a reference point for project development teams, the full integration of resilience measures in investment projects will require further assessment and consultation during project design.

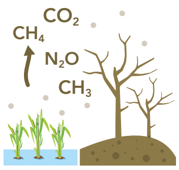
1 CROPPING SYSTEMS

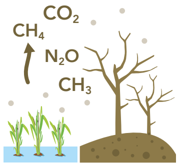
HAZARDS	PRACTICES	DESCRIPTION AND ADAPTATION/MITIGATION BENEFITS
 EXTREME HEAT	Heat tolerant crops (e.g. quinoa, pearl millet, sorghum) or crop varieties	■ Promote crops and/or crop varieties with a higher heat tolerance and/or optimal heat range. ■ Enhance yields in areas where temperatures are expected to exceed heat thresholds that are harmful to existing cropping systems.
	Short cycle varieties	■ Reduce the effect of heat stress at key phenological phases (germination and flowering) and improve final yields. ■ Reduce plants' exposure to heat by shortening the growing cycle. ■ Reduce the total water requirements during the growing season.
	Optimizing crop calendars	■ Optimal crop calendars based on historical climate data and seasonal forecasts support decision-making, avoiding heat-stress conditions at crop's sensitive phenological phases, and increasing yields.
 WILDFIRE	Firebreaks (e.g. rock walls, roadways, high moisture and low resin plants, flame-retardant plants)	■ Limit the spread and impact of wildfires on crops. ■ Reduce social, environmental, and economic losses deriving from wildfires. ■ Decrease air pollution by reducing black carbon emissions.
STRONG WINDS	Windbreakers	■ Rows of trees can protect crops by breaking strong winds, reducing soil erosion, increasing crop yields, and protecting livestock from heat and cold conditions.
 COLD, FROST & HAIL	Frost protection (e.g. plant row covers, irrigation, anti-frost candles, mulching, wind machines)	■ Row covers increase downward long-wave radiation at night and reduce heat losses by convection and advection. ■ Frost protection irrigation allows the release of latent heat fusion when water turns into ice, protecting the plant's canopy from extreme cold temperatures. ■ Anti-frost candles can increase the air temperature ad reduce the plant's exposure to frost. ■ Low or walk-in tunnel greenhouses warm the soil and protect plants from frost and wind. ■ Canopy cover can provide protection against frost damages by reducing net radiation losses.

HAZARDS	PRACTICES	DESCRIPTION AND ADAPTATION/MITIGATION BENEFITS
 COLD, FROST & HAIL	Frost protection (e.g. plant row covers, irrigation, anti-frost candles, mulching, wind machines)	■ Soil covering with mulching and/or other materials increases the surface temperature. This is most applicable for small farms (e.g. gardens or small orchards), where other protection methods are unavailable. ■ Wind machines redistribute sensible heat that is already present in the air.
	Early warnings	■ Alerts and advisories tailored to farmers' needs forecasting potential frost times support decision-making on frost damage, while considering farmers' traditional knowledge and management practices.
	Optimizing crop calendars	■ Select crop practices based on timing of sensitive stages and critical damage temperature (Tc) relative to the probability and risk of sub-zero temperatures. ■ For annual field and row crops, it is important to determine the planting date for minimizing the potential of sub-zero temperatures. Field and row crops can be planted in protected environments and be transplanted to the field after the risk of frost has passed. ■ For deciduous and subtropical crops, it is important to detect critical temperature thresholds at early growing stages.
	Hail protection nets and greenhouses	■ Reduce crop damage and loss by buffering the impact of hail on crops. ■ Protection from bird predation.
 DROUGHT	Agroforestry	■ Through carbon sequestration, agroforestry has the potential to offset greenhouse gas (GHG) emissions from the agricultural sector. ■ Root systems stabilize the ground and reduce soil erosion. ■ Improves soil health by increasing soil organic matter, nutrient availability and microbial activity. ■ Leaves from trees enrich the soil and help keep soil moisture, contributing to efficient and self-sufficient use of water. ■ Canopy cover reduces evaporation from direct sunlight and by decreasing air and soil surface temperature. ■ Other co-benefits of agroforestry include: sustainable firewood, timber, fodder for animal feeding, and medicinal uses. Fodder trees can also be grown as a substitute or supplement to a basal diet including crop residues.

HAZARDS	PRACTICES	DESCRIPTION AND ADAPTATION/MITIGATION BENEFITS
 DROUGHT	Agronomic practices (e.g. weeding, harrowing, grafting, mulching)	■ Weeding and defoliation reduce soil water losses from plant transpiration. ■ Cover crops reduce soil erosion by increasing soil organic matter, water, air, and nutrient availability. ■ Harrowing (breaking the soil into small fragments) can prevent the loss of land moisture by evaporation. ■ Grafting techniques can reduce yield losses caused by drought. ■ Hydroponics with re-circulating water systems can reduce water losses. ■ Covering the soil with crop residues (mulching) in combination with no-tillage reduces the exposure of crops to heat-stress conditions. It also increases soil moisture by reducing direct soil evaporation.
	Half-moons	■ Improve the efficiency of fertilizers by adding the required amount of nutrients to a planting hole instead of spreading them over the entire field area. ■ Reduce soil erosion, increase macronutrient deposition and infiltration by reducing surface runoff.
	Zaï pit systems	■ Improve the efficiency of fertilizers by adding the required amount of nutrients to a planting pit instead of spreading them over the entire field area. Reduce soil erosion, increase macronutrient deposition and infiltration by reducing surface runoff. ■ Increase water infiltration rates as water is trapped in the pits close to the root systems of crops. ■ Protect the main stem and branching system of crops by reducing the area exposed to strong winds.
	Terracing	■ Reduces soil erosion, increases macronutrient deposition and infiltration by reducing surface runoff.
	Drought tolerant crops (e.g. sesame, millet, sorghum, quinoa)	■ Crops with low water requirements reduce evapotranspiration losses during photosynthesis by rapidly closing their stomata and maintaining leaf water potential and photosynthetic rate. ■ Enhance food production during the dry season when food insecurity levels are highest.

HAZARDS	PRACTICES	DESCRIPTION AND ADAPTATION/MITIGATION BENEFITS
 DROUGHT	Drip irrigation systems	■ Increase water-use efficiency by providing sufficient water according to the crop. ■ Partial-root zone drying (PRD) maximizes water use efficiency by adding water only on half of the root zone. ■ Reduce soil erosion and macronutrient losses from leaching. ■ Promote weed control as water is locally applied. ■ Reduce the risk of diseases that occur under damp conditions.
	Programmed irrigation	■ Uses water resources more efficiently and avoids permanent wilting point as well as field capacity. ■ Reduces losses from direct evaporation by providing water when evaporation rates are lowest (dawn and/or dusk). ■ Promoting irrigation at dawn and dusk reduces direct soil evaporation, making better use of water resources.
	Small scale reservoirs	■ Increase water availability to counteract the impacts of drought shocks. ■ Provide supplemental irrigation on rainfed fields.
	Reuse of treated waste water, desalinated water	■ Brings additional nutrients to the plants and enhances yields. ■ Increases water use efficiency and promotes sustainable withdrawal and supply of freshwater to address water scarcity.
 FLOODING AND WATERLOGGING	Raised bed system	■ Removes excess water during plant growth by better draining the water retained in the soil. ■ Promotes optimal growth of root systems through soil aeration. ■ Improves soil structure by limiting the compaction from human feet.
	Field dredging	■ Removes excess water during plant growth, reduces soil erosion and prevents the development of fungal diseases. ■ Efficient drainage systems control excess soil water and accumulation of excess salts in the crop's root zone. ■ Decreases the prevalence of important water-related diseases that affect human, plant and animal health. ■ Organic matter applications improve soil structure and avoid soil compaction.

HAZARDS	PRACTICES	DESCRIPTION AND ADAPTATION/MITIGATION BENEFITS
 **LAND DEGRADATION AND GREENHOUSE GAS EMISSIONS**	Agronomic (e.g. sub-soiling)	■ Sub-soiling can break possible hard pans and improve soil aeration. ■ Introduction of root crops (e.g. horseradish) for deep root penetration and soil structure improvement.
	Early sowing, vigorous, and strong root crops	■ Reduce the impacts of excess water at early growing stages. ■ Cultivars with a higher geotropic root angle (roots that develop horizontally) exploit a soil zone that is less saturated with water.
	Legumes (e.g. groundnuts, soybean and cowpea)	■ Fix nitrogen in the soil and allow the plant to produce leaves fortified with nitrogen that can be recycled by the plant. This allows the plant to increase its photosynthetic capacity, which in turn results in nitrogen-rich seeds. ■ Increase organic matter in the soil by storing carbon. ■ Green manure increases organic matter content, nitrogen content and soil water retention.
	Crop rotation, crop association and fallow	■ Increase soil fertility as each crop has different nutrient requirements and plant-soil dynamics. ■ Increase crop yields with the diverse nutrient availability. ■ Reduce soil erosion and prevent nutrients from being washed away by wind or water (through an increase in crop cover). ■ Limit concentration of pests and diseases and lower selective pressure on pathogens (as each crop has different pathogens). ■ Reduce fertilizer use and associated pollution by improving nutrient cycling. ■ Increase soil carbon sequestration.
	Grass strips	■ Reduce soil erosion and nutrient losses in steep areas. ■ Increase water infiltration by reducing surface runoff.
	Mulching	■ Increases soil moisture by reducing losses from direct evaporation. ■ Reduces weed growth by keeping light from reaching the soil surface. ■ Moderates soil temperatures by keeping the soil warmer during cold nights and cooler in hot days. ■ Reduces irrigation requirements by reducing losses from direct evaporation.

HAZARDS	PRACTICES	DESCRIPTION AND ADAPTATION/MITIGATION BENEFITS
 LAND DEGRADATION AND GREENHOUSE GAS EMISSIONS	Minimum tillage or zero-tillage	■ Promotes minimum disturbance of soil structure and organic matter found in the soil by increasing the decomposition of plants in-situ. ■ Higher infiltration caused by the vegetation present in the soil. ■ Organic matter increases and enhances the cycling of nutrients. ■ Less resistance to root growth due to improve structure, allowing crops to germinate and develop faster with additional soil moisture. ■ Reduces soil evaporation as plant residues increase soil moisture.
	Crop residues in combination with reduced and no-tillage	■ Increase water availability for crop production by improving infiltration and evaporation from the top layer and improving soil structure and moisture. ■ Increase soil organic matter content and microbial activity present in the soil. ■ Reduce soil evaporation as plant residues increase soil moisture.
	Bio-fertilizers	■ Application of living organisms to seeds, plant surfaces and/or soil. ■ Reduce the environmental impacts (from volatilization and leaching) from chemical fertilizers which have a high macronutrient concentration. ■ Improve nutrient availability for plants and increase yields.
	Split fertilization	■ Reduces fertilizer use and avoids leaching and volatilization. ■ Increases uptake efficiency by crops. ■ Reduces risk of ground and surface contamination.
	Wetting/Drying rice	■ Reduces rice water requirements by 30 percent. ■ Reduces CH_4 emissions by 48 percent. ■ Reduces weed development by reducing water inputs necessary for the expansion of weeds.
	Carbon fixation in C3, C4, CAM plants	■ Elevated CO_2 can increase biomass production and the physiological efficiency of water use by crops and weeds. ■ C3 plants (e.g. wheat and rice) tend to benefit more (in terms of seed yield and biomasss) from high CO_2 concentrations than C4 plants (e.g. maize).
	Machine transplanting	■ Seedlings are nursed 12-15 days in advance (e.g. rice). ■ Reduces cultivation time and improves water use efficiency.

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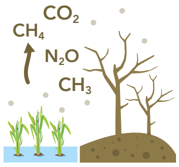
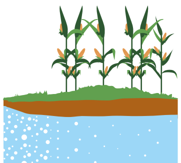
 **LAND DEGRADATION AND GREENHOUSE GAS EMISSIONS**	Direct seeding into crop residues	■ Direct seeders can accurately place seeds through crop residues without any tillage, therefore keeping the soil structure intact, and increasing the soil organic matter content.
	Site-specific nutrient management	■ Provides economic benefits for farmers from lower input costs (fertilizers) and yield enhancements. ■ Reduces GHG emissions (N2O) through a more efficient use of nitrogen.
	Remote and proximal optical sensors (e.g. Green Seeker and SPAD-502, Canopeo App.)	■ Optimize crop nitrogen inputs and reduce farming inputs. ■ Reduce environmental impacts (deriving from volatilization and leaching) by optimizing fertilization rates and timing of application ■ Crop yields and biomass can be estimated during the growing season (e.g. rice).
 **SALINIZATION**	Primary salinization management (from saline water)	■ Promotion of halophyte crops. ■ Well sitting: avoid well drilling (< 50m) close to the sea. ■ Well depth: avoid drilling excessively deep in coastal areas. ■ Monitoring: quality of water during drilling to avoid excessive salinity. ■ Close wells or reduce drawing to reduce groundwater contamination and the vertical movement of saline water. ■ Form a straw barrier to reduce salt content in the cultivated layer by burying chopped straw approximately 30-40 cm deep in saline-alkali soil with the use of special machinery. This technique has significant salt control and salt suppression effects and increases water storage and moisture retention. It can also improve soil structure, enhance soil fertility, and promote microbial activity.
	Secondary salinization management (from intensive agriculture)	■ Promotion of halophyte crops and soil-less cultivation. ■ Use of saline resistant varieties and grafting techniques in traditional crops. ■ Water supply should include the leaching fraction (LF) for washing away salts from the root zone due to secondary salinization. ■ Seed bed management and field grading to minimize local accumulations of salts. ■ Proper maintenance of irrigation systems and better tuning of irrigation scheduling.

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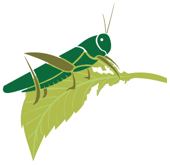
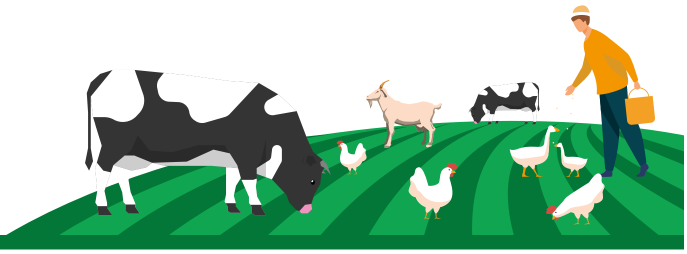
 PESTS AND DISEASES	Biological control	■ Natural enemies (insects) are introduced in the environment and can sustain themselves by feeding from pests affecting the crop. ■ Use beneficial entomopathogens to reduce the need for chemical pesticides. ■ Reduces the need for chemical fertilizers, as well as herbicides and pesticides.
	Crop rotations	■ Limit concentration of pests and diseases and lowers selective pressure of pathogens (as each crop has different pathogens).
	Bio-pesticides (e.g. Neem oil-based insecticide for hornworms, mildews)	■ Can be used as a fungicide and pesticide. ■ Reduce the environmental impacts as they are organic and biodegradable. ■ Do not create "death zones" that can kill beneficial insects. ■ Reduce the negative effect on human health associated with chemical pesticides.
	Pheromone traps	■ Pheromone traps lure pests by mimicking potential mates.
	Integrated Pest Management (IPM)	■ Sampling, scouting and monitoring systems for a proper early identification of pests. ■ Plant quarantine and 'cultural techniques' e.g., removal of diseased plants, and cleaning pruning shears to prevent spread of infection. ■ Association with other plants that deter insects, e.g. lemon grass, can reduce pests on leafy vegetables, e.g. relay inter-cropping of tomatoes and cabbage. ■ Beneficial fungi and bacteria are added to horticultural crops vulnerable to root diseases. ■ Management of unacceptable level of infestation through mechanical methods such as handpicking, barriers, traps, vacuuming and tillage can disrupt pest breeding. ■ Resistant crop varieties and grafting to suppress insect pest management. ■ The use of anti-insect nets limits the spread of pests. ■ Removal of weeds that are host of pest and diseases. ■ Cultural practices such as pruning, trellising, monitoring sticky traps, planting density.

2 LIVESTOCK SYSTEMS



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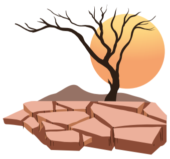
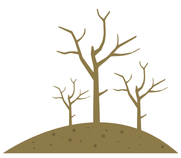
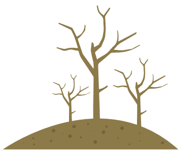
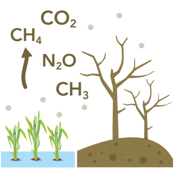
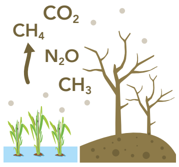
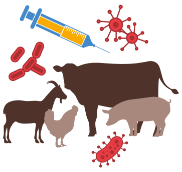
 DROUGHT AND HEAT	Water reservoirs and basins	■ Optimize water resources by reducing the exposure to drought and heat-stress conditions. ■ Limit the movement of cattle and reduce overgrazing. ■ Reduce transhumance time by placing water along transhumance corridors.
	Adapted cattle breeds, heat tolerant breeds (e.g. gyr cattle in the tropics)	■ Use of breeds with lower water intake requirements can reduce animal mortality and optimize the use of water resources. ■ Reduce animal mortality by minimizing animal's exposure to drought and heat stress conditions. ■ Ensure high productivity under heat and drought stress-conditions.
	Switching livestock species (e.g. camel or smaller animals)	■ Promote thermo-tolerant livestock capable of withstanding dry conditions for numerous days. ■ Contribute to diversifying livelihoods under changing climatic conditions. ■ Lowers water requirements from animals.
	Shelter (e.g. agroforestry, barn, stables)	■ Tree shelterbelts can reduce the exposure of livestock to heat-stress conditions and therefore reduce animal mortality.
	Pastoral water points	■ Limit overgrazing by reducing animal displacement. ■ Reduce the exposure of animals to heat-stress conditions and therefore reduce animal mortality.
 LAND DEGRADATION	Transhumance corridors	■ Increase and preserve vegetation cover by limiting grazing to specific zones. ■ Contribute to soil formation, soil fertility, pest and disease regulation, biodiversity conservation and fire management. ■ Improve management of forage resources. ■ Limit potential conflicts amongst herders and farmers. ■ Reduced stocking density will limit soil compaction, thereby facilitating more rapid infiltration during precipitation events and potentially reducing peak flows and sediment runoff.

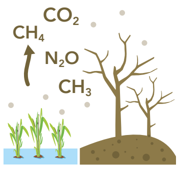
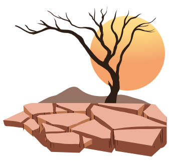
HAZARDS	PRACTICES	DESCRIPTION AND ADAPTATION/MITIGATION BENEFITS
 LAND DEGRADATION	Rotational grazing	■ Increases forage production by minimizing overgrazing of some plants in the pastureland. ■ Improves soil fertility and reduces soil compaction, which in return increases water absorption. ■ Allows a higher number of animals to feed on the same surface. ■ Improves animal management during droughts and prevents animals from eating all the forage before the arrival of rains.
	Ex-closures	■ Reduce pressure on natural resources (hay and water) by supporting the regeneration of native species. ■ Minimize land degradation from soil compaction.
	Reduced herd size	■ Minimizes soil erosion and limits overgrazing by controlling the number of animals per unit of land.
	Silvopastoral systems (crop-livestock)	■ Incorporating trees into grazing land enhances carbon storage above and below ground. ■ Improve cattle's diets with complementary tree by-products. ■ Improve soil fertility and natural fertilizers. ■ Limit the expansion of weeds through periodical grazing. ■ Diversify farm income losses.
	Cut and carry fodder system	■ Reduces grazing pressure, limits conflicts over livestock as local communities harvest grass within the ex-closure ■ Carry back the fodder to the homestead areas where the livestock are kept.
 LAND DEGRADATION AND GREENHOUSE GAS EMISSIONS	Sustainable management strategies	■ Reduce enteric CH_4 emission by extending the lactation period, reducing the number of animals, improving nutrition and grassland management, animal breeding, and promoting alternative livestock systems.
	Manure Management	■ Use manure for biogas production and as bio-fertilizer. Shortens storage time in farms, reduces CH_4 emissions.
	Nutritional strategies	■ Reduce enteric CH_4 emission through plant breeding, improvement of forage quality, diet supplementation (including concentrate, oil, and tannic acid), enzymes and probiotics, and diet modification. Grass or leaves from specific trees that reduce CH_4 emissions may also have unintended undesirable effects, such as reduction in N in the manure that is used as a fertilizer.

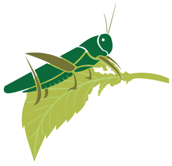
HAZARDS	PRACTICES	DESCRIPTION AND ADAPTATION/MITIGATION BENEFITS
 LAND DEGRADATION AND GREENHOUSE GAS EMISSIONS	Rumen manipulation	■ Reduces enteric CH_4 emission through biological control using predators for methanogens, antibiotics, and bacteriophages (selectively kill rumen methanogens).
	Advanced strategies	■ Reduce enteric CH_4 emission through bacteriophages, chemical defaunation, and reductive acetogenesis.
 ANIMAL DISEASES	Vermin control measures (e.g. flies, rats, fleas, cockroaches)	■ Promote animal health and reduce mortality. For instance, installing door sweeps, store feed bags on pallets, screening materials, caulk, vermin traps and disinfectant are among the most effective measures for controlling/preventing and/or eliminating the presence of pests in the animal's environment.
	Managing livestock	■ Improves livestock feed. For instance, through feed ration improvement, residues valorization, supplementary forage sources, and additional wood production.
	Adequate animal spacing	■ Reduces probability of disease outbreak.
	Managing	■ Maintains the quality of fodder.

FAO Livestock Sector Coordinator, Khalid Saeed vaccinates Mahal Abdillahi Mohamed's goats against parasites and treats them for other diseases, near the village of Bandar Beyla, Puntland, Somalia. *©FAO/Karel Prinsloo*

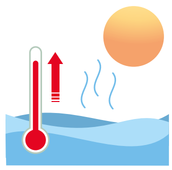
3 FOREST SYSTEMS

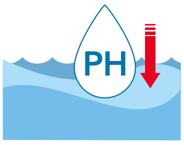
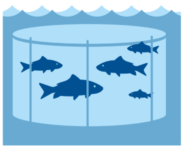
HAZARDS	PRACTICES	DESCRIPTION AND ADAPTATION/MITIGATION BENEFITS
 FOREST DEGRADATION	Forest inventory	■ Promotes sustainable forest management by providing critical information about the status of forests including: forest growing conditions, standing timber volume (diameter and height), forest stock resources, resource planning, estimate annual growth, forest composition, wildlife population, assessment of potential fire hazard and carbon sequestration of the forests. ■ Supports effective and efficient forest planning.
	Controlled timber harvesting	■ Increases carbon storage of forests by allowing the regeneration and growth of the vegetation beneath. These openings can be created by harvesting over mature and/or low quality trees. ■ Promotes sustainable management of forests by balancing harvesting of timber and non-timber products, having a lower impact on forest ecosystems and preserving biodiversity. ■ Reduces the effect of competition among desirable trees.
	Veld management	■ Stabilizes and conserves the topsoil through perennial grasses. ■ Limits overgrazing.
	Forest management	■ Reduces the risk of fire by selectively removing trees and clearing undergrowth.
	Forest thinning	■ Enhances the growth of healthier and younger trees. ■ Reduces the vulnerability of the forest to disease and insect attacks. ■ Reduces the area affected by natural hazards (e.g. strong winds) and fires. ■ Enhances forest biodiversity (e.g. lichen communities). ■ If the removed parts are left on the ground, they work as mulching and improve the capacity of forests as a source of water.
	Payments for ecosystem services (PES)	■ PES policies compensate individuals or communities for undertaking actions that increase the provision of ecosystem services. There are multiple benefits of PES including: ■ Promote carbon sequestration and limits GHG emissions. ■ Preserve natural resources, wildlife biodiversity. ■ Reduce soil erosion.

HAZARDS	PRACTICES	DESCRIPTION AND ADAPTATION/MITIGATION BENEFITS
 FOREST DEGRADATION	Payments for ecosystem services (PES)	■ Generate income from ecotourism and/or other by-products (e.g. medicinal plants). ■ Regulate climate and improve water quality. ■ Reduce risk of fire. ■ Generate employment.
	Changes of species and genetic management	■ Provides a good alternative in case natural evolution of the present species is too slow in relation to the adoption of these new species.
 LAND DEGRADATION AND GREENHOUSE GAS EMISSIONS	Reforestation, regeneration and afforestation	■ Promote carbon sequestration. ■ Enhance existing biodiversity. ■ Reduce soil erosion. ■ Increase soil and air moisture. ■ Reforestation in near and/or in cities can limit heat island effect besides having a recreational role.
	Controlled fires	■ Mitigate large-scale fires by dead trees, tree branches and other residues, reproducing the benefits of periodic and small natural fires. ■ Create more space for young trees to grow. ■ Increase soil nutrient through residues of burnt vegetation. ■ Reduce the probability of releasing carbon stored in forests into the atmosphere.
 DROUGHT	Change of species and genetic management	■ Provide a good alternative in case natural evolution of the present species is too slow in relation to the adoption of these new species.
	Selection of traits and provenances	■ Promotes sustainability and biodiversity to enhance resilience to dry conditions.
	Mixed and uneven-aged stands and forest conversion	■ Species with different rotation periods offer advantages as they allow greater diversity of structure. They also react differently to rain interception and soil quality. ■ Enhance resilience to drought by avoiding clear-cut logging and preserving the forest biome.
	Afforestation and reforestation techniques	■ Plantation design, election of stand structure and silvicultural treatments should be adapted to the expected new drought conditions.
	Sustainable forest management for soil and water conservation	■ Preserves water storage properties. ■ Thinning regimes have to be reevaluated from a water-saving point of view.

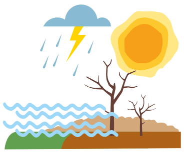
HAZARDS	PRACTICES	DESCRIPTION AND ADAPTATION/MITIGATION BENEFITS
 PEST AND DISEASES	Integrated Pest Management (IPM)	■ Supports early pest detection, for instance, by monitoring the competition levels among trees and other plants as well as the types, quantities and location of weeds. ■ Identifies which pests are present, how much damage has occurred, how much damage is likely to occur if no control measures are taken. ■ Identifies threshold levels to determine whether control measures have to be applied to mitigate damages.
	Do nothing	■ Applied in situations where the pest does not damage the crop value, or the crop value is so low that is not cost effective to apply a control measure.
	Cultural management (e.g. selective pruning and planting resistant varieties)	■ Reduces the likeliness of a pest to survive, colonize, grow or develop through site selection. ■ Planting resistant varieties reduces need for pesticide use and avoids exotic species. ■ Selective pruning is an effective method to control pests.
	Mechanical management	■ Excludes or removes the pest from the habitat by introducing mechanical traps, screens, fences and nets that can remove the pest or prevent its access. ■ Tillage and mowing are also used to mechanically manage the weeds. ■ Other mechanical control measures include: rising or lowering temperatures to those lethal to the target pests, reducing moisture content of grains by drying them, and/or using Ultra-Violet or infrared radiation. For small farms, hand picking, shaking plants, and crushing can be a cheap and sustainable preventive method.
	Biological management	■ Biological controls include the beneficial predators, parasites and pathogens that kill pests. There are different types of biological controls: classical biological control (introduction of an exotic biological control for permanent establishment and long-term pest control), augmentative biological control (use of low densities of biological control agents to first establish in the crop and afterwards suppress the potential populations), conservation biological control (use of nectar-producing plants in the edges of cropland to support carbohydrate sources and provide shelter for both pollinators and biological control agents).
	Natural pesticides	■ Allow the reduction, delay or elimination of pesticide treatment of a minor pest problem. ■ Knowledge of the pest's life cycle, selection of an appropriate pesticide, proper timing of the application, and use of the right application equipment will improve coverage and effectiveness.

4 FISHERIES, AQUACULTURE AND INTERNATIONAL WATERS

HAZARDS	PRACTICES	DESCRIPTION AND ADAPTATION/MITIGATION BENEFITS
 **SEA SURFACE TEMPEARTURE RISE**	Monitoring of autonomous adaptation	■ Change the timing or location of fishing as species arrive earlier/later or shift to new areas. ■ Monitor fish and feed population shifts to support adaptation.
	Catch limits	■ Set catch limits based on changes in recruitment, growth, survival and reproductive success via adaptive management, monitoring and precautionary principles to prevent overfishing.
	Transboundary agreements	■ Cooperation between neighboring countries and regions, including developing and/or modifying fishing agreements and collaborative management will support sustainable adaptation.
	Protected areas	■ Promote research and policies that safeguard biodiversity-rich environments and species by identifying and protecting areas with high conservation value.
	Zonation and artificial reefs	■ Marine spatial planning for demarcating no-catch zones where spawning takes place promotes the efficient use of resources and space, and reduces conflicts among incompatible uses.
 **STORM SURGES AND SWELLS**	Early warning systems	■ Access to effective and tailored early warning systems increases the adaptive capacity of fishing communities and reduce losses by enabling climate resilient anticipatory action.
	Disaster management	■ Links early warnings to disaster preparedness and protective green-grey infrastructure (e.g seawalls and flood reservoirs, or buffer zones via afforestation or mangrove reforestation).
	Mangrove and coastal ecosystem restoration	■ Buffer coastal communities against extreme weather events (e.g hurricanes and storm surges). ■ Stabilize coastlines and reduce soil coastal erosion. ■ Mangrove ecosystems can adjust to sea level rise by growing vertically and can play a crucial role in soil accretion by producing and accumulating sediments. ■ Nourish biodiversity and act as nursery grounds for many coastal and marine species (habitats that enhance the growth and survival of juveniles). ■ Contribute to the restoration of coastal ecosystems, coral reefs, etc. ■ Improve source of income and coastal livelihood and assets.

HAZARDS	PRACTICES	DESCRIPTION AND ADAPTATION/MITIGATION BENEFITS
 OCEAN ACIDIFICATION	Shifting from harvesting to breeding	■ Reduces direct damage and impact to coastal ecosystems, including coral reefs.
	Upstream stenohaline species	■ Adjust fishing activities to saltwater intrusion.
	Better and selective breeding	■ Promote breeding of species, stocks and genetic strains that can live and perform adequately in a wide range of environments.
 COASTAL EROSION	Mangrove restoration	■ Mangroves stabilize the coastline, reducing erosion from extreme weather events (e.g storm surges, hurricanes) and protects coastal communities. ■ Mangrove ecosystems can adjust to sea level rise by growing vertically and play a crucial role in soil accretion by producing and accumulating sediments. ■ Mangroves harbor biodiversity and act as nursery grounds for many coastal and marine species, contributing to sustainable fisheries.
	Salt marshes restoration	■ Reduces the height of large waves and, therefore, minimizes coastal erosion and flooding. ■ Protects water quality by filtering runoff. ■ Salt marshes act as nurseries and refuges for many species of marine species.
	Seaweed conservation (e.g. kelp forests)	■ Enhances sediment deposition by reducing wave erosion. ■ Reduces ocean acidification. ■ Contributes to removing CO_2 from the atmosphere, acting as a carbon sink. ■ Promotes biodiversity conservation and provides food resources for coastal communities.
 AQUACULTURE	Spatial planning	■ Terrestrial zoning for siting of aquaculture facilities and mangrove areas to balance aquaculture needs with terrestrial development and shoreline protection.
	Introduction of locally available fish species	■ Enhances suitability and resilience of fish that are locally available and reduces nutritional deficiencies. ■ Provides additional income and reduces exposure and vulnerability to changes in climate. Reduces livelihoods vulnerability to food shortages from fihseries cause by fish species migration.
	Trap pond management	■ Reduces the amount of uncultivated land during flood periods.Trap ponds on seasonally flooded land provide a habitat for young native species.
	Aquaculture feed management	■ Increases resource use efficiency by planning the timing of feeding activities.

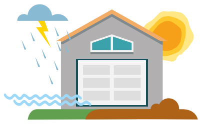
5 | BIODIVERSITY

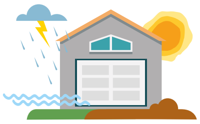
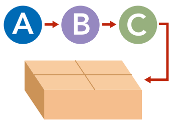
HAZARDS	PRACTICES	DESCRIPTION AND ADAPTATION/MITIGATION BENEFITS
 CLIMATE CHANGE AND WEATHER EXTREMES	Integrated biodiversity management	■ Promotes ecosystem-based adaptation and nature-based solutions, including ecosystem restoration and rehabilitation. ■ Enhances forest connectivity by promoting habitat corridors and through reforestation, removing barriers for dispersal and locating reserves close to each other; mitigates other threats, e.g. invasive species, fragmentation, pollution. ■ Study response of species to climate change from a physiological, behavioral, and demographic point of view. ■ Practice intensive management to secure species populations. ■ Translocate species to most suitable environments depending on physiological and demographic factors. ■ Increase the number of reserves and new areas for conservation management to ensure protection of key biodiversity areas. Protect large areas and increase reserve size. ■ Create new buffer zones around reserves, as well as increasing reserve size to promote ecological reserve networks and conservation. ■ Create ecological reserve networks of large reserves, connected by small reserves. ■ Develop applied remote sensing and modelling for biodiversity monitoring and analysis. Avoid implementing CO_2 mitigation activities that negatively affect biodiversity. ■ Initiate long-term studies of species' responses to climate change.
 CLIMATIC ENVELOPE SHIFTS	Research and monitoring	■ With climate change, the geographic location of climatic envelopes will shift resulting in migration to cooler and moister environments, usually uphill or to different latitudes. A robust understanding of changing climate envelopes is essential for understanding biodiversity and shifts in species, both native and invasive. ■ Increase and support research and development related to climate change drivers of invasive plant species and treatment measures. ■ Support the preservation of germplasm and living genetic resources (seeds or tissues) maintained for the purpose of animal and plant breeding. Support can include seed bags, nurseries, animal breeding lines maintained in animal breeding programs or gene banks. Germplasm collection is important for the maintenance of biological diversity and food security.

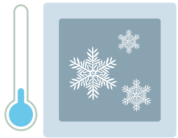
HAZARDS	PRACTICES	DESCRIPTION AND ADAPTATION/MITIGATION BENEFITS
 CLIMATIC ENVELOPE SHIFTS	Planning	■ Ensure that climate information is a key aspect of planning activities related to biodiversity to design and implement management plans for native and invasive alien plant species.
	Early warning systems	■ Incorporate climate topics and early warning systems in the development of training modules and curricula on biodiversity management for local forestry and agricultural extension staff and forest managers, and policy makers. ■ Reinforce local early warning systems including day-to-day weather observations.
 GENETIC DIVERSITY LOSSES	Genetic diversity	■ Enables changes in genetic composition to cope with forthcoming environmental changes, and adapt to biotic and abiotic stresses.
	Species diversity	■ Diverse ecosystems are likely to include species with a greater tolerance to abiotic and biotic stresses, increasing the likelihood that some species will contribute to ecosystem functioning under different stresses and increasing overall ecosystem resilience.
	Ecosystem diversity	■ Diverse ecosystems are more efficient carbon sinks; reduce vulnerability to climate-related hazards (e.g. mangroves protect coastal zones from extreme weather events) and ensure the sustainability of essential ecosystem services (food, medicine, material for living, air and water purification, temperature regulation etc.). ■ Diverse ecosystems support climate change adaptation by providing more diversified natural and food resources and reducing vulnerability to climate hazards.

6 CLIMATE RESILIENT PRACTICES ACROSS FOOD VALUE CHAINS

SUPPLY CHAIN	CLIMATE RISK	CLIMATE SERVICES	CLIMATE RESILIENT MEASURES
 HARVEST	Flooding and Drought	Real-time weather forecasts during crop growing stages	■ Use proper harvest equipment and conduct training on harvesting methods and best timing to minimize losses caused by falling of fruit and food spoilages. ■ Strengthen early warning systems to prevent and reduce climate impacts to crop yields.
	Extreme heat	Extreme heat advisory	■ Use proper harvest equipment to minimize losses caused by falling of fruit and food spoilages. ■ Cover perishables to preserve them until they reach maturity. ■ Implement cold chains and ice cooling to remove heat from fresh fruit and vegetables quickly after harvest, reducing food loss. ■ Conduct training on optimum temperature range to preserve products, tailored to local production. ■ Use Information and Communication Technologies (ICTs) such as temperature and humidity sensors to prevent food loss from heat or humidity.
	Storm/wind	Storm or strong wind advisory	■ Use proper harvest equipment; conduct training on harvesting methods and best timing. ■ Strengthen early warning systems to prepare for storm and wind impacts on crop yields and minimize losses caused by falling of fruit and food spoilage.
	Pests and diseases	Pest and disease alerts	■ Practice earlier harvest and conduct training on best harvest timing. ■ Ensure appropriate work hygiene and sanitation practices. ■ Use of immediate drying techniques such as sun drying or heated-air drying to prevent spread of pests and diseases. ■ Strengthen early warning systems to reduce impacts to crop yields caused by pests and rodent attacks, as well as spread of plant pathogens.
	Relative humidity	Daily relative humidity forecast	■ Use of immediate drying techniques such as sun drying, heated-air drying to reduce food moisture.

SUPPLY CHAIN	CLIMATE RISK	CLIMATE SERVICES	CLIMATE RESILIENT MEASURES
 STORAGE	Extreme heat	Extreme heat advisory; Seasonal climate advisory	▪ Strengthen early warning systems to prepare for and reduce food spoilage from extreme heat. ▪ Use cold rooms to prevent biological degradation. ▪ Install efficient energy infrastructures to support temperature-controlled storage and contribute to offsetting GHG emissions from fossil-fuel based sources of energy. ▪ Develop renewable energy technologies to reduce reliance on fossil fuels offering mitigation benefits and increasing resilience. ▪ Use appropriate preserving techniques (e.g., drying, chilling and freezing, heating, salting, pickling, preserving in oil/honey/alcohol, smoking, irradiation, high pressure processing). ▪ Use ICTs such as temperature and humidity sensors to prevent food losses from heat. ▪ Reduce time of storage to reduce risks of food deterioration.
	Flooding	Flood advisory	▪ Strengthen early warning systems to prevent flooding impacts to storage infrastructure and food products. ▪ Develop climate resilient practices such as storing on wood pallets, maintaining distance with walls and hygiene. ▪ Build climate proof warehouses that meet sustainable structural requirements and standards (e.g., appropriate location with respect to floodplains, dimensions of the building, type and slope of the roof, roof ledge, thick underlying plans). ▪ Deploy rainwater collection systems such as rainwater tanks, pumps, purifiers; use drying hangers and storm drain maintenance.
	Storm/wind	Storm or strong wind advisory	▪ Strengthen early warning systems to prevent storm and wind impacts to storage infrastructure and food losses. ▪ Build climate proof infrastructure (e.g. appropriate location, dimensions of the building; brick and concrete buildings instead of wood infrastructure).

SUPPLY CHAIN	CLIMATE RISK	CLIMATE SERVICES	CLIMATE RESILIENT MEASURES
 STORAGE	Pests and Diseases	Pest and disease alert	■ Strengthen early warning systems to prevent impacts to food products caused by pests and rodent attacks, as well as spread of mycotoxins. ■ Store in jute bags and wool blankets to let the air circulate, or hermetic bags to decrease food contamination and spread of mold. ■ Ensure food safety standards and food quality controls. ■ Ensure appropriate work hygiene and sanitation practices.
	Relative humidity	Daily relative humidity forecast	■ Improve storing conditions (e.g. fan systems for ventilation in temperate climates or reduced moisture and temperature in warm, humid environments). ■ Use dehumidifiers, roof ventilators and wall air vents. ■ Implement vapor heat treatment/hot water treatment; use crates to conserve food products. ■ Use Communication and Information Technologies (ICTs) such as temperature and humidity sensors.
 PROCESSING & PACKAGING	UV light	UV index forecast	■ Use UV lamps to preserve food quality and safety. ■ Switch from sun drying to solar drying techniques (e.g., using solar cabinet dryer technologies).
	Relative humidity	Daily relative humidity forecast	■ Use mechanical dryer techniques such as heated air-drying. ■ Provide advice on modern processing techniques (e.g., optimum thermal processing conditions, creation of by-products, use of food dehydrators). ■ Use large or small packaging, containers, aseptic packaging, impermeable to moisture and oxygen bags. ■ Implement modified atmosphere packaging and pulsed electric field techniques. ■ Dry and package food right after harvesting to prevent food spoilage. ■ Install sustainable, safe, and energy efficient machines (e.g., for milling, drying, grating) to increase productivity, time and cost effectiveness of labor work and operations. ■ Use ICTs such as temperature and humidity sensor systems.

SUPPLY CHAIN	CLIMATE RISK	CLIMATE SERVICES	CLIMATE RESILIENT MEASURES
 REFRIGERATION	Extreme heat and relative humidity	Climatic parameters for appropriate temperatures and moisture levels	■ Build cold chain infrastructures and technologies such as ventilation, pre-cooling, air conditioning. ■ Deploy accessible, efficient, affordable, and renewable energy technologies, e.g., biogas production from anaerobic digestion of organic waste, including spoiled food, to reduce food waste and GHG emissions. ■ Build sustainable energy infrastructure to support temperature-controlled storage.
 TRANSPORT	Heavy precipitation	Extreme rainfall advisory	■ Strengthen early warning systems to prevent impacts to road infrastructure and reduce food losses from heavy rainfall events. ■ Build resilient drainage systems and infrastructures. ■ Elevate roads and bridges above flood level. ■ Ship products when external conditions are less critical. ■ Reduce transport speed and implement more efficient planning of transport routes. ■ Promote safe, efficient routes for transportation of fresh, perishable food to reduce time, food losses, and energy use. ■ Provide training and advice on food storage manufacturing techniques to reduce losses during transportation.
	Thunderstorm	Thunderstorm advisory	■ Strengthen early warning systems to prevent impacts to road infrastructure and reduce food losses from storm events. ■ Conduct road network vulnerability assessments tailored to specific means of transport. ■ Reduce transport speed and implement more efficient planning of transport routes.
	Wind	Wind advisory	■ Strengthen early warning systems to prevent impacts to roads, vehicles, and reduce food losses from strong winds. ■ Reduce road traffic when external conditions for drivers' safety are critical. ■ Implement embankment protection infrastructures.
	Fog, dust, and snow	Dense fog, dust, and snow advisories	■ Use LED panels and appropriate lighting and planning to reduce road accidents.

SUPPLY CHAIN	CLIMATE RISK	CLIMATE SERVICES	CLIMATE RESILIENT MEASURES
	Extreme sea conditions	Coastal and offshore warnings	■ Strengthen early warning systems to avoid shipment of products when external conditions are critical. ■ Promote the use of navigational equipment. ■ Use colour-coded warnings to inform on the best timing to ship products.
	Extreme heat	Heat warnings	■ Strengthen early warning systems to avoid shipment of products when external conditions for drivers' safety are critical. ■ Improve insulation of refrigerated trucks while reducing energy consumption of vehicles. ■ Promote safe, efficient routes for transportation of fresh, perishable food, to reduce time, food losses, and energy use.
 **MARKETS & RETAIL**	Extreme heat	Heat index values and warnings	■ Enhance availability of water-rich food products and beverages.
	Pests and diseases, food contamination	Alert systems for food contamination	■ Promote appropriate work hygiene and sanitation practices. ■ Provide warning on identified risks to consumers' health at the market level, after occurrence of complaints or spread of illnesses, linked to product-specific consumption. Ensure immediate removal of the product from markets, stopping further distribution and informing all other actors along the value chain about its non-compliance with health safety requirements.
	Changes in temperature and rainfall patterns	Seasonal forecasts	■ Provide seasonal advisory on climate impacts on yields and changes in food availability within national and international production to enable value chain actors to set transparent and competitive food prices for both domestic markets and food exportation.
	Heavy precipitation	Extreme rainfall advisory	■ Develop efficient rainwater collection systems such as rainwater tanks, pumps, purifiers. ■ Use ICTs to enhance communication and information sharing between actors along the value chain.

SUPPLY CHAIN	CLIMATE RISK	CLIMATE SERVICES	CLIMATE RESILIENT MEASURES
	Flooding	Flood advisory	■ Strengthen early warning systems to enhance flood preparedness and reduce disaster risks. ■ Develop flood-proofing practices such as storing on wood pallets, maintaining distance with walls and hygiene. ■ Build flood-proof infrastructures that meet sustainable structural requirements and standards (e.g., appropriate location with respect to floodplains, dimensions of the building, type and slope of the roof, roof ledge, thick underlying plans). ■ Promote rainwater collection systems (e.g., rainwater tanks, pumps, purifiers); use drying hangers and storm drains maintenance.

Dima Jedeed, from Lattakia Governorate, Syria, is a 34-year-old woman working in a small juices processing-unit to support her young children. *©FAO/Jafar Almerei.*

7 GOVERNANCE ON CLIMATE CHANGE ADAPTATION AND MITIGATION

MECHANISMS	PRACTICES

PLANNING AND POLICY MAKING

- Integrate climate change mitigation, adaptation and disaster risk reduction, into national, regional, and local policy strategies, plans and investments. Ensure alignment of environmental policies and investments across global, regional, national and sub-national levels.
- Mainstream climate-smart agriculture and nature-based solutions into land-use policymaking.
- Promote climate information and projections as a fundamental element to ensure climate-smart action plans.
- Conduct strategic environmental assessments.
- Enforce regulations that facilitate national and international exchange of genetic resources in order to provide farmers with the most suitable seeds for shifting climatic zones.
- Ensure direct involvement of climate/meteorological/agronomic experts, researchers, institutions, as well as local stakeholders – citizens, farmers, value chain actors, civil society organizations – in the decision-making process.
- Apply a comprehensive spatial planning approach to strengthen polycentric, multi-stakeholder governance mechanisms.
- Strengthen climate finance in planning frameworks at all levels.
- Integrate climate risk management into national budgeting process.
- Participatory land use planning, land tenure governance. Implementation of land-use management policies to secure land property, values, access, and information. Secure indigenous land rights and compliance with environmental law.
- Strengthen disaster recovery, social protection, agricultural insurance measures.
- Promote short market circuits, develop of City Region Food Systems to connect regional and local urban and rural citizens, from producers to consumers, to foster food security and resilience to climate change at smaller scale.
- Regulate and ensure transparency of whole food value chains to enhance stakeholder engagement in participatory management and governance.

MECHANISMS	PRACTICES
 **SYSTEM-WIDE CAPACITY DEVELOPMENT AND TECHNICAL SUPPORT**	■ Strengthen vertical and horizontal coordination mechanisms between sectors and stakeholders across national and sub-national levels to ensure country-owned streamlined climate resilient practices. ■ Provide operational guidance and technical support to improve operational, institutional, policy interventions, and coordination mechanisms. ■ Ensure transparency in spending, investments, and revenues. ■ Support effective learning approaches for the analysis and application of climate data in impact assessments for all the agricultural systems (crop, livestock, forestry and fisheries) and value chains. Ensure country-driven climate impact assessments tailored to national priorities. ■ Enhance multi-level cooperation and multi-stakeholder partnership and platforms with national and international climate and agriculture research institutes, as well as with local decision-makers, communities, indigenous peoples, and minorities. ■ Improve multidisciplinary data collection from field surveys, ground data, remote sensing and global/regional resources; improve data access for policy makers, private organizations, and local communities. ■ Ensure direct involvement of climate/meteorological/agronomic experts and researchers in assessments and decision-making processes. ■ Strengthen extension systems for incorporation of climate resilient practices and provide learning opportunities for extension services providers on the interpretation and application of national level assessments in local contexts. ■ Develop participatory farm-level engagement (e.g. Farmer Field Schools, Climate Field Schools, seminars and meetings with multiple stakeholders) to enhance pro-active learning, and participatory management. Ensure farmer engagement in assessments and production of services at all levels. This includes self-monitoring and evaluation. Simple monitoring can be done on the ground, which improves awareness and ownership in the field as well as data management at upper levels. ■ Strengthen hydro-meteorological infrastructure to support disaster risk reduction and provide technical expertise for maintenance. ■ Strengthen knowledge and use of climate information and early warning systems by governments and the private sector. Ensure that information is accessible by the stakeholders involved, with adequate levels of engagement on use of resources.
 **ENVIRONMENTAL MARKET-BASED INSTRUMENTS**	■ Engage national and international climate investments, public and private funds for climate adaptation and mitigation. ■ Assess the institutional political economy supporting or impeding climate action across global, national and local level including government subsidies, energy loans to households and/or private entities. ■ Support environmental taxation and charges on specific activities and emissions, energy use, use and disposal of toxic, pollutant products, and on fossil fuel-based electricity use for irrigation (e.g. pumping, moving water through drips). ■ Support climate insurance schemes to improve resilience among farming, agro-forestry, and fishing communities (e.g. multiple peril crop insurance; group risk plans).

MECHANISMS	PRACTICES
 CLIMATE RISK-BASED INSTRUMENTS	■ Ensure direct involvement of climate/meteorological/agronomic experts, researchers, and institutions in the decision-making process. ■ Deliver climate and weather information services tailored to end users' needs and according to their level of exposure, vulnerability and adaptive capacity. ■ Enhance ownership and effectiveness of climate and weather information services by fostering knowledge exchange and improving communication and dissemination means.
 VOLUNTARY INSTRUMENTS	■ Promote certification procedures: sustainable and ecological labels, certifications, and standards. ■ Promote reward systems for good environmental practices: payments for ecosystem services provided by public institutions and organizations to farmers or landowners. ■ Promote voluntary agreements and partnerships between public and private sector.
 MONITORING STRATEGIES	■ Monitor the environmental, social, sanitary, and economic sustainability of the project and relative positive and negative impacts. ■ Use a combination of long-term climate projections and short-term weather monitoring to ensure both robustness and flexibility of the project to changes (e.g. adaptive management practices). ■ Promote the sharing of results, achievements, good practices, best strategies, communicated to stakeholders to ensure knowledge transfer and replicability of results. This will depend on every stakeholder's specific needs, vulnerability and level of access to information. ■ Provide open access to climate and policy data. ■ Promote direct involvement of climate experts to enhance capacity to produce and share evidence-based assessments, as well as communications specialists to spread information. ■ Promote participatory monitoring through direct involvement of farmers and citizens to generate a larger volume of data in a cost-effective way. ■ Promote constant monitoring of, and adaptation to, changes in stakeholders' needs. ■ Use communication technologies that are appropriate, innovative, traditional, affordable and accessible to end-users.

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