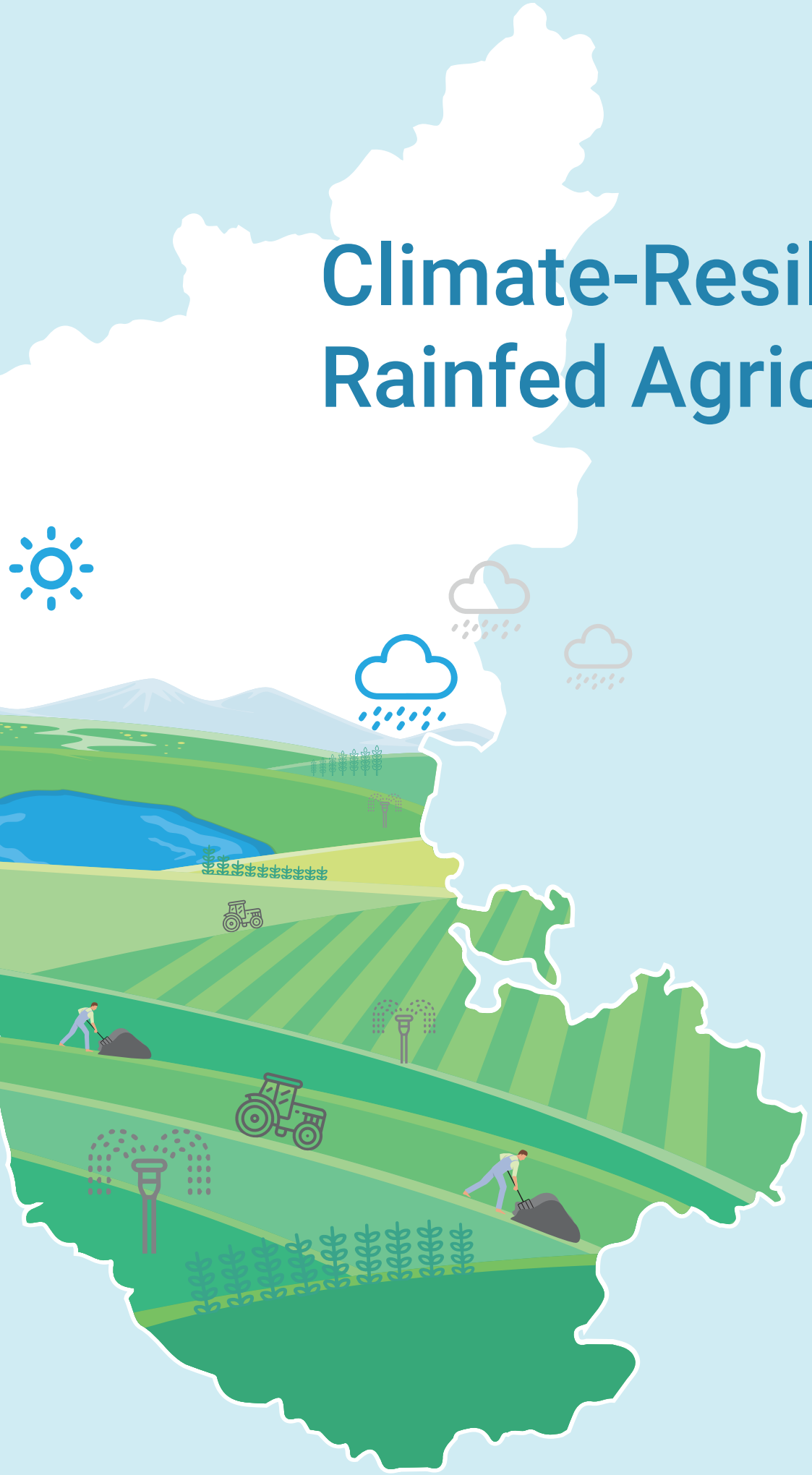
Climate-Resilient Rainfed Agriculture



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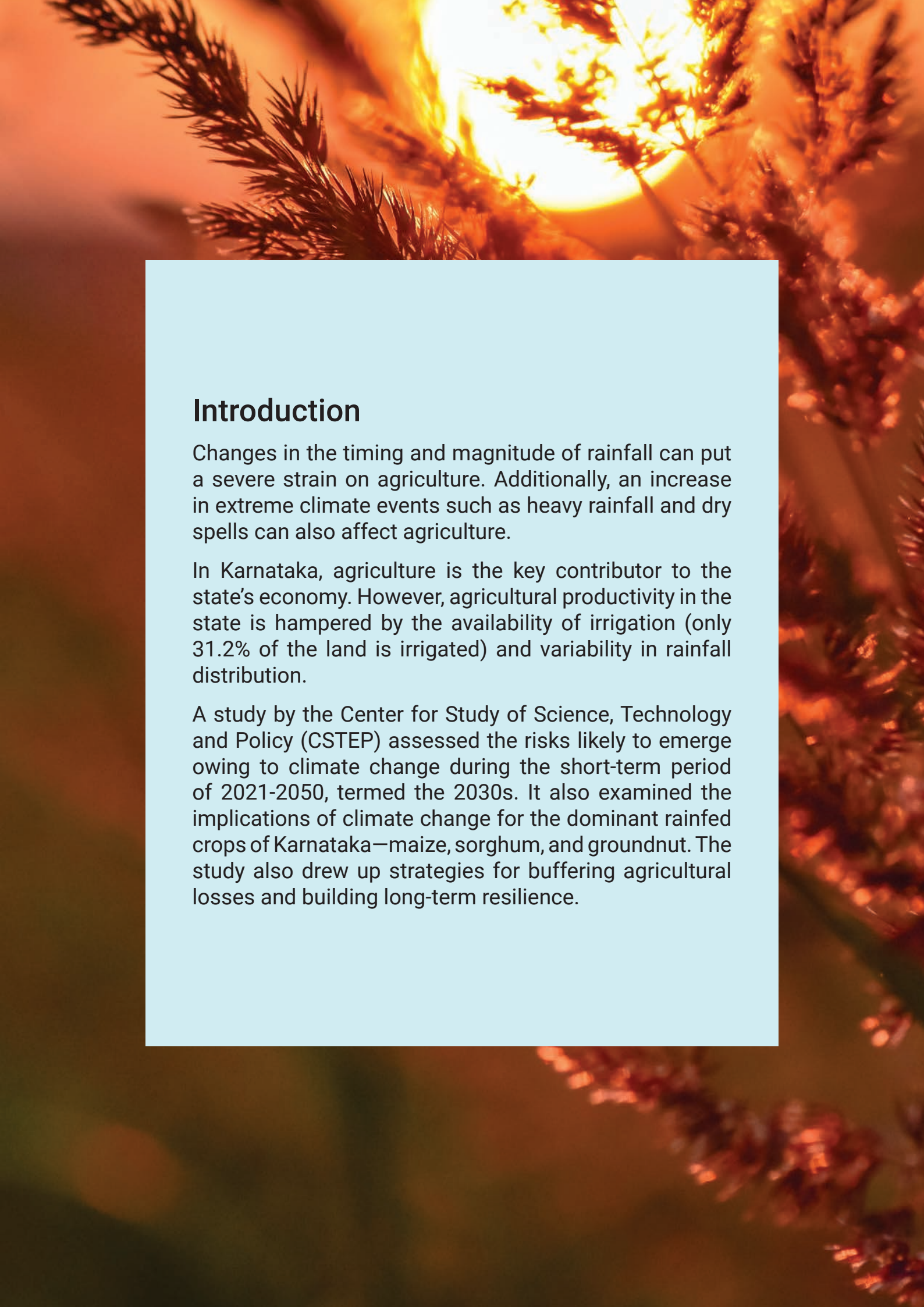


Introduction

Changes in the timing and magnitude of rainfall can put a severe strain on agriculture. Additionally, an increase in extreme climate events such as heavy rainfall and dry spells can also affect agriculture.

In Karnataka, agriculture is the key contributor to the state's economy. However, agricultural productivity in the state is hampered by the availability of irrigation (only 31.2% of the land is irrigated) and variability in rainfall distribution.

A study by the Center for Study of Science, Technology and Policy (CSTEP) assessed the risks likely to emerge owing to climate change during the short-term period of 2021-2050, termed the 2030s. It also examined the implications of climate change for the dominant rainfed crops of Karnataka—maize, sorghum, and groundnut. The study also drew up strategies for buffering agricultural losses and building long-term resilience.

Key Insights

The study examined two of the four Intergovernmental Panel on Climate Change (IPCC) scenarios or representative concentration pathways (RCPs) — RCP 4.5 (moderate emission scenario) and RCP 8.5 (high emission scenario).

Projections for temperature

- Likely increase in summer maximum temperature in the range of 0.5°C–1.5°C across Karnataka
- Likely increase in winter minimum temperature in the range of 0.5°C–2°C across Karnataka

Projections for rainfall

- Likely increase in the magnitude of kharif season rainfall by 7-18% under RCP 4.5 and 13-28% under RCP 8.5 in all the districts
- Likely increase in the magnitude of rabi season rainfall by 7-39% in all districts
- Likely increase in kharif season rainfall variability, but decrease in rabi season rainfall variability under both the scenarios in most districts

Projections for extreme events

- High intensity rainfall (51-100mm/day) events are likely to increase by 1-6 events annually relative to historical period under RCP 4.5 scenario, and by 1-8 events annually under RCP 8.5 scenario.
- Very high intensity rainfall (> 100mm/day) events are likely to increase by 1-2 events annually relative to historical period under RCP 4.5 scenario, and by 1-3 events annually under RCP 8.5 scenario.
- The occurrence of high and very high intensity rainfall events in some districts—Bagalkote, Chamarajanagar, Chikkamagaluru, Chitradurga, Vijayapura and Yadgir— with no historical record.

What Climate Change Foretells for Rainfed Crops

The study also examined climate risks to major rainfed crops in Karnataka using mean seasonal temperature, mean seasonal rainfall, and extreme rainfall events projections under the high emission scenario in conjunction with crop climate thresholds. The percentage deviation in projected temperature and rainfall from the defined optimum for crucial growth stages of crops was computed, and its consequence on yield derived from literature. The study found that there is no single dominant climate risk across the state or for all the crops.

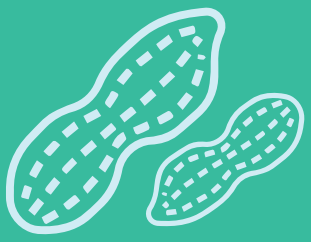
Projected changes in climate in rainfed-crop-growing districts under RCP 8.5 scenario during the cropping period:

- Maximum temperature will be higher than the defined optimum temperature in three maize growing districts (Davanagere, Chikkballapur and Chamarajanagar); 12 groundnut growing districts including Bagalkote, Belagavi, and Chamarajanagar; and nine sorghum growing districts (including Bagalkote, Bidar, and Dharwad)
- For maize, rainfall will be lower than the defined optimum at the crucial stages of germination, tasselling, and silking in districts such as Chitradurga, Davanagere, Kolar, Koppal, etc.
- For groundnut, rainfall will be higher than the defined optimum at flowering-to-peg initiation, and pod-filling stages in districts such as Belagavi, Chikkamagaluru, Dharwad, Yadgir, etc.
- Heavy rainfall events are projected during the kharif season in some maize-growing districts such as Bengaluru Rural, Chamarajanagar, Hassan, Mysuru, etc., during grain formation. In the case of groundnut, such events are projected to coincide with sowing and germination in the districts of Belagavi, Dharwad, Koppal, Udupi, etc.

How it Affects the Yield

A potential yield loss of
7-18% in sorghum
due to exposure to higher than the defined maximum temperature threshold

An yield loss of
21-50% in maize
due to deficit in rainfall during vegetative, flowering, and grain-filling stages

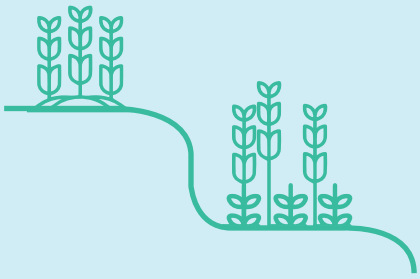


A potential yield loss of
13-19% in groundnut
due to rainfall deficit during emergence-to-peg initiation stages

Loss in the overall yield
and quality of produce of all rainfed crops due to increase in the frequency of heavy rainfall events leading to excess soil moisture, which could induce flower shedding, root rotting, and wilting.

Climate-Proofing Rainfed Agriculture

How it Works?



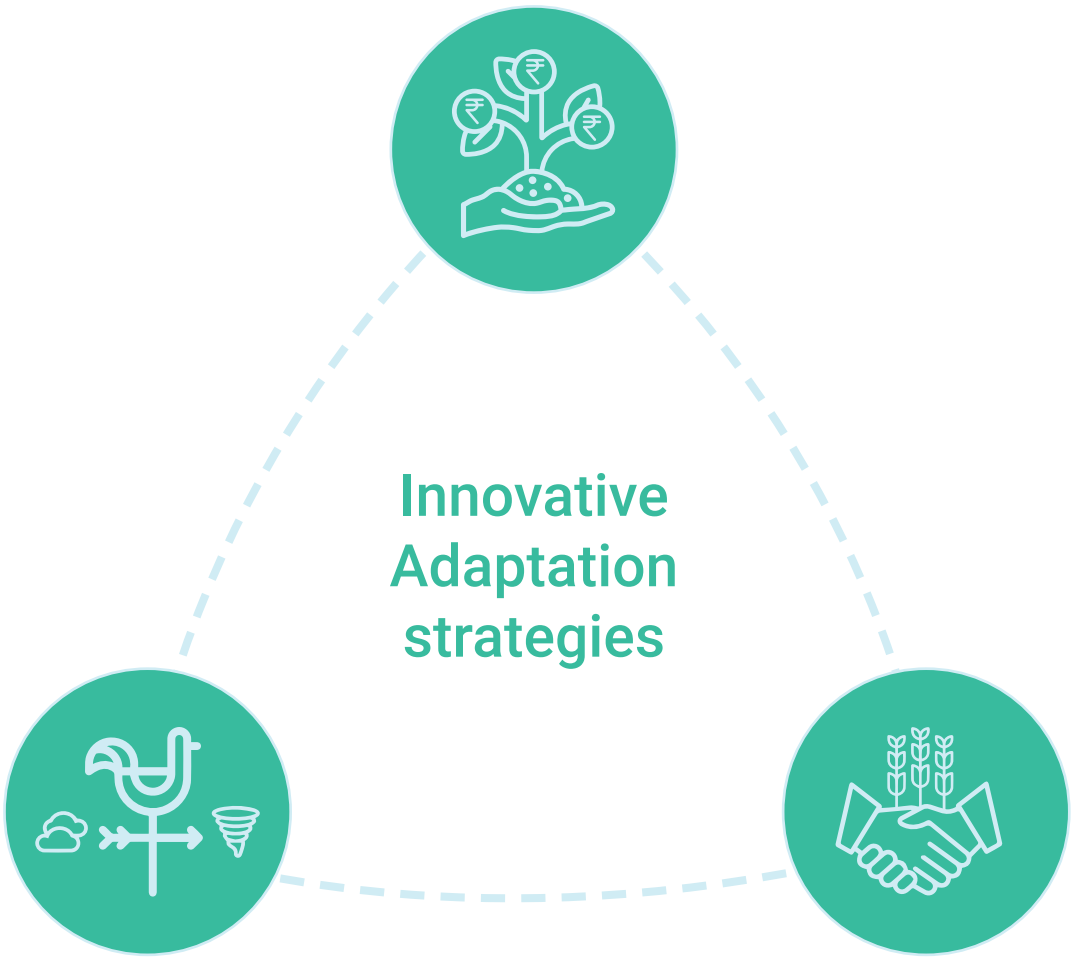
Contour bunding, contour farming, and farm ponds to deal with dry spells

Mulching, reduced/no tillage, cover cropping, and agroforestry to handle flooding

Change in the time of sowing, use of climate-resilient seeds, crop diversification, etc., to manage the shocks of climate change

Climate information services to enable farmers to make informed decisions

Crop Insurance with No 'Claims' Process: unlike traditional crop insurance, this one piloted in Kenya, clears claims based on deviations in weather—which are then compared to indexed past weather data and correlated with production losses. Requires a dedicated budget.



Forecast-Based Financing for Social Protection: a financial mechanism, being piloted in Africa, that anticipates hazards using a set of pre-agreed triggers (or danger levels) and predefined actions, is another option that can be looked at. Requires a dedicated budget.

Public–Private Partnership for Agroforestry: could provide an assured market for agroforestry produce, thereby providing income and livelihoods in the event of annual crop loss.

Benefits

1. Buffer and minimise losses from rainfed agriculture crops
2. Stabilise household incomes for farmers
3. Enhanced environmental benefits such as increased soil fertility and improved water management

Barriers

1. Lack of district-level climate change projections for planning long-term resilience strategies
2. Absence of crop insurance and social protection mechanisms tied to automated weather triggers
3. Inadequate funding for adaptation

Annexure

Crop Insurance with No 'Claims' Process

A variant of the weather-based insurance scheme is the innovative Weather Index Insurance (WII)—a relatively new type of financial risk transfer product, which could help overcome some of the problems with traditional insurance schemes (IFAD, 2010; Barnett and Mahul, 2007). WII has been piloted in Kenya and India. This insurance scheme, unlike traditional crop insurance schemes wherein compensation is offered for loss that can be verified at the end of the growing season, clears claims based on the realisation of an objectively measured weather variable such as rainfall that is correlated with production losses (Musshof et al., 2011).

Kilimo Salama (Swahili term meaning 'safe farming') is an agricultural insurance programme launched in Kenya. This insurance scheme has been designed specifically for smallholders, helping farmers cope with climate change and devastating weather shocks in Kenya. Kilimo Salama is a partnership between Syngenta Foundation, the Kenyan insurance company UAP, and Swiss Re Corporate Solutions. WII uses weather data from satellites and automated weather stations as a proxy to estimate farmers' harvest situation. At the end of each growing season, the collected weather data is automatically compared to an index of historical weather data, and if the rainfall, for example, is lower or above average, insurance pay out that the company owes to client farmers is calculated and sent. There is no claims process involved in this[1].

Payment for Ecosystem Services

Payment for Ecosystem Services (PES) related to water management assumes that activities in one part of a watershed may have implications for other parts of the watershed. For example, upstream adoption of soil and water management techniques are likely to reduce soil erosion and sedimentation in downstream water bodies, benefiting the downstream farmers. Such activities generate positive externalities, giving an opportunity for monetising and formulating schemes for payment (World Bank, 2009). Many of the soil and water management techniques provide many non-hydrological services, including carbon benefits from organic or non-tillage farming. Soils with increased carbon stocks have higher water retention capacity. Some projects implemented by the World Bank in Kenya have included payment for soil carbon enhancement as a strategy for promoting soil conservation measures on a pilot basis.

[1] https://www.syngentafoundation.org/agricultural-insurance-kenya

Forecast-Based Financing for Social Protection

A financial mechanism that is put together by anticipating hazards—based on forecasts if properly linked with social protection systems such as MGNREGA—can help buffer climate-related shocks, and can help cope and manage climate risks in a proactive and effective way (Coughlan de Perez et al., 2015). Such a mechanism has been piloted by World Food Programme through the Food Security Climate Resilience Facility wherein early action is taken by: (i) a set of pre-agreed triggers (or danger levels); (ii) pre-defined actions to be taken when those triggers are met, and (iii) a financing mechanism to automatically fund them (RCCC and GRC 2017).

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