Mainstreaming climate change resilience and stakeholders engagement in water and agriculture sectors

Reflections from policy analysis and ground surveys highlighting current status and pathways to bridge the sectoral strategy linkages between national and state.

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25 Years
Hanns Seidel Foundation India

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Disclaimer

The study document has been prepared by the Centre for Environment Education (CEE) as part of the partnership with Hanns-Seidel-Stiftung India. It has attempted to represent the needs and gaps in the state of Karnataka pertaining to climate change, water and agriculture based on qualitative surveys and key stakeholder interviews, and the same should not be construed as accurate information for the entire population for any purposes whatsoever. The authenticity of the secondary research presented and information gathered as part of the study lies with the respective agencies. Certain elements of the Karnataka State Action Plan on Climate Change (KSAPCC) concerning the agriculture and water sector are beyond the scope of this study and hence are not taken into consideration. While all care has been taken researching, compiling, editing and reviewing this report, the accuracy of the data included cannot be guaranteed. Reproduction is authorized, provided the source is acknowledged

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Executive Summary

Climate change is a rapidly growing concern leading to international discussions and negotiations worldwide and requires action for implementation. The mode of achieving climate action is through realistic targets, implementation and monitoring as highlighted by UNEP (2021). Within Climate Change, agriculture, followed by water draws maximum global effort, research, action, and funding for meeting challenges towards human survival.

India responded to the challenge of climate change in 2008 with the National Action Plan on Climate Change (NAPCC). NAPCC through its inclusive and sustainable climate-sensitive strategies for development aims to protect the poor and vulnerable sections of society.

The State Action Plan on Climate Change (SAPCC) is a framework of action for responding to the effects of climate change in each state, based on the guidelines provided in the NAPCC. Karnataka State Action Plan on Climate Change (KSAPCC) is a framework of action for implementing the missions laid by the NAPCC and aligning them with the specific effects as well as vulnerabilities of climate change in each of the states of India. The KSAPCC was the first policy document to tackle climate change at the state level in Karnataka. It laid the ground for crucial mitigation and adaptation action and is oriented towards development goals that are harmonious with 'climate change co-benefits'.

The aim of this study is to reflect on the possible linkages between the Karnataka State Action Plan on Climate Change (KSAPCC) and National Policy. The study sought inputs from the state government functionaries and other stakeholders and on qualitative surveys. This report provides recommendations for further improvements in KSAPCC, with a focus on implementation challenges as well as gaps and recommendations to strengthen the efficacy of these interventions. It is proposed to create a strong institutional network partnership for joint actions and to bring together multiple knowledge stakeholders including policymakers, service providers, scientists, academicians, professors, sectoral experts, youth, students, representatives from civil society, etc. Discussions with experts resulted in specific recommendations to create mechanisms of linkages at ground level such as those for water management, climate adaptation strategies for agriculture and disaster plans.

1.Introduction

Climate over the Indian subcontinent has varied significantly in the past century in response to natural variations and anthropogenic forcing. In recent times, there has been considerable progress in understanding the influence of anthropogenic climate change over the Indian subcontinent, particularly the regional monsoon (Krishnan *et al*., 2020).

State-of-the-art global climate models project a rising trend of anthropogenic global warming and associated climate change during the twenty-first century, the impacts of which have profound implications for India. Yet, there remain substantial knowledge gaps concerning climate projections, particularly at smaller spatial and temporal scales. For instance, CMIP 5 simulations of historical and future changes in the monsoon rainfall exhibit wide variations across the Indian region posing difficulties for clearly comprehending the projections, potential impacts and devising effective policies around it (Sperber *et al*., 2013; Turner and Annamalai, 2012).

At the Conference of the Parties (COP) in Copenhagen in December 2009, India reinforced its commitment to address climate change by putting forth a voluntary pledge to reduce the emissions intensity of its Gross Domestic Product (GDP) by 20-25 percent compared to its 2005 level, by 2020. Following this, in January 2010, the Expert Group on Low Carbon Strategies for Inclusive Growth was established by the Planning Commission of India to provide sector-specific recommendations to support the formulation of the country's 12th Five-Year Plan (2012–17). The final report, released in April 2014, outlined sectoral mitigation opportunities and an assessment of the macro-economic and welfare implications of a low-carbon growth strategy for India (India Climate Report, Vol-1, 2015).

The Intergovernmental Panel on Climate Change Assessment Report 6 states that, climate change impacts and risks are becoming increasingly complex and more difficult to manage. Multiple climate hazards are most likely to occur simultaneously, and multiple climatic and non-climatic risks will interact, resulting in compounding risks and cascading risks across sectors and regions. So if global warming transiently exceeds 1.5°C in the coming decades or later (overshoot), then many human and natural systems will face additional severe risks, compared to remaining below 1.5°C. Depending on the magnitude and duration of the overshoot, some impacts will cause a release of additional greenhouse gases and some will be irreversible, even if global warming is reduced (IPCC 2022: Summary for Policymakers).

Developing countries like India have a limited capacity to deal with the impacts of climate change and are hence more vulnerable. For instance, according to the estimates stated in the climate action plan or the Nationally Determined Contributions (NDC), India will require a whopping $2.5 trillion to deal with the impacts of climate change by 2030 (Kumar, 2018). The NAPCC provides a general framework to achieve climate goals. To make it more state specific and also to go with the entire climate goal of our country, linkages between the national and the state plans are necessary. The Centre has encouraged the states to draft their action plans as well as revise them under a common framework to complement the missions and NDC targets while prioritising their local needs and making a policy that is specific to the state circumstances and capacities.

2. About the study

This study aims to strengthen the efficiency of the Karnataka State Action Plan on Climate Change (KSAPCC) with a particular focus on Sustainable Agriculture and Integrated Water Resource Management by reflecting on the possible linkages to bring National Policy and the State Policy in consonance while at the same time finding existing sectoral linkages for implementation of the policy.

The study sought inputs from the state government functionaries and other stakeholders including representatives from water and agriculture departments, non-governmental organizations, and knowledge partners, while drawing lessons in the form of recommendations. Accordingly, the study report has been developed based on such qualitative surveys

This report provides recommendations for further improvements in KSAPCC, with a focus on implementation challenges as well as gaps and recommendations to strengthen the efficacy of these interventions. Recognising that Climate Action cannot happen in silos, it proposed to create a strong institutional network partnership for joint actions and to bring together multiple knowledge stakeholders including policymakers, service providers, scientists, academicians, professors, sectoral experts, youth, students, representatives from civil society, etc.

Objectives:

The main objective of this study is to improve the efficiency of the policy design and implementation of the KSAPCC for the two thematic areas of sustainable agriculture and Integrated Water Resource Management (IWRM) to bolster the effectiveness of climate action in the state of Karnataka.

Further, this study aims to understand, document, and reflect on the existing linkages between NAPCC/ NDC and SAPCC, with a focus on National Water Mission and National Mission for Sustainable Agriculture. A policy-based recommendation will be developed for strengthening the provisions and implementation effectiveness of interventions aligned to KSAPCC.

Lastly, this study would also help to identify mechanisms and tools to strengthen the linkages between NAPCC/NDC and SAPCC through multi-stakeholder approaches, and help develop a communication package to enhance the awareness of relevant stakeholders, which in turn can enhance the implementation of priority actions of KSAPCC the outcome as a way forward, as well as knowledge dissemination on climate change, sustainable agriculture, and water use efficiency, in line with the KSAPCC.

Methodology:

The methodology of this study is two-fold: desk study of the public documents, majorly the NAPCC (2008) and KSAPCC assessment conducted by EMPRI and TERI (2013), and on-site research with semi-structured interviews.

The secondary analysis of the NAPCC and KSAPCC documents was done by developing linkages between the national and state-level policy. The primary data collection for the research study was undertaken by capturing the views of different stakeholders through an open-ended questionnaire, with specific questions for target respondents (refer Annexure I). The questionnaire consisted of 12 questions, the first 6 questions were

related to linkages between NAPCC and KSAPCC, and the rest 6 questions were related to the agriculture and water sector in India and Karnataka. The surveys were done through virtual and in-person discussion with stakeholders.

The key informant interviews were divided into 2 main categories as shown in the figure below:

The Survey, which aimed to "Briefly study on NAPCC (two missions- water and agriculture) and the linkages between NAPCC and KSAPCC" and challenges in the State Action Plan on Climate Change, covered responses from 10 Key Informant Interviews. All interviews were held from August to October 2022.

Key Informant Interviews:

The key informant interviews focused on representatives involved in agriculture and water-related policy implementation and planning, as well as experts from research institutions, and NGOs. Interviews were conducted under 2 different categorises viz., knowledge Partners and Government line department.

Knowledge Partners: This group comprised research institutions from multi-disciplinary backgrounds, including the Institute for Social and Economic Change (ISEC), The Center for Study of Science, Technology and Policy (CSTEP), Centre for Policy Research (CPR), Centre for Sustainable Development (CSD), Ashoka Trust for Research in Ecology and the Environment (ATREE), and Environmental Management for Policy and Research Institution (EMPRI). The institutions were identified owing to their long-term experience in climate change-related research projects and contributions at a policy level to combat climate change issues nationally.

Government Line Department: An electronic mode of the interview was conducted with representatives of Agriculture Departments to understand the linkages between national mission and state departments' schemes/policies and to identify the challenges in policy implementation and planning from a government's perspective.

Table 1: Total Number of Qualitative Survey completed for the study of KSAPCC by interacting with multiple-stakeholders

Qualitative Survey	Number of Surveys from each Stakeholder	Total Surveys from Multiple-Stakeholders
Knowledge Partners		**9**
Institute for Social and Econo mic Change (ISEC)	3	
The Center for Study of Science, Technology and Policy (CSTEP)	1	
Centre for Policy Research (CPR)	1	
Centre for Sustainable Development (CSD)	1	
Ashoka Trust for Research in Ecology and the Environment (ATREE)	1	

Qualitative Survey	Number of Surveys from each Stakeholder	Total Surveys from Multiple-Stakeholders
Environmental Management for Policy and Research Institution (EMPRI)	2	
Government Line Department		**1**
Karnataka State Department of Agriculture (KSDA), GoK	1	
Total Key Informant Interview		**10**

Stakeholder Consultations:

A policy consultation at National Level was held on 28 October 2022 to understand the gaps and make a recommendation for improving the linkages between the NAPCC and KSAPCC. Experts from different fields of education, water, and agriculture were invited to provide their inputs on the preliminary findings of this study, mainly collated through the surveys. Their insights and recommendations have been taken into consideration while preparing this study.

The discussion was based on data collected from interviews for providing insights into both the agriculture and water sector in the KSAPCC for the national missions/NDC. It also suggested mechanisms and tools to strengthen the linkages between NAPCC and KSAPCC.

3. Emergence of NAPCC and SAPCC in India

3.1 NAPCCs and Missions

The National Action Plan on Climate Change (NAPCC) was launched in 2008 by the Prime Minister which outlined a national strategy aimed at enabling the country to mitigate climate change, adapt to it and enhance the ecological sustainability of India's development path. At the core of the national action plan were the eight national missions that focused on building strategic knowledge and understanding of climate change as well as promoted climate change mitigation and adaptation in key sectors like energy, water, agriculture, human habitats and natural resource conservation. The 8 national missions forming the core of the NAPCC which represent multi pronged, long term and integrated strategies for achieving key goals in climate change are: National Solar Mission, National Mission for Enhanced Energy Efficiency, National Mission on Sustainable Habitat, National Water Mission, National Mission for Sustaining the Himalayan Ecosystem, National Mission for a Green India, National Mission for Sustainable Agriculture and National Mission on Strategic Knowledge for Climate Change. Out of this, the study focus is on National Water Mission and National Mission for Sustainable Agriculture.

NAPCC addressed the country's critical and urgent needs by directionally shifting the development path and enhancing the current and planned programmes and technologies. It identified measures that promote our developmental goals and generate co-benefits by addressing climate change also. NAPCC through its inclusive and sustainable climate-sensitive strategies for development aims to protect the poor and vulnerable sections of society.

National Water Mission

The National Water Mission is governed by the Ministry of Water Resources, River Development, and Ganga Rejuvenation. It ensures better-integrated water resource management leading to water conservation, less wastage, and equitable distribution forming better policies. It looks into the issue of groundwater and surface water management, domestic and industrial water management, improvement of water storage capacities, and protection of wetlands.

The functions and goals are to review data collection on the network of hydrological, automatic weather, and automated rain gauge stations, expeditiously implement water projects in climate-sensitive regions, and promote water purification and desalination techniques. Making enactments of a bill for the regulation and management of groundwater sources is its goal. Research in water use efficiency in industry, agriculture, and domestic sectors and providing incentives for water-neutral and positive technologies is to be encouraged.

National Water Policy includes integrated water resource management, evaporation management, and basin-level management. The need to place a water database in the public domain and assess the impact of climate change on water resources has been stressed. Focus is also on promoting participation of citizens and interface with state action for water conservation, augmentation, and preservation. To provide greater attention to the overexploited area and improve water efficiency by 20% through regulatory and pricing mechanisms.

National Mission for Sustainable Agriculture

The National Mission for Sustainable Agriculture is governed by the Ministry of Agriculture. It works towards devising strategies to make Indian agriculture less susceptible to climate change. It would identify and develop new crop varieties, and use traditional and modern agriculture techniques. This mission sees dry land agriculture, risk management, access to information, and use of biotechnology as key areas of intervention

The mission aims to provide information and collation of off-season crops and preparation of state-level agro-climatic atlases. It will also come up with strategies to evolve low-input agriculture with enhanced water and nitrogen-efficient crops and prepare nutritional strategies to manage heat stress in dairy animals. The focus of the mission will be on the use of micro irrigation systems and promote techniques of minimum tillage, organic farming, and rainwater conservation. The mission will promote the capacity building of farmers and other stakeholders to ensure its success.

While the Government of India proposed a National Action Plan on Climate Change (in 2008) to mitigate climate change consequences on a national scale, it also encouraged the states to draft their respective state action plans (SAPCC) to complement the missions whilst prioritizing their local needs.

3.2 Linkages between NAPCC and KSAPCC

Karnataka State Action Plan on Climate Change (KSAPCC) is a framework of action for implementing the missions laid by the NAPCC and aligning them with the specific effects as well as vulnerabilities of climate change specific to the state. The plan outlines the state's strategies for a range of sectors, including proposed actions and, in some cases, a timeline and budget for each. The rationale for the formation of the SAPCC was to decentralise action beyond the eight missions of the NAPCC, particularly covering subjects like water and agriculture which are state subjects. A Common Framework Document was developed, with the assistance of expert agencies, to guide this process, stressing that it be participatory, build capacity, develop a vulnerability assessment, and draw on experts and donors for guidance and support.

Linkages are required in specific areas to address implementation challenges, close policy gaps, close communication gaps, and provide extensive stakeholder engagement platforms.

The focus areas of the proposed National Mission for Sustainable Agriculture are dryland agriculture, risk management (strengthening of current agricultural and weather insurance mechanisms), access to information, and the use of biotechnology. Realising the enormous agricultural growth potential of the drylands in the country and secure farm-based livelihoods, there is a need to prevent declines in agricultural yields during climatic stress. Priority areas are development of drought and pest-resistant crop varieties, improving methods to conserve soil and water, stakeholder consultations, training, workshops, and demonstration exercises for farming communities, for agro-climatic information sharing and dissemination. Financial support enables farmers to invest in and adopt relevant technologies to overcome climate-related stresses.

Broad areas of linkages between the KSAPCC And the National Mission for Sustainable Agriculture

KSAPCC looks into the preparation of an inventory of cropping patterns and changes in the same concerning agro-climatic zones of the state. Web-based services will provide all weather-related information through a single window, preferably through Karnataka State Natural Disaster Monitoring Centre. The KSAPCC intends to expand crop insurance schemes, particularly Weather Based Crop Insurance through adequate packaging to cover a greater share of farmers. Incentives and subsidies will be provided for efficient energy consumption for agriculture and the promotion of renewable energy at the farm level. A state-level policy body will be established to develop suitable mechanisms for encouraging cropping shifts through the redistribution of existing subsidies. An incentive in form of a capital investment subsidy for rainwater harvesting structures will be devised. Model farms will be created so also fodder banks will be provided as envisaged in the National Mission on Sustainable Agriculture. Suitable drought and pest-resistant crop varieties will be developed under the use of instruments provided by the National Mission on Sustainable Agriculture. Pressurised micro-irrigation techniques at larger scales will be promoted. A market for products will be created for promotion of indigenous varieties of crops. The network of state agencies including the Horticultural Producers' Cooperative Marketing and Processing Society (HOPCOMS) would help market these as specialties for a higher price. A comprehensive inventory of the agro-biodiversity of the state can be prepared at regular intervals. For this, the ongoing preparation of People's Biodiversity Registers is establishing a solid fundament. Research studies could focus on the regional-level prediction of the likely impact of climate change on cropping patterns and the development of weather derivative models. Agro-biodiversity parks have also been proposed.

Karnataka Agriculture Mission

The Karnataka Govt is well aligned with the center in its focus on the protection and improvement of soil health, conservation of natural resources with emphasis on water and micro-irrigation, timely availability of credit and other inputs to the farmers, integration of post-harvest processing with the production process, reduction in the gap between labs-to-land in technology transfer.

One of the objectives of the mission is to develop new programmes for agriculture under the close involvement of agriculture universities and line departments. The mission also includes streamlining and coordinating the functions of line departments and agriculture-related universities to provide technical information and services through a single window. The mission envisages drafting new programmes for sustainable agriculture, conservation of natural resources such as land, water and improving the fertility of the soil and water use efficiency, promotion of organic farming, intensification of farmer training in modern agriculture and marketing and providing infrastructure for seed storage, water harvesting and water use efficiency, processing and value addition.

Existing state water policies and schemes in the state

The State Water Policy of Karnataka aims at providing drinking water at the rate of 55 LPCD in rural areas, 70 LPCD in towns, 100 LPCD in city municipal council areas and 135 LPCD in city corporation areas. It

aims to step up irrigation to reach an accumulated 45 lakh hectares under major, medium, and minor irrigation projects. Involving users in improving the productivity of irrigated agriculture for irrigation management will be very helpful. It also aims to provide fair, just, and equitable distribution and utilisation of water resources.

The establishment of a Rainwater harvesting (RWH) structure has been made mandatory for certain categories of buildings within the area of Bangalore Water Supply & Sewerage Board (BWSSB) and enforced by BWSSB itself through the Bangalore Water Supply and Sewerage (Amendment) Act 2009. As agriculture is the largest water-consuming sector, the state of Karnataka has been investing a large share of its budget in major, medium and minor irrigation facilities. The state is also promoting the adoption water-efficient technologies such as drip and sprinkler irrigation techniques in order to enhance the water productivity and consequently the cost of cultivation.

Existing state government programs that link up with the National policy

Karnataka has an existing broad and efficient policy framework to achieve sustainability in agriculture and allied sectors. The government of India also supports the state government financially and technically, through various schemes. The following schemes integrate the National Level schemes with Accelerated Maize Development Program (AMPD) has been integrated with integrated Scheme for Oilseeds, Pulses, Oil Palm, and Maize (ISOPOM) in all districts. ISOPOM was launched by Govt. of India. This scheme is being implemented in all 30 districts. The main activities under the scheme are the purchase of breeder seeds, the production of foundation and certified seeds, and the distribution of certified seeds, plant protection chemicals, plant protection equipment, biofertilizers, gypsum as a nutrient, phosphorus solubilising bacteria (PSB) and block demonstration of Integrated Pest Management (IPM) besides farmers' training and infrastructure development.

Risk management

The NAPCC stresses on strengthening of current agricultural and weather insurance mechanisms. Karnataka state introduced crop insurance in 2000 with the National Agricultural Insurance Scheme (NAIS). It indemnifies farmers against loss of yield from natural calamities for notified crops based on region, season and risk. Being open to all farmers for a decade now it is compulsory for loan-taking farmers. And even though 10% of the premium is subsidised for small and marginal farmers it is yet to find acceptance with the majority of farmers. In 2007 the central government introduced the Weather Based Crop Insurance Scheme which indemnifies farmers against anticipated loss in crop yield due to adverse whether conditions. The higher premium is subsidised by both the center and state (50:50), offering the farmer a premium identical to that under NAIS. In response to lessons learned with this still new instrument, a modified NAIS (or MNAIS) is being implemented since 2010. It fixes the indemnity level at 70% and covers pre-sowing and post-harvest risks.

Weather-Based Crop Insurance Scheme (WBCIS) is intended to provide insurance protection to the farmers against adverse weather incidence, such as deficit and excess rainfall, high or low temperature, humidity etc. which are deemed to impact adversely the crop production. Its premium rates have been streamlined with the latest scheme.

Pradhan Mantri Fasal Bima Yojana (PMFBY) reduces the burden of premiums on farmers significantly and expands coverage. Four insurance schemes are being implemented in Karnataka namely, Pradhan Mantra Fasal Bima Yojana (PMFBY), Weather Based Crop Insurance Scheme (WBCIS), Coconut Plan Insurance Scheme (CPIS) and Pilot Unified Package Insurance Scheme (UPIS) in 45 districts.

Karnataka State Remote Sensing Application Centre has the capability of mapping vulnerable eco-regions (regional soil database) and pest and disease hotspots. This will help in developing and implementing region-specific contingency plans based on vulnerability and risk scenarios.

Access to information

Dept of Agriculture in Karnataka has a dedicated web page for farmers with a Krushi Sanjeevani helpline. The Department has also listed the following objectives: dissemination of technology/information to farmers, ensures supply of agricultural inputs and their quality control for enhanced production and productivity and maintenance of soil health. Focuses on rainfed farmers and encourages rain water conservation and reuse, Plant Protection and quarantine. Provides implements/ Machinery to the farmers of rural areas in time and at subsidised cost. To develop an e-portal to receive applications online under Farm mechanisms and Micro irrigation scheme. Transfer of technology from the lab to the land through farm information services, training staff and farmers, laying out demonstrations and arranging study tours. Youtube channels by the University of Agriculture Sciences provide information of research and extension, research station Krishi Vigyan Kendra of the Universities. Linking of block-level data on agro-climatic variables, land-use, and socio-economic features and preparation of state-level agro-climatic atlases can be prepared.

Areas where national and state challenges can be linked

The state is endowed with limited water resources that are stressed and depleting. Sectoral demands are growing rapidly on account of increase in population, urbanisation, rapid industrialisation, and rising incomes. Water Resources Department has initiated comprehensive actions on conservation needs, replenishment, supply and the participation of common people in watershed management. The mission document emerges as recommending a revision of the National Water Policy to address vulnerabilities related to climate change. The attention to rainwater harvesting and groundwater recharge schemes within the Karnataka State Water Policy is in line with the NAPCC. One of the most important goals of the mission is to improve the efficiency of water use by 20%. This objective is to be achieved by ensuring improved efficiency both on the demand and supply sides. Consistent water metering and water audits recommended by the mission are a necessity. Information needs to be collected on sectoral groundwater consumption for domestic or agricultural uses. Comprehensive studies proposed under the mission will be crucial for identifying water shortage and surplus regions. Basin-wise designs for integrated water resources management will also be beneficial to address Karnataka's water shortage.

3.3 National Agriculture and Water Landscape

India has one of the largest agriculture sectors in the world and it is the primary source of livelihood for about 58% of India's population. India has the world's largest area planted to wheat, rice, and cotton. It is the second-largest producer of fruit, vegetables, tea, farmed fish, cotton, sugarcane, wheat, rice, cotton, and sugar. The agriculture sector in India holds the record for the second-largest agricultural land in the world generating employment for about half of the country's population. Furthermore, agriculture has undergone slow and gradual transformation from a subsistence-based and labor-intensive system to a modernised, capital and knowledge-intensive one. The availability of water for irrigating crops (either through rainfall or other irrigation sources) is one of the most crucial factors affecting cropping intensity. In India, cropping intensity has improved. Fertilizer consumption has also increased in most states.

Agriculture in India has diverse cropping systems across agro-climatic zones, mainly based on soil type, rainfall, climate, technology, policies, and the existing socio-economic situation of the farming community. Farmers are gradually shifting from traditional, subsistence farming of non-commercial crops to commercial/ cash crops to meet changing demand patterns and get higher returns. However, decreasing size of land holdings makes the viability of marginal and small farmers a major challenge for Indian agriculture. Since agriculture cannot sustain the workforce, job-seekers are pushed to urban areas to take up any work that can give them some sustenance keeping the labour productivity in agriculture low.

Agricultural intensification caused a decrease in human labour, rainfed lands received higher irrigation cover resulting in increased cropping intensity and fertilizer consumption. Although this process gave India much-needed food, feed, and fiber security it caused some negative consequences. It adversely affected the natural resources and environment, leading to the degradation of soil in places, depletion of groundwater, salinisation in irrigated areas, increased resistance to pests and weeds, pollution of soil, air, and water and greenhouse gas (GHG) emissions (Xie, Huang, Chen, Zhang and Wu, 2019; Aditya, *et al.,* 2020). Hence it is necessary to plan cultivation in keeping with the climatic and biodiversity scenario across the country.

Out of the total water consumption in India, about 80% is by the irrigation sector. Groundwater irrigation accounts for a major proportion. Water is being utilized in an unsustainable manner and has resulted in depleting our groundwater resources. Since the irrigation sector uses maximum amounts of water it is necessary to conserve and follow judicious measures to get good yields while following water savings.

Rice, wheat, and sugarcane represent 90 percent of India's crop production. These crops are all heavy water users. This puts pressure on the water table as these crops are water-intensive which puts great pressure on groundwater resources. To compensate for water shortages that result from droughts, groundwater resources are relied upon; this in turn increases the stress on these resources.

The government of India has felt the urgency of launching initiatives that are needed to mitigate over-extraction and overuse of water and to promote sustainable management of water resources driven by water efficiency and increased water productivity, growing different crops, and considering a shift to more water-efficient alternatives. In May 2019, the Ministry of Jal Shakti was created for sustainable water management. The ministry has schemes to enhance irrigation efficiency and outreach, and optimal utilisation of water resources through innovative measures.

3.4 Karnataka State Action Plan on Climate Change (KSAPCC)

In June 2009, the Government of Karnataka organised a Co-ordination Committee to oversee the adoption of the NAPCC at the State Level. It mandated the preparation of The Karnataka State Action Plan on Climate Change (KSAPCC) to the Environmental Management & Policy Research Institute (EMPRI) and The Energy and Resources Institute (TERI), with the first assessment resubmitted in December 2013. The KSAPCC focuses on those sectors that are important to the local economy and livelihoods, such as agriculture, water, biodiversity, health, transport, energy, industries, urban development, and forestry. The KSAPCC was the first policy document to tackle climate change at the state level in Karnataka. It laid the ground for crucial mitigation and adaptation action.

Based on climate research and scenarios from 2004 to 2011, the KSAPCC identified the scope for immediate actions. The document defined 200 actions of which 31 were tagged as priorities or entry points. It established sector-wise target areas with determined action points. The implementation mechanism, determination of interventions, and emerging trends in each section are based on missions identified in NAPCC. In order to achieve sector-wise targets, the document charts out the responsibilities of various departments for the implementation of the plan and allocation of funds. The bulk of implementation concerning individual action points as well as allocation of funds for each target area, and action point for five years beginning from 2012 till 2017, lies with the state government departments.

For the first attempt, the action plan has covered sectors of importance such as agriculture and water. However, the state-level action plan, being the first of its kind and developed almost a decade ago, provides an adequate start for addressing climate change and lays a foundation for climate-focused planning.

The KSAPCC is a fundamental sub-national policy document focusing on climate change at the state level. This state policy aims to align its framework of action for implementation with the mission laid out by NAPCC. KSAPCC outlines its strategies for a range of sectors, including proposed actions, a timeline, and a budget for each specific effects as well as vulnerabilities of climate change in each. KSAPCC aims to decentralise action beyond the eight missions of the NAPCC, particularly covering subjects like water and agriculture which are state subjects. The focus of KSAPCC is to make its plan participatory, build capacity, develop a vulnerability assessment, and draw on experts and donors for guidance and support.

Water and Agriculture in KSAPCC

The State Action Plan for Water resources is linked in several ways to the National Water Mission. Just as envisaged in the National Mission, the SAPCC plans to conduct spatial and temporal assessments of water availability for micro-watersheds and analyse the trends using models such as the Surface Water Assessment Tool (SWAT). It plans to set up dedicated facilities with advanced computing systems to make predictions for water resources, conduct GIS-based aquifer studies for assessing recharge possibilities, assessments on reducing evaporation losses within water storage structures, wastelands, fallow lands, agriculture lands through the usage of mulches, canal lining etc. KSAPCC intends to manage pilot studies to explore the augmentation of water resources from flood water and study efficient crop water utilisation and pressure irrigation methods. Studies on the measurement of flows of major irrigation canals will be conducted to improve efficiency and

a better accounting of losses. And most importantly the focus will be on regulating the use of bore wells, creating a policy on water metering for bulk consumers of groundwater, and formulating a legal provision in by-laws of local bodies for water conservation

Groundwater in KSAPPC

KSAPCC intends to enforce regulation measures under the newly enacted Groundwater Act. It will conduct inventorying and mapping ground water using GIS at the sectoral level. By using models such as the Soil and Water Assessment Tool (SWAT) the spatial and temporal assessment of micro-watershed based water will be assessed. GIS-based technologies will be used to study geo-hydrology. Qualitative and quantitative monitoring of groundwater will be done at the block level while expanding the promotion of groundwater recharges beyond present levels. A state-level policy body may be considered to review the possibility of prohibiting the use of groundwater for non-drinking and non-emergency uses. Introduction of a ground-water cess from which a groundwater fund would be created. The groundwater fund would finance ground-water recharge schemes proposed by private and public project proponents.

Surface water in KSAPCC

KSAPCC intends to extend the already existing BWSSB rule on rainwater harvesting to other urban local bodies. An incentive-based capital investment subsidy for rainwater harvesting structures will be encouraged. The state policy will promote multiple-use water services in drought/flood-prone areas. Soil and Water Assessment Tool (SWAT), will help in the spatial and temporal assessment of micro-watershed-based water availability.

Prediction of actual water availability and trends in the state using high-resolution climates impacts studies will be conducted at the block level. Assessing the potential volume of treated water will help in its reuse and application areas like in the usage of treated water for watering parks in existing layouts. Water Resources Department will lead a cost-benefit analysis to assess the financial burden of irrigation water and to formulate a pricing policy, rationalising irrigation, because of long-term sustainability and the need for adequate finance. Estimating a safe minimum river water flow will ensure the maintenance of ecosystems. Conducting socio-economic studies will help to understand the social acceptability of treated water and also create awareness to enhance the social acceptability of treated water so that best conservation practices can be encouraged on a pilot scale. The state policy aims at setting up integrated water resources management in public buildings to set examples and inspire confidence in the public.

4. Mechanisms and tools to strengthen the linkages between NAPCC/NDC and SAPCC

Linkages are of utmost important because states are the key implementation agencies of the NAPCC. Karnataka State Action Plan on Climate Change (KSAPCC) is a framework of action for implementing the missions laid by the NAPCC and aligning them with the specific effects as well as vulnerabilities of climate change in each of the states of India. The rationale for the formation of the SAPCC was to decentralise action beyond the eight missions of the NAPCC, particularly covering subjects like water and agriculture which are state subjects. The Centre developed a Common Framework Document, with the assistance of expert agencies, to guide this process, stressing that it be participatory, build capacity, develop a vulnerability assessment, and draw on experts and donors for guidance and support. Linkages address implementation challenges, close policy gaps, close communication gaps and provide extensive stakeholder engagement platforms.

Some of the mechanisms and tools to strengthen the linkages between NAPCC/NDC and SAPCC could be to **encourage links and coordination within state departments**. Implementation efficacy will increase by breaking down the targets mentioned in the state-level action plan into the district, block, and village levels. Greater clarity in financial support from centre and revenues within the state will help in for smooth implementation of schemes. A decentralized integrated watershed management approach for sustaining rainwater and rejuvenating lakes and ponds in Karnataka is needed. Introducing or expanding existing climate-specialized departments and personnel in government. Focus on increasing engagement with civil society; and creating systems for coordination across government departments and with local bodies Eg. Climate change cells in every taluka. Creating climate nodal units and introducing climate specialists within departments where possible, with a priority focus on departments that have a bearing on mitigation and adaptation such as power, water, agriculture, and transport. At the state level, Nodal units could manage climate-related planning and monitoring processes, as well as coordination with local governments.

5. Insights from water and agricultural sector strategies in the Karnataka State Action Plan on Climate Change for the national missions/NDC

1. Alignment of sectoral missions with NAPCC and policy shift of KSAPCC to accommodate NAPCC's vision of a 'directional shift in development pathways'

The KSAPCC and NAPCC reports are structured differently but the issues addressed are very similar. KSAPCC is focused on what the state department's role is in minimizing the climate change impacts on individual sectors. The NAPCC comes under the central ministries and SAPCC is a state-level document that is prepared based on the state climate profile. So the state steering committee/Advisory team should work on bringing more local-specific policies because each state has specific climate issues. So NAPCC's directional shift in the development pathways' cannot apply to all states. Key factors that give a different perspective to the KSAPCC are:

- Importance for drought resilient resistance varieties.
- Conservation of wild varieties especially in fruits and rice.
- Organic farming/natural farming for sustainable agriculture.
- Increase in farmer's income through carbon credits.
- ENVIS and NGC departments are conducting capacity-building training on climate change at the local level in Karnataka. Even other training centres, NGO's and research institutions in Karnataka like ATREE, IISc, and GKVK are focusing on this.

However, the NAPCC's sectoral mission may not be completely aligned with the state to tackle climate because of

- Majority of our agriculture system mainly depends on groundwater resources which are not priorities in both documents.
- KSAPCC hasn't laid out any strategy or road map for mainstreaming sectoral links and establishing the capacity to make an organised effort.
- KSAPCC needs to be rooted in gram panchayat levels which will address different issues in the state and the policy that can be effectively implemented.
- The directional shift in the development pathway is completely missing in KSAPCC. This is because the data in the KSAPCC is all secondary based and primary analysis of data on the ground is not done.
- No plans are chalked out by KSAPCC for capacity building and mainstreaming sectoral linkages in Karnataka state.

Experts have made the following recommendations

- KSAPCC needs to identify specific local issues in Agriculture and Water Resources. It could look into specific climate-driven initiatives and intensify rather than expand existing schemes.
- Local-specific problems related to climate change should be studied and documented before planning actions for local-specific issues. Right now, modeling outputs are at a higher scale and an understanding of these within the local context is limited.

- Every state government department should have one nodal cell for climate change and one nodal officer who will direct climate change initiatives in the department at the planning stage itself
- A climate change module must cover the following subjects in a module on how to tackle climate change: i.e. i.) Methods for replenishing groundwater on a per-farm basis. ii.) To encourage individuals to use fossil fuels responsibly, impose higher taxes on their consumption after the threshold level. It is crucial to track the consumption of fossil fuels by vehicle owners so that they are progressively taxed and not a flat tax. iii.) Expand irrigation areas by supplying farmers with piped water from canals. iv.) Educating farmers on which crops to plant when and encouraging them to use less water to grow high-value crops. v.) Capacity building of farmers regarding water budgeting to cultivate low water high-value crops especially using groundwater resources to maximize net returns per Rupee cost of water rather than producing more crops per drop since groundwater is economically scarce.

The KSAPCC and SAPCC reports are structured differently but the issues addressed are very similar. While the NAPCC national goals under each mission with clearer climate outcomes, SAPCC takes a conventional sectoral approach focused on interventions to achieve sectoral goals and impacts, and little on climate change outcomes - Dr. Srinivasa Badiger

In KSAPCC, there is no separate plan chalked for capacity building and mainstreaming sectoral linkages. Both are in-built into the action points under each sector. I suggested that every state government department should have one nodal cell for climate change and one nodal officer who will direct and implement climate change initiatives in the department at the planning stage itself - Dr. Hema N

The SAPCC being revised has a clear mandate from the center to be aligned with not only the NAPCC mission but also the NDC and SDG goals. A clear dedicated vision to align the two through stakeholder consultations and brainstorming is the way forward. A local perspective can be brought in only with a local understanding of the climate problem. Right now, modeling outputs are at a higher scale and an understanding of these within the local context is limited. It is also important to start looking at climate change through the intersectional lens of hazard, vulnerability and exposure - Dr. Indu K Muthy.

2.Limitations for state-specific climate Actions and the challenges of implementation

Many State Programmes like Bhoochetana Program which aim for an increase in rainfed crop productivity, Krishi Bhagya Scheme for rainwater harvesting and ensure protective irrigation during the critical stages of the crop, and Raitha Siri Programme aims to promote drought-resilient millet production. Though there are many schemes formed to mitigate the effects of climate change, limitations are evident. Both Agriculture Mission and Water Mission are largely development-centric but not climate centric. From the study, we found that Karnataka's state-specific climate actions may have limitations because of the following factors-

- Separate budgetary allocations have not been made for adaptation and mitigation of climate change
- There is a lack of institutional mechanisms at the state level with very little inter-departmental coordination
- There is a need for government supervision of climate change projects because monitoring and evaluation are very important.

- Active public participations and people partnership are lacking because knowledge on climate change issues is not disseminated properly.
- The state government mainly supports developmental projects.

Challenges of implementation

- *Data and Resources*: Major challenges in implementing KSAPCC are accessing data and resources. The state has been at the forefront of collecting sectoral data as compared to other states. Data on land-use and cropping patterns are available every 3-5 years from many of the state organisations including KSRSAC and Agriculture departments, but this is often not accessible in recent years. To address climate change challenges, we need granular information on climate parameters.
- *Institutional capacity and funding*: There is also a lack of technical and institutional capacity and inadequate financial support and dedicated budget allocation.
- *Coordination and information dissemination*: Lack of intrastate departmental coordination, overlapped responsibilities between the departments is a challenge since there is limited leadership and guidance to steer climate actions in various departments.
- *Information dissemination*: Inability to mainstream climate change concerns in sectoral regulations and policies, and lack of dissemination of information
- *Government projects and schemes*: It was observed that there is a lack of political will and climate knowledge among various stakeholders. Most of the staff are trained in the execution and management of developmental schemes but not in the direction of mitigation and adaptation to climate change.
- *Preparation of Action plans*: Agriculture and water are season-specific, therefore actions should be ready before starting each season. The state should develop region-specific actions for example rainfed area actions, river basin actions, coastal area actions etc.
- *Climate resilient agriculture and research*: This is also a very prominent challenge because it involves using seeds that are specially designed to take care of extreme weather or using a bio-molecules based treatment that protects plants from extreme weather like - excess rain, or excess heat. Rapid testing & validation of such new products in agriculture is much needed, given how quickly the weather is becoming extreme.

There is a lack of strategic planning based on current problems/ground limitations. Lack of budget allocated on climate change issues and lack of institutional structure/mechanism at the state level - Dr. Aditya Valiyathan Pillai.

The most prominent challenges in the implementation of State climate action, especially in the context of water and agriculture are lack of dissemination of information, overlapping responsibilities between the departments and inability to mainstream climate change concerns in sectoral regulations and policies at both state and central levels - Dr. Hema N.

Lack of political will on climate change issues in the State as the focus is largely on ad hoc and symptomatic developmental projects. The State has rejected both the Environmental reports – the Gadgil Committee and Kasturirangan Committee reports as a prima facie reflection of utilitarian motives as against sustainability motives in environmental development. Dr. M. G. Chnadrakanth

The most prominent challenges in the implementation of State climate action, especially in the context of water and agriculture are:

i. Lack of capacity building concerning surface water and groundwater resources and irrigation is leading to overexploitation of groundwater, as well as a lack of maintenance of irrigation tanks.
ii. The irrigation tanks which were and are the mainstay for groundwater recharge have been continuously neglected and they need adequate attention and support
iii. Crucial to educate farmers and users of groundwater regarding individual bore well recharge
iv. Crucial to educate urban property site owners and builders about green buildings as well as tree planting, rooftop rainwater harvesting, and groundwater recharge. There are no strict regulations towards these and policies need to be generated for stricter implementation
v. Currently, limited leadership and guidance to steer climate actions in various departments.

3. Managing climate data to face current and future climate risks

There are several challenges in both water and agriculture sector in Karnataka and across all states in India. In the water sector, at a basin level the research suggests there will be more intense, erratic and extreme rainfall events, with fewer rainy days. This will lead to frequent droughts and floods, and their magnitude and duration will be extended which will pose a whole new set of challenges for managing the reservoirs and drought mitigation programmes.

The state has proposed reforms in water, agriculture, and allied sectors to minimise the impacts on crop yields and loss of livelihoods including animal husbandry. The Karnataka State Natural Disaster Monitoring Centre (KSNDMC) has been providing climate crop advisories and ensures that the meteorological data is delivered to all stakeholders and to the registered farmers daily to reduce the impact of a disaster.

Data gaps in the data at the sectoral level are a major setback to improving our understanding of the climate change impacts. Placing data in the public domain will greatly help non-profits and private researchers.

The state can fill the data gaps by providing funding to the organisations like academic institutions, Think tanks, NGOs working in this field that will do the monitoring and provide the time-related projections of region-specific climate data. Climate change projections at the district level by CSTEP, Karnataka are available for use.

There are plenty of data gaps and to overcome these issues our state should find ways to reduce the problem in cities, building resilience in crops, practice crop rotation and alternative crop systems, timely action to prevent floods, increase soil fertility and provide soil health cards to farmers - Dr. Srinivasa Ravindra.

Both floods and recurrent droughts are the current and foreseeable climate threats in Karnataka's water and agricultural sectors. The data gaps include forest areas planted to different tree species, in the State as well as in the western ghats covering native tree species as well as non-native such as silver oak in shade tree coffee plantations, Still, there is no integration of KSNDMC with IMD as well as the Irrigation Department's water level data for reasons beyond comprehension. It is crucial to integrate especially for use in interstate river disputes - Dr. M.G. Chandarakanth.

4. Guidelines and methodologies for stakeholder consultations and placing data in the public domain

Guidelines and methodologies for Focus group discussion with stakeholders and interviews with leaders of Gram Panchayat, Zilla Panchayat, farmers' producer organisations, and local leaders of NGOs need to be chalked out. Stakeholder consultations are very helpful before and after each season in a year. Whenever there is an extreme event there should be stakeholder consultations to mitigate the issue in the future. Stakeholder consultations while sharing water resources are very important. Region-specific climate change training led by ENVIS and NGC coordinators serves as the methods of consultations and guidelines for stakeholder consultations in the KSAPCC. The methodology used at each level, from planning to implementation, for each department and stakeholder is highlighted in the KSAPCC second assessment report that will be released soon.

Each department can establish a nodal cell or nominate a nodal officer to oversee the transparency and public disclosure of all consultations, evaluations, and comments. The majority of the acts, research findings and records are not in the public domain, thus their availability is necessary. Every decision should be made public by publishing or sharing it on various media. Study findings should be posted on institutional websites. Sharing decisions through mobile SMS and holding knowledge-sharing meetings at the village level would be helpful. It is recommended that all of this information be made available for free viewing on their official websites.

Information about climate change needs to be shared with education programmes, awareness videos, and social media.

The methodology used at each level, from planning to implementation, for each department and stakeholder is highlighted in the KSAPCC second assessment report that will be released soon. Each department should establish a nodal cell or nominate a nodal officer to oversee the transparency and public disclosure of all consultations, evaluations, and comments - Dr. Hema .N.

In Agriculture Dept previously there were Gram Sevaks who were in charge of the overall development of the village and were the main point source of information as well as hand-holding for farmers, but they are now totally dismantled after the T and V system existing during the green revolution. It is crucial to once again revisit the T and V system model and develop a new agricultural extension system utilizing Agricultural, Horticultural, and Agri Engineering graduates of the State. Utilizing social media, institutional websites, and roadside education sign boards along with Mobile data apps for complementing extension efforts is crucial - Dr. M. G. Chandrakanth.

5. Research gaps in water management and the relevance of water budgeting

Karnataka water resource department is a regulatory agency that mainly focuses on implementing, monitoring, and evaluating the water resource data. It is meant to study demand management and assessment of resource availability throughout the year. But they never work on improving research gaps in water management or increasing external participation in rural areas. It seems to be a national authority with no powers to change allocation, and decisions and implement any reforms that conform with the goals of NAPCC.

The Karnataka water resources department is currently focusing on the two main rivers used for irrigation, the Kaveri and Krishna, while largely ignoring the groundwater resources used by the bulk of farmers. There isn't enough political will, which makes it harder to improve rural water management.

It should focus on managing violations in designed cropping patterns at command areas, drinking water, industrial extractions, distribution losses etc. Monitoring of overutilization at domestic levels and in irrigation fields is also needed.

Water budgeting is a very effective method for planning water conservation in the state, particularly in the arid water scarce north Karnataka districts. It is effective in terms of resource conservation, utilization, and crop production. Moreover, it will be beneficial for demand management. But in Karnataka, budgeting for water is ineffective. Focussing on developing a water budget at each panchayat level, river basin, watershed area, urban and rural would be helpful for crop growing, drinking, environmental management, and climate mitigation and adaptation.

The experts have suggested that all farmlands be equipped with low-loss water meters so that farmers can be compensated for the amount of water they use during cultivation. To determine how much water is lost to leaks and evaporation, dams should also be equipped with water meters and measuring systems.

6.Role of hydrological observatory station in the state for weather forecasting

Karnataka has improved in the management of recent floods. The "Disaster Management Task Force and Karnataka State Natural Disaster Management Centre (KSNDMC)" provide predictions one week before the event and weather forecasting data is available to farmers on their website which is the best for flood forecasting and warning systems. To prevent future losses of life and property in the state, flood forecasting systems must be improved and advanced technologies must be used.

Karnataka has improved and it has the best flood forecasting and warning systems. Karnataka State Natural Disaster Management Centre (KSNDMC) is providing flood forecasting alters to farmers and the public before disasters - Dr. Lenin Babu K

7. Organic farming and indigenous/climate-resilient crop varieties

Karnataka State is 4th largest in terms of "Organic Farming in hectares". It would be helpful if this traditional system is strengthened because traditional land races internalize the local changes in weather and other agronomic practices. It was opined the Government provides incentives for organic farming which will help in the initial stages of farming but the effort is not successful because the market has not yet been improved, so endpoint sale is very difficult for farmers. That is why farmers hesitate to take up organic farming. Hence future efforts should put a greater emphasis on market support.

Apart from the market value we also have to be aware that such reforms may have implications for immediate household-level food security and sustainable income generation during the transition for small and marginal farmers.

One way to incentivise organic farming is through Carbon Credits. When organic farming is pursued, it increases the carbon content of soil. This also leads to the sequestration of CO_2 from air, and thus an important aspect of climate change CO_2 reduction. This is measured in terms of Carbon Credits. These credits are sold in voluntary carbon markets and thus can provide an incentive to farmers for organic farming.

Indigenous/traditional varieties are highly suitable for sustainable agriculture. The discussion with experts has been towards seed procurement, financial vulnerabilities, end point sale or help from the government in marketing the crops.

Seed procurement: Seeds are controlled by government agencies like KVK and also Bhoochetana scheme provide seeds through seed bank. To some extent, there is an involvement of the state in protecting climate-resilient crop varieties but it is doubtful whether they provide climate-resilient crop variety seeds. Mass varieties of seeds are available but they still need a scope of improvement in production, quality assurance, distribution, transportation, and making available for farmers.

Government can promote community seed banks, incentives to traditional seed growers and subsidies for traditional crop cultivators. Moreover, Government should help farmers to store their seeds at their homes. It should provide subsidies/grants to seed storage equipment.

Subsidies, incentives and crop Insurance: Crop insurance (Scheme) is providing vulnerability assurance only to some extent at both state and national level. The government has only some vulnerability assurance concerning growing indigenous/traditional crop varieties as against cash crops. The government may Increase farmers' income through carbon credits.

The vulnerability assurances from the government concerning growing indigenous/ traditional crop varieties are Raitha Siri, Zero Budget Natural Farming (ZBNF), Organic Farming

Research: Government can support research activities related to traditional crop cultivation and nutrition analysis of local varieties. It should recognize more traditional crops and promote them in specific regions. In Karnataka, Agriculture universities and Karnataka State Seeds Corporation Limited (KSSC), GoK are working on conserving climate-resilient crop varieties. All the agriculture universities have seed breeding centres that provide seeds for farmers. Government must provide research funds on climate-resilient crops to agriculture universities.

End point sale and marketing: The best traditional crop varieties grown in Karnataka for climate resilience are millets. Farmers cultivate millets on a considerable scale in the districts of Tumkur, Raichur, and Koppal. Due to low market support and low consumer demand, these crops are not profitable. It has been recommended that all state governments provide market support to all farmers and raise public knowledge in order to enhance consumer demand for indigenous and climate-resistant varieties. This will encourage more farmers to cultivate these climate-resistant crop varieties.

State governments offer incentive programmes for cultivating organic and indigenous crop varieties, but there is a lack of end-to-end market assistance. Future efforts should put a greater emphasis on market support - Dr. M. G. Chandrakanth.

Although there is no market support for these crops, the state government provides some vulnerability assurance for indigenous and traditional crop varieties through incentives and subsidies to double the farmers' income against cash crops - Dr. M. G. Chandrakanth.

Funds from the government should be made available to Agriculture University for research on climate-resilient varieties. Seeds are controlled markets by government agencies like KVK and also Bhoochetana scheme provide seeds through seed bank. Government should promote community seed banks, incentives to traditional seed growers and subsidies for traditional crop cultivators. Moreover, it should help farmers to store their seeds at their homes. It should provide subsidies/grants to seed storage equipment. Government should support research activities related to traditional crop cultivation and nutrition analysis of local varieties. It should recognize more traditional crops and promote them in specific regions - Dr. Srinivasa Ravindra.

6. Recommendations

1. Rain Water Harvesting and Ground water level assessment

Aquifer mapping to determine the water level should be given importance since the water mission always highlights water efficiency by 20% but does not explain how to do it. The only way is rainwater harvesting. So rain water harvesting methods/ techniques need to be given more importance in the future. Ground water assessment after implementing RWH is needed to focus on recharging methods and assessment of its levels. For this, there is a need to combine all the organisations working in this field and their help, and knowledge should be disseminated to all. It was also suggested that government should install grey water treatment plants in every district so that water wastage can be minimized.

2. Adaptation strategies and Climate resilient crops

While suggesting the growing of climate-resilient crops instead of rice, the alternatives such as millet need to be linked to the food basket so that the gap between yield and income is closed. If we mean to increase farmers' income, more focus must be given to given to yield. So adaptation strategies should be focused both on increasing yield along with income. Under climate adaptation plans gaps between the yield and income need to be bridged properly. It was also pointed out that carbon credits are applicable only for plantation crops, so if organic farming systems need to be incentivize then reducing chemical fertilizers should be the best way.

3. Crop Insurance

While Carbon Credit suggested in the insights is a very good way to incentivize farmers' income, it is only applicable to larger farmers. The small and marginal farmers cannot use this benefit in their farmlands. The government has to provide incentives through crop insurance. However, crop insurance schemes have not been effective in Karnataka because of delays while claiming the insurance. It was suggested that processing claims in the shortest possible time will benefit all farmers and risk transfer will be the main focus.

4. Fund Allocation and Climate budgeting

The climate budgeting will provide funds for mitigation and adaptation strategies taken by the state and also will be mainly used for disaster risk enforcement. It is necessary to link vulnerability assessment with adaptation strategies and climate budgeting while focusing on block/district/village levels. The vulnerability assessment should be non-lapsable so that the remaining funds can be utilized for the next financial year.

Since energy demand plays a major and Karnataka state energy consumption is high, its role in water and agriculture sector and the consequent GHG emission count is very much important. It was suggested that climate risk mapping like multi-hazard vulnerability mapping should be always made available through KSNDMC which works on such mapping in Karnataka. All coastal regions are already working on climate risk mapping in India.

5. Need for a legal framework

According to EMPRI, in a recent meeting with the MoEFCC, for the revised version of KSAPCC, it was suggested to include a legal framework along with an implementation plan because the KSAPCC only highlights facts and figures. The Ministry would like to know the implementation status of the actions at each department level. A legal framework will help in evaluating the implementation status of the action plans.

6. Risk and Disaster management plan

The experts from stakeholder consultation shared some of the points that were missing in the insights like the district disaster management plan which will be a road map to reduce disaster risk. KSNDMC is already working on weather prediction by providing daily meteorological data. It was debated whether to involve the education institution in climate change projects/weather data predictions, following which it was pointed out that KSNDMC is providing flood forecasting daily to all the stakeholders and it was upto the people to take note of it.

7. Inter departmental co ordination and responsibilities

The experts expressed their opinion on improving inter-departmental coordination by preparing a proper work plan which will decrease the duplication of work between departments. Proper reporting systems would help to know what each department is doing so that duplication of work can be brought to attention. It has been recommended that persons who are eligible to take decisions must be involved in such discussions to ensure action on issues.

It was also pointed out that in the first assessment of the KSAPCC, the document chalked out the responsibilities of each department. This information needs to be disseminated to all government representatives from all departments mentioned in the plan.

Examples of good inter-department coordination were cited such as the involvement of BWSSB with KSCST in Karnataka for RWH, combining ministries for the Montreal Protocol discussions, NITI-Aayog initiatives, and WASH of Karnataka where several departments worked and collaborated successfully. An implementation status evaluation needs to be made at each departmental level, based on which funds can be allocated.

8. Capacity building and Implementation of plan

The study found that there are no plans chalked out by KSAPCC towards capacity building although it is very essential. Firstly, a list of stakeholders has to be prepared before beginning capacity-building training. The implementation plan has to focus on capacity building strategies necessary like those related to organic farming, rainwater harvesting, and climate resilient crops etc. However, they see a lack of clarity from the ministry on this. The role of each department at all levels should be highlighted in the implementation plan along with empowering the public on climate change literacy at all levels in society with a focused area like livelihood, personal health, and well-being. This will create awareness in gram panchayats and help them to decide on implementation on the ground.

7. Conclusion

Karnataka has involved and consulted with premier research Institutions and Universities at the policy level for the preparation of the KSAPCC. The policy aims at a comprehensive plan which will find greater acceptance in all sectors. Our discussions and interviews with stakeholders and experts showed that vulnerability assessments of different agro-zones will be very useful to decide on a further course of action. Shifting to climate-resilient crop varieties and conservation of wild and indigenous crop and fruit varieties is another important point that has also been the focus at the National level. Encouragement and incentivising organic agriculture till the end point sale will be very helpful to further acceptance of such schemes. Aquifer mapping to determine the water level should be given importance in the water mission so that rain water harvesting methods/techniques can be given more importance with continuous assessment. Additionally it is necessary to install grey water treatment plants in every district so that water wastage can be minimized. Many schemes and actions are already adopted by the state which is in the right direction but awareness has to be created about KSAPCC and the state schemes by capacity building and training targeting particular sectors.

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Annexures

Annexure 1- Questionnaire

1. Are the NAPCC's sectoral missions aligned with the state government of Karnataka to tackle climate change?

a) If yes, How?

b) If not, how can it be integrated with our state?

c) What are the plans chalked out by KSAPCC for capacity building and mainstreaming sectoral linkages to make a coordinated effort?

2. The existing SAPCCs were formulated and implemented from 2011 onwards. While the focus of the National Action Plan on Climate Change (NAPCC) has been to meet mitigation goals through central policies, the adaptation goals fall largely in the domain of state governments to be met through ongoing programmes and channelized through KSAPCC. What is the limitation for Karnataka for the state-specific climate actions?

3. How far has there been a 'directional shift in the development pathways' as envisaged in the NAPCC to accommodate a policy shift in KSAPCC to make it more local specific? What are the key factors that give a different perspective to the KSAPCC?

4. What are the current and future climate risks in the Water and Agricultural sector in Karnataka? How will our state fill the data gaps of region-specific and time-related projections of climate data?

5. What are the methodologies of consultations and guidelines regarding stakeholder consultations in KSAPCC? How does the State plan to make consultations, reviews, and feedback transparent and place it in the public domain?

6. What according to you are the most prominent challenges in the implementation of State climate action, especially in the context of water and agriculture?

7. The Centre in its National Water Mission has developed a model template for the preparation of State Specific Action Plans (SSAP) with a dedicated component on water budgeting which will be useful for any future planning. How do the schemes align with Karnataka's Water management? Since Karnataka has diverse geographical area, do you think the water budget is effective?

8. Karnataka Water resources department is meant to improve research gaps in water management and increase external participation. How has it lined up with their expectations in rural areas?

9. Hydrological observation stations are supposed to improve flood forecasting and warning systems. Is there an improvement in the management of recent floods in the country/ in the state of Karnataka?

10. The state government's thrust on organic farming and growing indigenous crop varieties is a welcome move. However, do we have plans to incentivise this from production to endpoint sale?

11. What will be the vulnerability assurance from the government with respect to growing indigenous/ traditional crop varieties as against cash crops?

12. What is the involvement of the state in protecting climate-resilient crop varieties?

How will the seeds be made available to the farmers?

For example: The 'Kagga' is a saline-resistant, nutritive variety of paddy. How can the state government protect such seed varieties if the agricultural department can only provide seeds certified by the Karnataka Seed Corporation or the agriculture university?

Annexure 2 - Expert Acknowledgment

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