Climate change and adaptation in agriculture and water sectors: Technology and Policy inputs, Andhra Pradesh State, India

ClimaAdapt
Adaptation through Innovation

ClimaAdapt
Policy Manual
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Project Partners

IWMI International Water Management Institute

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1. Background

Climate change and climate variability is already affecting agricultural and water sectors in India. Climate change projections from RCP Scenarios for India indicates that the mean temperature will increase by 1.7 to 4.78 °C by 2030-2080 with an increase in precipitation from 1.2 to 11.3 % influencing the agricultural and water sectors. The extreme weather events and erratic monsoon patterns will have serious implications for agriculture development and food security in the country. There is an immediate need for targeted technology and policy interventions to reduce the risks and increase productivity of major crops, and mitigate droughts and floods.

The Andhra Pradesh (AP) state needs climate adaptation strategies through the adoption of smart water and crop technologies.

The bifurcation of AP into two states: namely Telangana and AP, has resulted in redistribution of natural resources between the two states giving rise to new challenges, particularly related to the primary sectors, namely, agriculture, livestock, horticulture, water resources, energy and marketing. In addition, AP consists of a long coastal line prone to frequent cyclones and flooding during the rainy season on one hand (Box 1), and droughts on the other.

Box 1: Climate change issues concerning the coastal regions

- The East Coast is considered as one of the most cyclone prone areas of the world. An analysis of the frequencies of cyclones on the East and West coasts of India during 1891- 1990 shows that nearly 262 cyclones occurred (92 severe) in a 50 km wide strip on the East Coast.
- More than 103 cyclones have affected AP in this century, of which 32 were severe in nature. Scientific prediction says that both the frequency and severity of cyclones will increase due to climate change.
- Out of 31.57 million people from the coastal districts of AP, approximately 2.9 million people mostly smallholder and rural poor are vulnerable to cyclones.
- According to an estimate by the Department of Disaster Management, GoAP about 44 percent of the state is vulnerable to tropical storms and related hazards.
- The coastal plains are largely delta regions formed by the Godavari, Krishna and Pennar rivers; and these are under intense agricultural use. The lack of adequate canal based irrigation facilities and large-scale aquaculture in the state is leading to heavy dependence on groundwater reportedly resulting in seawater intrusion into the fresh water aquifers in the east coast (Nageswara Rao 2005). This increases the salinity of the soil (Mahesha 1995) and affects agricultural land and productivity (Datta et al. 2009).

The State is popularly known as the "rice bowl of India" is under constant threat due to extreme weather. The productivity of paddy is stagnant due to the drought and flood impacts, in addition to other factors including urbanization and price variations. The cost of cultivation has increased, whereas, farmer incomes have declined relative to the increasing cost of labour and inputs, rural out migration and inflationary pressures putting added burdens on farmer's livelihoods.

2. Climate Change Adaptation and Mitigation in Andhra Pradesh

The Government of Andhra Pradesh (GoAP) has prepared the State Level Action Plan on Climate Change (SAPCC) to address existing and future climate risks and vulnerabilities. The SAPCC of the GoAP (EPTRI, 2011) indicates that the coastal, rain-fed, forest and urban ecosystems of the state are highly prone to climate change; and climate change is expected to negatively impact the water

resources sector here. This plan may need revisions and follow a more integrated and targeted approach taking the challenges related to water and agriculture sectors of the newly formed state.

The current challenges involved in water management are low Irrigation efficiency (i.e., 35%) and water productivity (0.48 kg/m3 of consumptive use) in canal irrigated agro-eco systems. Good water management practices will increase yields, improve crop quality, conserve water, save energy, decrease fertilizer requirements, and reduce non-point source pollution. Timely information and knowledge is most critical to decide on exact amount of water required by a crop in a given climatic condition and for effective design and management of irrigation system and irrigation scheduling.

ClimaAdapt project has tried to address some of these problems including climate change risk assessment and vulnerability mapping, and further identifying suitable climate smart adaptation measures, capacity building of men and women farmers and stakeholders, and providing policy recommendations. Gender was considered as an important factor in adaptation within agriculture sector. The project has identified important technology and policy recommendations jointly with the stakeholders that could serve as inputs to the state adaptation plans. Some of the technologies tested and found successful are discussed in this brief.

2.1. Climate Smart Agriculture

a) Climate Smart Rice farming systems: In ClimaAdapt project, various adaptation technologies related to water management for improving the on-farm water use efficiency

were tested with the participation of men and women farmers and implemented under canal commands of Andhra Pradesh. Direct Seeding of Rice (DSR), Machine Transplantation of Rice (MSRI) and Alternate Wetting and Drying (AWD) were validated over 5 seasons and implemented in a systemic or cluster approach (adopted by a group of farmers) in the canal commands of Krishna river basin. Results showed that the water use efficiency (yield /water used) was higher under the tested climate smart adaptation technologies compared to conventional practice under Nagarjuna Sagar Project area (Table 1).

Table 1. Water use efficiency (WUE) under different adaptation strategies (kg/m3)

Methods	NM	DSR	NM	MSRI	NM	AWD
DSR	0.35	0.59				
MSRI			0.46	0.57		
AWD					0.30	0.40

NM=normal method; DSR=direct sown rice; MSRI=modified SRI; AWD=alternate wetting and drying

As the cost of the labor was high due to labour intensive nature of rice crop, DSR found to be alternative adaptation strategy. The DSR method is suitable to rain-fed and irrigated environment with better water control. Our studies showed that DSR is most favourable to

rain-fed lowlands and irrigated areas with good drainage facilities. The DSR method if adopted can save labour, and water resources (25%) and crop matures 7-10 days earlier and reduced the cost of cultivation by INR 10,000 per hectare. DSR also reduces the methane emissions by 30% from rice. The method was adopted in 64% of cropped area under rice during 2015-16 in Guntur district.

The other method MSRI performed better under labour scarcity conditions, and intense of pest and disease was lesser. In MSRI method the seed rate, seed cost per ha and water usage was less with improved WUE (15%). However, timely availability of transplanters through service providers is challenging. Rice grown under AWD in the Nagarjuna Sagar Project was found to improve WUE from 0.16 in light to 0.30 in black soils. AWD showed better nutrient uptake and increase water productivity (25%). AWD has increased the yield by 14% in the study sites. All the three methods can reduce the methane emission, increased water productivity and income to the farmers.

b) System level: For more accurate hydrological measurements, there is a need to develop alternative soft approaches that permit to estimate water fluxes in catchments with a higher spatial sampling rate. In this context, sensors are required as alternative. ClimaAdapt project has used RBC flumes and sensors on distributary committee (DC) 21 to monitor and measure water levels and discharges. This also helped to create awareness amongst farmers. One of our recommendation is to install the innovative low cost sensors (CLICK and TWEET) developed by the climaAdapt program at DC and water user association (WUA) level that could help in water budgeting and scheduling of irrigations according to the need of the crop.

Training and increasing awareness of men and women farmers, WUA personnel, and engineers is essential to improve WUE at the

farm and system level. The main challenge will be the ability of irrigation institutions to change their operations from a top down water distribution system to a demand driven one in the future. This could help the state to optimize water use in agriculture, especially rice.

2.2 Initiatives to risk minimization-weather based crop insurance scheme (WBCIS):

The WBCIS another issue of focus, expected to provide significant way out to reduce vulnerability to weather risks in agricultural sector. It is being tested and implemented in most of the states in India. But, its uptake by the farmers is poor due to lack of awareness, trust and quality of data from the weather stations. In the climaAdapt project, the challenges to implement WBCIS were analysed involving farmers, private agriculture insurance companies and government agencies. Automatic weather stations were installed to overcome some of the constraints in developing customised weather index products. Results showed that, in case of the crops grown in the wetlands, an extended dry

[1] *ClimaAdapt program contribute to the improvement of adaptive capacity of farmers and link science-policy research to develop adaptation framework for water and agricultural sectors (www.climaadapt.org)*

period coverage accounting is needed to address consecutive days in a month without rain. The minimum temperatures can also be considered from second fortnight of November until end of December in the WBCIS.

On the other hand, extended dry periods could affect forage yields in the dryland system but wouldn't necessarily trigger a claim payment because the monthly average rainfall could be close to the historical average. Hence, contracts should be revised with cumulative rainfall over shorter intervals, as observed in ClimaAdapt and agreed by stakeholders. The crop insurance schemes such as the Pradhan Mantri Fasal Bima Yojana (PMFBY) can take up such recommendations provided for revised WBCIS, and work together with farmers and private agricultural insurance companies in the future more closely. At the same time, there is a need to develop farmer awareness about climate risks and measures to overcome weather risks. The crop insurance schemes should also have continuous monitoring and timely pay-outs for improving the adoption of the weather insurance products.

2.3. Farmers Capacity building

A demand driven capacity building and knowledge dissemination is the need of the hour to increase the adaptation to climate change and up-scale the technologies. The baseline research findings from ClimaAdpat project indicate that technology adoption is rather slow (less than 10%) and the major constraint is the lack of technical knowhow and timely information. Timely trainings to men and women farmers coinciding with the crop calendar, agricultural and irrigation officials in the project demonstrated that it had direct impact on the crop performance and better productivity.

In the state of AP, trainings on climate change and impacts, climate smart adaptation strategies for improving WUE, awareness on water accounting were popular. Use of different training methods by WALAMTARI, one of the core project partner, were planned in a gender sensitive manner including lectures,

field days, videos, demonstrations and farmer to farmer exchange that proved to be more effective, especially in reaching women farmers. One of the recommendations for the state government is that it should provide adequate funds for training and capacity building with specification to reach 50% women farmers. Selected training modules and innovations from ClimaAdapt project have been standardized and integrated into the curricula of the training institutes in the state.

2.4. Institution building - Village Knowledge centres

The community based Village Knowledge Centers (VKCs) were established in two study sites of Andhra Pradesh State and they demonstrated that effective use of communication technologies and timely information and knowledge to men and women farmers undertake informed decisions to reduce risks and increase income.

As knowledge hub, these VKCs cater to the information and knowledge demands of farming community in the context of climate change for informed decision making in time to maximize water-use efficiency, ensure sustainable agriculture and improve livelihoods. Knowledge generated through VKCs cover climate resilient technologies, pest

and disease management, soil and water conservation, market trends etc. Experience shows that VKCs can significantly promote climate literacy among the farming community with due importance to women farmers. VKCs are an useful platform for farmers to meet and interact where learning becomes important. Each VKC has the capacity to connect 8000-10,000 farmers.

The use of multiple communication technologies that are managed largely by women knowledge workers from the same village facilitated improved access to demand driven climate specific knowledge among women and men. Strategic partnership has been established with the Agriculture University, Krishi Vigyan Kendras and Department of Agriculture that helped VKCs to provide critical information and knowledge pertaining to farming inputs and advisories.

Timely decision-making and direct discussion with experts enabled to significantly reduce gender and digital divide, reduce loss, risks and vulnerabilities, maximize economic returns. Some key observations from the VKCsare presented in Box 2.

Box 2: Key observations of VKCs

VKCs in ClimaAdapt have directly reached 21,666 households on a daily basis average (30 per cent of women and 70 per cent of men).

Women are able to access new information that gives them the freedom to make valuable and meaning choices, and apply new and key information from VKCs, for bettering their livelihoods.

The timely information and knowledge on various aspects such as water management, seed treatment, pest and disease management, and nutrient management enable farmers to gain additional income of 11. 85 lakhs in addition to reduced risk.

The women knowledge workers who hailed from the local community and hardly passed primary education are now able to realize the intangible benefits such as (a) Increase in the knowledge on diversified subjects, (b) Increased confidence, communication, mobility and self-esteem (c) Improved recognition at the household and community level (d) Participation in village level meeting, and (e) Ability to make informed decision.

2.5 Climate cells for weather forecasting

A unique initiative taken-up in the program is establishment of Climate cell and weather forecasting centers in the state. Training the trainers program designed under the project has targeted a wider outreach, having a multiplier effect. The climate cell set-up in the state (in Guntur) is responsible for carrying out climate and hydrological scenario development activities, improve accuracy of weather forecasting, advice farmers on adaptation measures, maintain climate and water related databases and advice the policy makers when needed. The climate cell has the potential to improve the capacity of irrigation engineers and scientists on modeling, developing hydrological scenarios and, flood monitoring tools.

2.6 State level supervisory committee/Stakeholder committee

In Andhra Pradesh a State Level Supervisory Committee (SLSC) was set up under ClimaAdapt project to review the progress of the Climate Change adaptation in the state. The validated and promising technologies were regularly discussed by the SLSC and proposed for the upscaling of the technologies through 'Rythukosam Program'. The DSR, AWD and MSRI are being validated at different locations in the state based on the SLSC recommendations. The Department of Agriculture has initiated measures to promote the DSR by conducting large number of campaigns, group discussions and result demonstrations at village level. Timely supply

of seed drills (253 seed drills supplied during 2011-2014) on subsidy basis by the Department of Agriculture has also increased the adoption.

3. Framework of up-scaling/ or scaling out

Innovations from the ClimaAdapt project are now entering into the curricula of training institutions and methodologies for enhanced outreach are developed. Some of them, such as the soil moisture sensors, plant clinics and village knowledge centers can provide high quality services at an affordable cost provided they deliver services to farmers on demand. The government will be able to scale out quality services and more cost effective dissemination methods must supplement the existing ones.

It is likely that the innovations will be scaled out by the respective government institutions, but given the constraints on resources this will take some time to materialize. It is upto to the state governments to prioritize the adaptation initiatives in agriculture and water sectors. The existing government programs need to be geared-up incorporating the recommended CSA practices. Up-scaling of these practices need to be supported by adequate investments and capacity development at different levels. ClimaAdapt has demonstrated how the implementation of the CSA practices through capacity building and linkage to markets and policy support can be successful. Integrated adaptation can increase the area under CSA, increase benefits to both men and women farmers, optimize input use and reduce greenhouse gas emissions. To summarize, the following recommendations are provided for the state of AP.

Policy recommendations

- Improve weather forecasting to men and women farmers with more certainty, timely messaging/and alerts to farmers on mobiles about extreme weather events.
- Update the inventory of water resources annually, and plan CSA for respective regions and allocation of water resources based on demand.
- Analyse the existing adaptation mechanisms, fine-tune strategies to suit different regions. Pilot the key interventions (DSR, MSRI, AWD, Green manuring, WUE for different crops) in new areas, in selected locations.
- Plan for demand based gender sensitive capacity building programs for various stakeholders in all the districts based on ClimaAdapt model.
- Build creative partnerships to facilitate CSA adaptation through stakeholder participation; work closely with local institutions.
- Convergence of ongoing government programs, (for example integration of VKCs into state extension programs) and agencies to address specific issues can help use of resources and implementation of the adaptation strategies effectively.
- Ensure that climate data/ information are readily available to scientists that is crucial for making climate projections with more accuracy, and identifying vulnerable groups and hot spots.
- WBCIS should be improved by including the agriculture infrastructure, crop and livestock components into insurance policy.
- An improved gender sensitive state action plan with defined investments for implementing the effective CSA adaptation practices, initiatives and institutions should be one of the state government's priority now.

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