ClimaAdapt
Adaptation through innovation

Climate Change Adaptation: Technology and Policy options for Tamil Nadu, India

ClimaAdapt **POLICY MANUAL** April 2017

Project Partners

IWMI International Water Management Institute

NIBIO Norwegian Institute of Bioeconomy Research

MSSRF

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1. Introduction

1.1 Overview of Agriculture in Tamil Nadu

Tamil Nadu State in India has historically been an agrarian state and it is a major rice producing State of the country. It is divided into seven zones based on the agro-climatic features and accordingly the type of crops grown in each zone differs. The Gross Cropped Area in Tamil Nadu is around 5.14 million hectares of which the Gross Irrigated Area is 3.0 million hectares (58%) (Tamil Nadu Economic Appraisal, 2014).According to official estimates of the Planning Commission, Government of India the incidence of poverty in Tamil Nadu is 21.12 per cent (20.55 % in rural areas).

Paddy is the major crop grown in all districts with a share of 44% of the total cropped area followed by groundnut and pulses each grown at 15% of the cropped area. The total cropped area has decreased over years due to erratic monsoon patterns, decrease in water and labour availability and urbanization, which has diverted more farmland to non-agricultural purposes and also the farm labour from agriculture. About 85% of the farmers belong to small and marginal category and their operational holdings account for 56% of the total area. Of the several factors, climate variability and more frequent extreme weather events isseriously affecting agriculture production. Small holders are highly vulnerable to climate change due to loss in production and farm income. Irrigated ecosystems are equally affected, similar to rain-fed systems due to the issues related to improper water harvesting, storage and distribution. Hence, managing water more efficiently in the future will be quite relevant for sustaining agriculture production.

Using the climate predictions, and results from the ClimaAdapt project field studies and modelling scenarios, suitable interventions aresuggested in this manual particularly to address the negative impacts of climate change on agriculture. This policy manual briefly provides climate change scenarios and their impacts in the state, the current interventions taken up by the state and the ClimaAdapt project derived outputs for incorporation in the state action plan on climate change to strengthen its initiatives further.

1.2. Impact of climate change on crop yield, area, production and income in Tamil Nadu

The climate of Tamil Nadu is expectedto change in the future timescale. Predictions from climate models (GCMs and RCMs) indicate that temperatures are expected to increase by 0.60C during 2020 and by 1.90C by 2050 with high confidence level (Geethalakshmi et al., 2011; Bhuvaneswari et al., 2013). Rainfall changes are uncertain and are expected to increase by 5 to 10 % during 2050 but not much change expected until2020 (SonaliMcdermid et al, 2016). However, frequency of extreme events such as droughts and floods are expected to increase due to improper distribution of rainfall as well as unseasonal rains.

The dynamic crop simulation modelling outputs show that the impact of climate change will be more towards 2050 compared to 2020. Sugarcane crop in the state will be more sensitive to climate change compared to paddy and groundnut crops. Average yield reductions will be ranging from 3.5% in paddy to 13.4% in sugarcane by 2020 and it will be 4.5% and 9.4% in 2050 respectively (Table 1).

The marginal effects of climate variables on net revenue will have negative effect. Most of the districts in Tamil Nadu, except Nilgiris (which is a hilly district) have negative effect on the net revenue. This explains that higher the change in climate variable, lower will be the net revenue. For example, Dharmapuri district farmers will experience a loss of INR 1,740 for one-degree increase in minimum temperature and Trichy, Cuddalore and Perambalur districts farmers will suffer a loss of 79%, 34% and 33% respectively in net

Table 1. Climate change impact on yield, area and production of major crops in Tamil Nadu

Production (hundred thousand tonnes)

	Existing	2020	% Change	2050	% Change
Paddy	76.06	69.32	-8.86	66.52	-12.55
Sugarcane	275.28	215.86	-21.58	218.19	-20.74
Groundnut	22.49	19.83	-11.80	20.51	-8.81
Area (Lac Hectare)					
	Existing	2020	% Change	2050	% Change
Paddy	22.39	21.15	-5.54	20.52	- 8.35
Sugarcane	3.28	2.97	- 9.45	2.87	- 12.50
Groundnut	12.89	12.23	-5.12	12.42	- 3.65
Yield : paddy and groundnut (Kg/ha); sugarcane (t / ha)					
	Existing	2020	% Change	2050	% Change
Paddy	3397.32	3277.68	- 3.52	3241.86	- 4.58
Sugarcane	83.93	72.68	- 13.40	76.02	- 9.42
Groundnut	1745.04	1622.10	-7.04	1651.58	-5.36

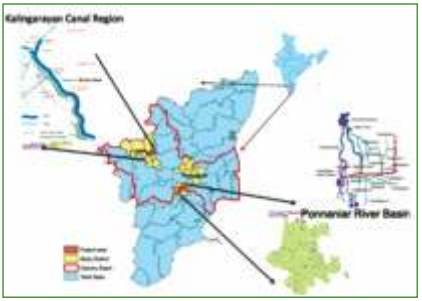
Source: Palanisami et al.2014.

revenue per one degree centigrade increase in maximum temperature.

2. Interventions by ClimaAdapt programme in canal irrigation systems

The ClimaAdapt program tested various climate change adaptation strategies in the two basins viz. Kalingarayan canal basin at Erode district (KB) and Ponnaniar reservoir basin (PB) at Thiruchirapalli district, Tamil Nadu, India from 2012-13with the participation of farmers and other relevant stakeholders. Kalingarayan canal is of 92 kilometres in length lying at 534 feet above mean sea level and irrigates 5269 ha of agriculture land. Out of this the project was implemented in the upper mid region in about 800 ha covering around 500 farm families with population of 12860, comprising of 6509 males and 6351 females. Ponnaniyar reservoir is situated in Mugavanur village of Manapparai Taluk, Trichy district across Ponnaniar River and the ayacut area is 840 ha. The project is operated in the entire 840 ha of area. Ponnaniar reservoir basin (PB) has 10860 people in which male and female are 5848 and 5012 respectively.

Figure 1. Study location in Tamil Nadu



2.1 Adaptation to the impacts of climate change

Technologies such as modified SRI for improving water use efficiency, promoting climate resilient rice varieties, Integrated Nutrient Management(INM) with soil test based nutrient application, Green manuring and biofertilizers application, integrated pest management, crop rotations with legumes, agro-advisory services, multilinear agri-extension systems supported by ICT tools and Village Knowledge Centres, promotion of alternate livelihoods and weather based agro advisory system to plan their agricultural

operations based on the expected weather conditions have the potential to reduce the water use and adapt to the changing situations of climate. Targeted capacity building of stakeholders and gender main streaming were the strategies adopted while promoting the above technologies.

a) Modified System of Rice Intensification (MSRI):

SRI is considered to be the most suited rice cultivation practice for changing climate because of its low water requirement, higher productivity, low GHG emission and higher profit compared to conventional flooded rice cultivation system. Given the advantages of SRI, less than 10 per cent of the farmers are

only adopting in the study basins. This was mainly due to the operational problems such as: (i) perfect land levelling and proper water management (ii) problems associated with very young single seedling planting, (iii) unavailability of skilled labour for square planting, and (iv)drudgery in cono-weeding operation. To overcome the difficulties, ClimaAdapt suggested modifications in the SRI principles and practices, including, machine planting 15 days old seedlings, 2 seedlings per hill, mechanized cono-weeders for weeding, perforated cylindrical field water tubes for effective implantation of alternate wetting and drying method of irrigation to suit to the study basins.

The rice grain yields under SRI plot in both basins were greater than the Conventional Technologies (CT). The grain harvest index for SRI was very high (75%) in both sites, which is above the normal index for rice plant (17-56 %), that might be due to higher grain yields recorded in SRI plots. The highest grain yield was produced in the treatment containing all six components of SRI, averaging 8.74 t/ha across the two sites. In contrast, the conventional flooded system yielded only 5.86 t/ha. The water consumed in SRI was lower than CT in all crop growth stages except during 46-60 days after transplanting (DAT) period, where water consumption was same under both SRI and CT. In total, 491 mm water was used by SRI against 630 mm under CT in addition to the rainfall of 480 mm received during cropping season.

In addition to the MSRI, the following package of recommended practices, programs and institution building are more relevant which were taken-up through farmer participatory action research trials in different locations of the project area.

b) Integrated Nutrient and Pest Management:

Green manure application: The impact of green manure application in improving soil organic matter content was demonstrated in the experimented fields. The organic matter content before green manure application was 0.90 and 0.86 percent in Kalingarayan and Ponnaiyar basins respectively. Through the addition of organic matter through green manure crop (Sesbaniarostrata) helps to increase the soil organic matter content to 0.96 and 0.95 percent respectively in Kalingarayan and Ponnaiyar basins. More than 1800 soil samples were analysed for available major and secondary nutrients for the entire KB and PB. Soil health card was issued to farmers with soil test based recommendations for the following seasons. Leaf colour charts

** It isfacilitated by TNAU and NIBIO, in partnership with Water Resources Organization and Irrigation Management and Training Institute for building the capacity of farmers and stakeholders in water management and to facilitate the water distribution and M.S.Swaminathan Research Foundation (MSSRF) to integrate and build knowledge management and gender perspectives.*

were given to decide the time of top dressing of N fertilizers with proper training to use the same. Micronutrient deficiency information was provided along with micro nutrient mixtures to apply in the fields. Bio-fertilizers such as Azospirillum and Phosphobacteium were applied in the main field as well as treated with the seeds. The water fern Azolla was introduced in the paddy field as dual crop to promote biological N-fixation. Azolla was multiplied in the nurseries and applied in the main field. This has improved the available nutrients to the crop, minimized the weed infestation, reduced methane flux from rice soils by 14% and increased the grain yield by 11%. The excess Azolla from the paddy fields was used as green feed to live stocks and many farmers sold the Azolla to near by cattle units @ Rs.25.00 per kg resulting in additional farm income. Moreover Azolla application as dual crop in rice resulted in the saving of chemical N fertilizer (50 kg of urea/ha)). Bio control bacterium, Pseudomonasfluorescense was recommended to control blast infestation in rice. Trichogramma egg cards were supplied to the farmers to encourage biological control of caterpillars. These bio control and integrtaed pest management practices helped the farmers to minimize the over dependence of synthetic pesticides and fungicides in rice farming.

c) Weather forecast and agro advisory services

Even though regular weather forecasts are available to farmers, they are not so familiar with farmers. Hence, timely and reliable weather forecasting to the farmers is important (as shown in the project where messages were given to both men and women farmers on every Tuesday and Friday for planning their farming decisions mainly on irrigation and pest and disease control). This has resulted in saving of inputs (water, pesticides), better labour management and increased crop yields by 8 to 15 %. Hence, weather forecasting with more accurate predictions and local cropping system based advisories is useful to farmers.

d) Alternate livelihood options

The Ponnanaiar basin in Tamil Nadu is a water deficient eco system. The economy heavily depends on Agriculture and animal husbandry. More than 90 per cent of the people in the Ponnanaiar reservoir depend on the agriculture sector for their livelihood and any disturbance to monsoon heavily affects

crop productivity and the income generation. This basin also has more number of small landholders and agricultural laborers. Hence creating awareness on various agro based alternate livelihood opportunities would help the farm families and agricultural laborers to generate livelihood income. Under ClimaAdapt project capacity building programs on alternate livelihood ventures such as mushroom cultivation, Azolla farming, Vermi composting, Bee keeping for honey production etcwere carried out periodically. The mushroom cultivation has gained significant importance in Ponnanaiar basin villages. Climaadapt project helped them to obtain mushroom seed spawn from Tamil nadu Agricultural University and also provided technical help through their field scouts. Many women farmers are successfully cultivating

oyster mushroom and selling the mushroom in 250-gram pockets @ Rs.150 per Kg. One farm family by maintaining 50 mushroom beds managed an income of Rs. 3500 in 40 days. These women groups are now confident on this mushroom technology and planning to increase the number of mushroom beds in the coming months. They also use the mushroom for their own use and as mushrooms are the richest source of protein and vitamins, household consumption would also overcome nutritional deficiencies among rural children. Therefore, promotion of the alternate livelihood options and creating awareness and opportunities especially to women about the alternate income generating activities is one of the main recommendations from the project.

e) Targeted capacity building

Both men and women farmers are in need of specific skills to take up the recommended package of practices and the need based capacity building programs were conducted by IMTI, Trichy in technical support from Tamil Nadu Agricultural University, Coimbatore. The impact of various training programs (on MSRI, AWD, weather forecast, alternate livelihood options, etc.) and the feedback from the trainees indicated that 86.7% of the trainees have expressed that the training has been very useful to them by imparting new knowledge and technology. As a result of the training, prospective field adoption is also quite high (67%) and a number of landless farmers and women are also willing to take part and share the knowledge with others.

f) Village Knowledge centres

Village Knowledge Centres (VKCs) played a key role in building adaptive capacity among the vulnerable farming community by rendering adaptation strategies and services such as timely forewarning of weather, pest and disease, irrigation scheduling and market rate, quality inputs and its availability including saline / drought tolerant seed varieties, alternate cropping and cultivation practices such as promotion of minor millets, system of rice intensification, alternate drying and wetting method, water management techniques and government schemes and associated entitlements.

VKCs were established in Tamil Nadu state with a goal to promote equitable access to information and knowledge among households through effective use of Information and Communication Technologies (ICT). Understanding the value of knowledge, the community mobilized Rs. 1.40 lacs, which shows their sense of ownership towards VKC.

Knowledge Workers were equipped with adequate capacity to manage VKC in a gender sensitive manner and disseminate need based information and knowledge. The common services centre of Government of India has been integrated with VKCs to enable community to get e-governance services.

The overall reach of VKC in the project locations of Tamil Nadu was83,136, of which 31, 591 were women farmers. The analysis of user pattern unveils that 84percent of the users depend on VKC for agriculture and allied interventions.

An assessment conducted among farmers indicate 88 percent of the farmers expressed that the knowledge received from VKCs meets their need and are satisfied of the quality of the knowledge services, of which 60% of the users have applied the knowledge and information services. It is useful to provide timely and relevant information to farmers for better decision making and planning. The strategic partners both public and private value VKCs and use it as a knowledge platform for reaching out their schemes to the community.

A study conducted among the users showed that 83% of the farmers follow the advisories and recommendations provided through plant clinic, in which 67% of farmers stated that they realized increased income between Rs. 8000 Rs.10000 per acre.

3. Policy Recommendations

The Government of Tamil Nadu (GoTN) has prepared the State Level Action Plan on Climate

Change (SAPCC) for seven identified sectors in October 2013. It was endorsed by the Ministry of Environment, Forest and Climate Change (MoEFCC) in March 2015. The major aspects of the initiatives include precision farming for efficient use of resources, infrastructure development to manage future water crisis, implementation of national food security mission on pulses (NFSM-P), and increasing farm income by horticulture crops, etc.

Apart from these initiatives, other government programmes that help to build the resilience among local men and women to cope up the adverse situations are:

- Self Help Groups promoted by Mahalirthittam to organise women in collectives, improve access to credit and alternate livelihoods. So far, 193,000 groups having a membership of about 3 million women have been organized and encouraged to take up multiple livelihoods depending on their skills and resources.
- National Rural Employment Guarantee Act (NREGA) which provides a legal guarantee of 100 days of wage employment in a financial year to every rural household whose adult members volunteer to do unskilled manual work with minimum assured wage.
- Crop insurance schemes and access to formal credit at lesser interest rates for farmers were also introduced in the state.
- Give the scope of expanding the implantation of the recommended package of adaptation strategies in the state along with the existing government initiative, the following recommendations are made from the ClimaAdapt project:
- The water saving and climate smart adaptation practices such as MSRI with alternate wetting and drying has to be up-scaled in the identified areas of Tamil Nadu. Technology adoption incentives can be provided to the farmers by convergence of different government programs to address the technology spread and adoption.
- Daily weather forecast and agro-advisory services to the farming community through VKCs can address immediate solutions and improve the adaptation of technologies.
- The key promising technologies and alternate livelihood activities viz.,azolla, value addition to millet products and mushroom production can be promoted as alternative adaptation practices to the climate variability.
- Up-scaling the successful capacity building program modules and VKCs at state level covering different project areas and crops.
- Gender main streaming component to be added in all the capacity building and implementation programs to address the climate change related implementation packages.
- Initiatives such as the Climate Water Forum will help to address some of the key emerging issues on climate resilient agriculture where all stakeholders can converge and exchange ideas and implementation protocols.

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