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Rivers from Source to Sea

Climate Change and Rice Production: Impacts, vulnerability and adaptation in rice growing areas in India

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Background of the study

- A part of a larger integrated project (www.tnau.ac.in/climarice)
- Aim: To study the impact of climate change on rice production in India (a case of Cauvery Basin)
- Emphasis on science-policy interface, and stakeholder integration
- Developing scenarios and adaptation measures through stakeholder participation

Map showing study area

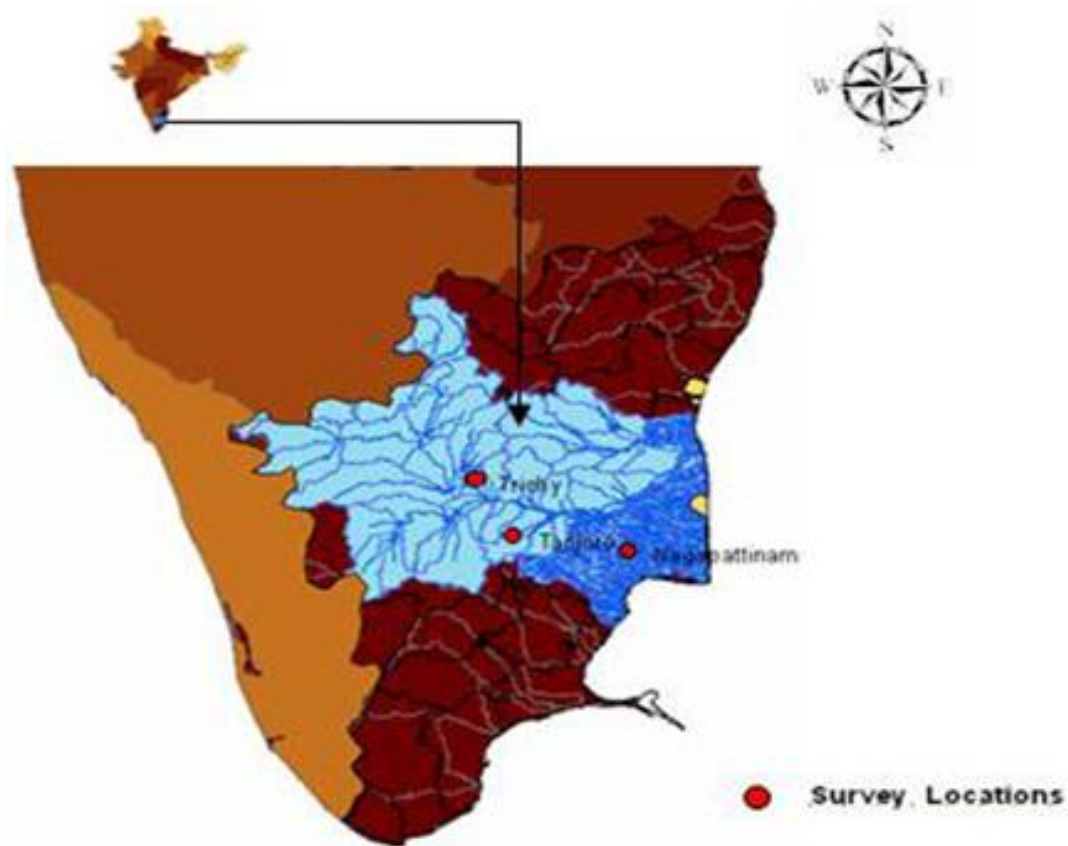


Fig. 1. Map showing the Cauvery River Basin and the survey location in India

Study area main features

- Densely populated ; Small farmers – 75%
- Agriculture is the main occupation,
- Rapid land use changes (new crops, urbanization, industries)
- Heavily irrigated region- tanks, canals and groundwater sources
- Subsistence to Market economy
- Technology shift from extensive to semi-intensive

Some major concerns

- i) Delayed monsoons, fewer rainy days
- ii) Irregular release of irrigation water
- iii) Monocrop of rice in the delta region
- iv) Labor shortage during peak seasons
- vii) Lack of standard price policy
- viii) Lack of timely support of inputs to small scale farmers.



Different project tasks

- Modelling (climate, hydrological and economic scenarios) ; Field and lab trials
- Stakeholder Analysis (stakeholder workshops, Focus group meetings, surveys, stakeholder panels)
- Integration of Stakeholders at Different levels



Vulnerability and adaptability

- **Vulnerability = f (exposure, sensitivity, adaptive capacity)**
- **Vulnerability** is the extent to which CC may damage a system; it depends not only on a system's sensitivity, but also its ability to adapt to new climatic conditions (IPCC, 2001).
- In the social realm, vulnerability can be defined as the exposure of groups or individuals to stress as a result of climate variability and change.

Vulnerability and adaptability

- **Sensitivity** is the degree to which a system will respond to a change in climatic conditions.
- **Adaptive capacity** encompasses the capacity to get exposed to risks due to climate change, absorb and recover from losses, and exploit new opportunities that arise in the process of adaptation.

(Article 4.1, UNFCCC; FAO report; IPCC; UNDP 2003)

- **Socio-economic Vulnerability** = Risk Exposure + Response + Unit's SE Characteristics
- **SE Vulnerability indicators**

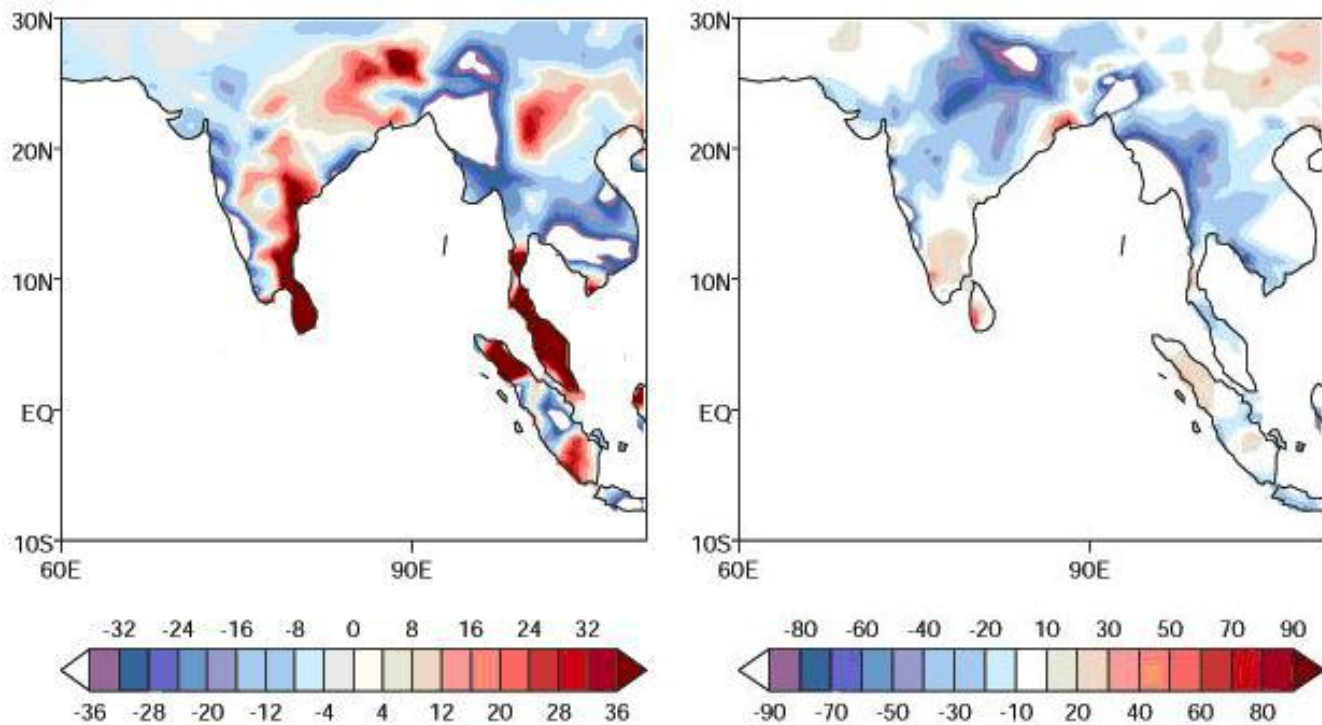


Fig. 2. Observed long-term rate of change (trends, mm/50 years) during NEM (Oct-Dec, left), and SWM (Jun-Sept, right)

Vulnerability indicators- Income diversity

Relationship between Net Income, Income from Agriculture, Livestock and other sources

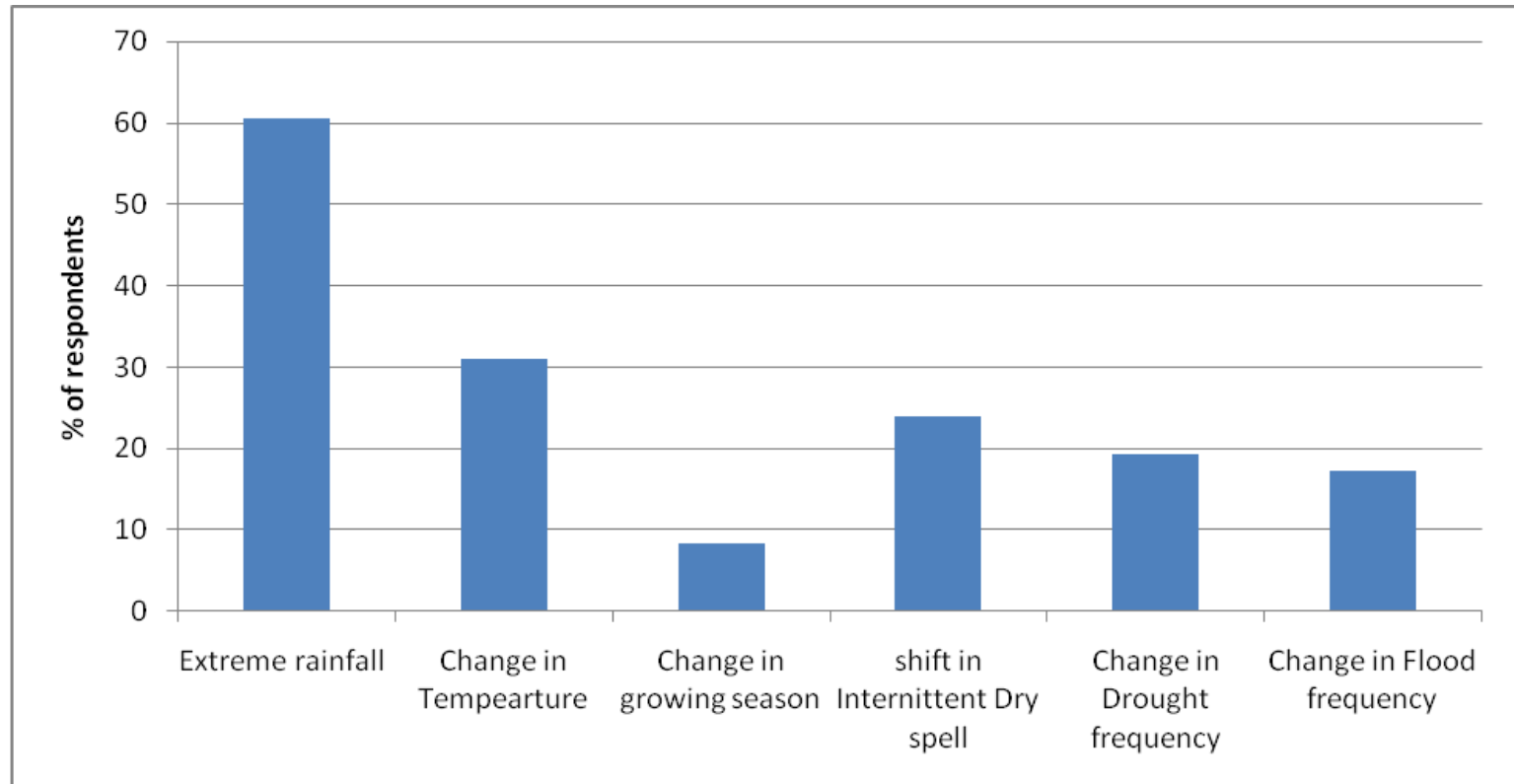
| <i>Correlation</i> | <i>Net Income</i> | <i>Agriculture</i> | <i>Livestock</i> | <i>Others</i> |
|--------------------|------------------------|------------------------|------------------------|---------------|
| NI | 1 | | | |
| Agri | 0.987743** | 1 | | |
| Livestock | 0.560068* | 0.482443* | 1 | |
| Others | 0.248196 ^{NS} | 0.116564 ^{NS} | 0.159091 ^{NS} | 1 |

Stakeholders' Analysis

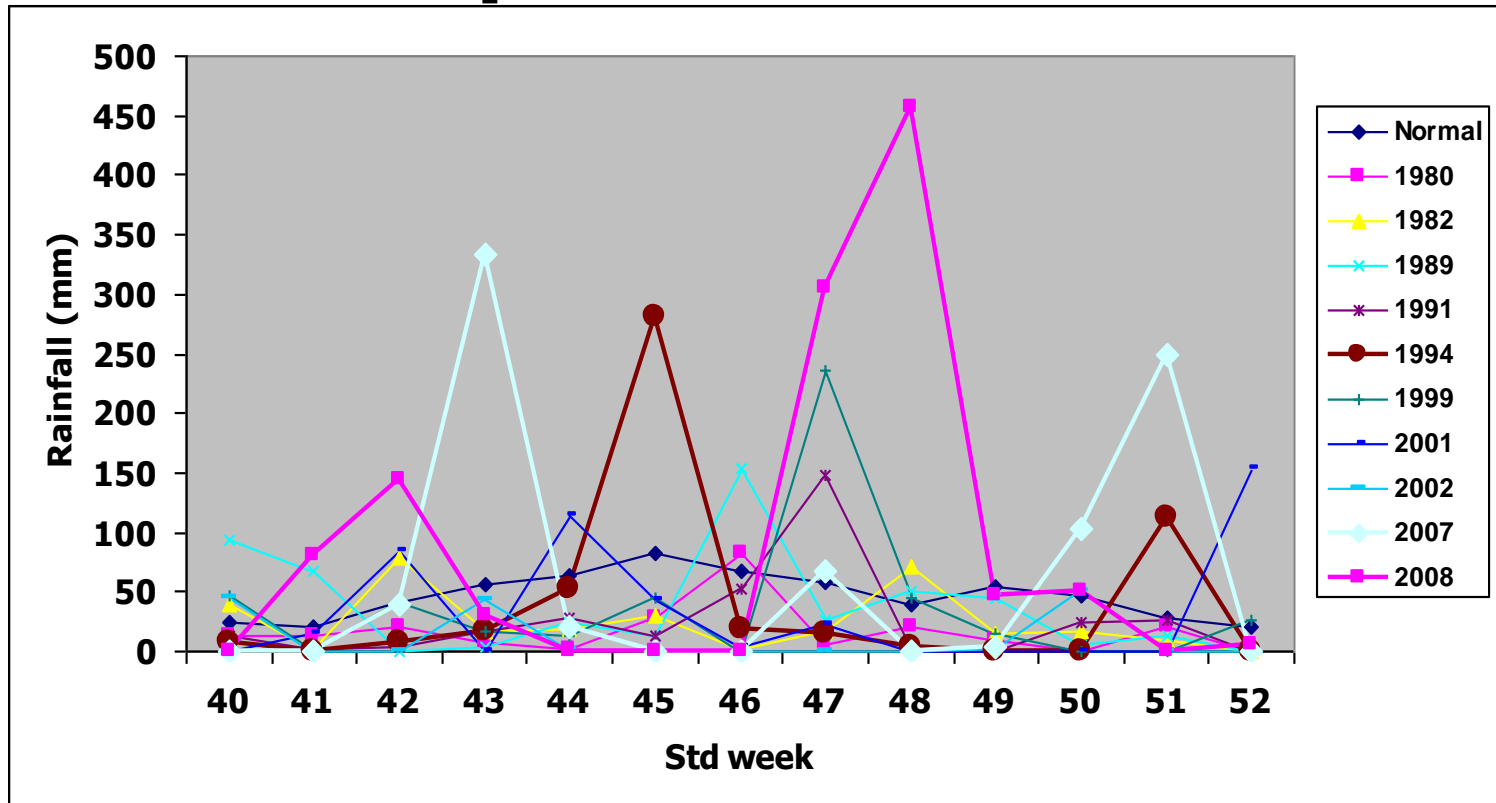
- Stakeholders perceived climate variability as a serious problem.
- Erratic rainfall as the outcome of climate change seriously impacting agriculture
- Farmers linked climate change to:
 - Delayed monsoons and
 - Fall in night temperatures



Farmers perceptions about CC



Climate Change-Erratic rainfall patterns



CC impacts on agriculture

- Farmers expressed that erratic and unseasonal rainfall due to climate change results in **poor crop establishment** and **losses in yield** ranging from 50% - 100% .
- Correlated climate change with changing pest ecology
- Degradation of agricultural lands due to flooding and salinity.

Adaptation measures suggested by farmers - 1

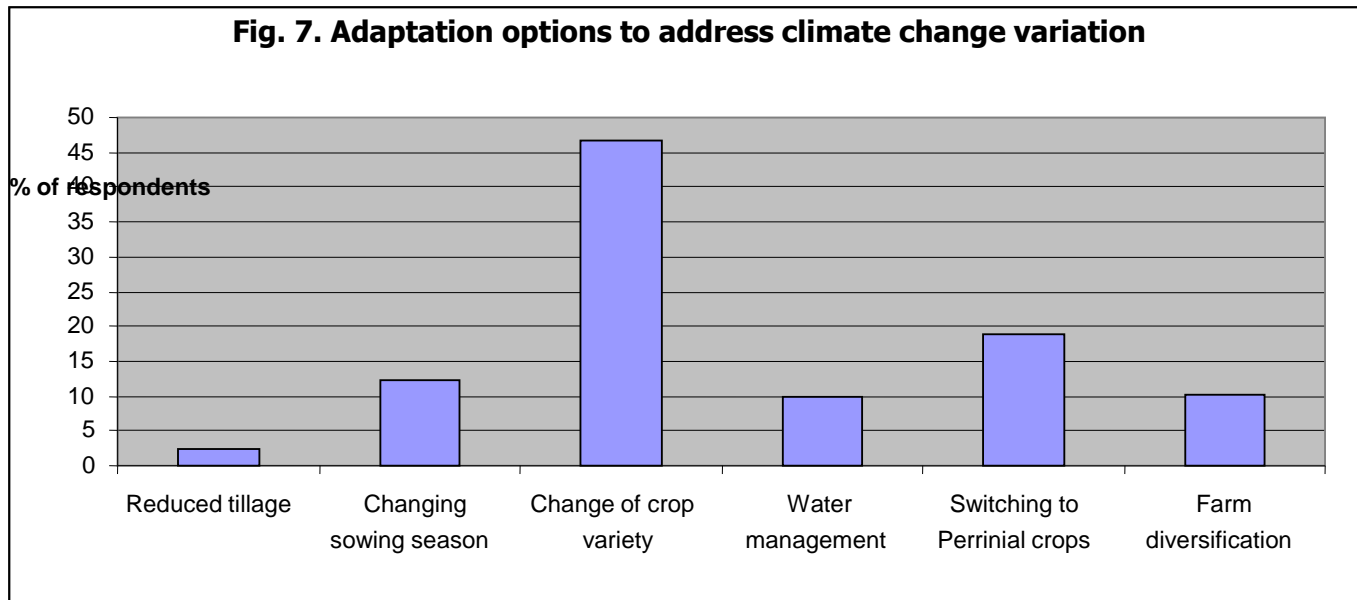
- Bio-fertilizers such as Blue green algae, *Azospirillum* and *Phosphobacterium*
- Usage of green manures to increase to improve the water holding capacity and soil structure.
- SRI - water requirement is 30% less than transplanted rice system, and Yields 25 – 30 % more than traditional rice systems.



Adaptation measures - 2

- New crop varieties
- Alternative cropping strategy
- Early planting (by 15 days)
- to improve water use efficiency and water conservation
- Regular strengthening of irrigation channels to minimize water losses and erosion.

Farmers preferences



Government programs and policies

- National Action Plan on Climate Change (NAPCC) – **High level mission headed by PM**
- National Mission for Sustainable Agriculture (climate resilient crops, farming practises, weather insurance mechanisms) - **lack of integrated effort, competing for resources**
- Provincial level CC adaptation programs – **adaptation strategies needed/ lack resources**
- District level contingency plans – **no clear strategy**

Conclusions

- **Current climatic risks are a good entry point**
- Adaptation must be addressed in the **broader context of vulnerability**
- Adaptation is a **social learning process** and **location specific**
- **Awareness raising and institutional capacity building** are very important
- **Cross-sectoral issues** are crucial to capture farmers' needs
- Better **linkages with development & research** and **capacity building** are needed
- Integration between **science and policy** through **stakeholder participation**