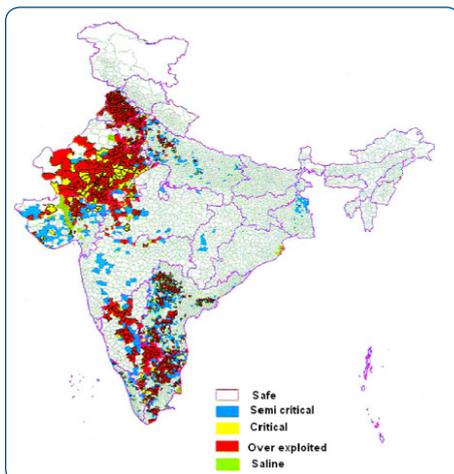


Ground water and farm incomes at risk from climate change in Tamil Nadu, India

Research from South India suggests that climate change will affect ground water availability with serious and negative implications for agriculture. Any increase in temperature above a threshold of 34.3°C, in particular, will have a negative effect on farm incomes. This threshold level of temperature has already been breached some 60 times in the last forty odd years.

Small and poor farmers will be the worst affected as a result of climatic effects. This is because they are unlikely to invest in additional or deeper wells to counter the effects of declining water tables and well failures. Two adaptation measures – testing and dissemination of drought tolerant seed varieties and regulation of deep-bore wells – will contribute to better conservation of scarce ground water resources.



Source: Planning Commission (India) 2007 *Report of the Expert Group to Review the Issue of Groundwater Ownership in the Country*

Indian agriculture is dependent on scarce groundwater resources

India is the largest user of groundwater in the world. More than 60 percent of India's irrigated farmland is dependent on groundwater and about 85 percent of rural India's drinking water requirements are met from underground water supplies.

However, over-exploitation of groundwater is common. Critically, this problem is set to get worse as climate change will increase demand for groundwater and reduce the rainfall needed to replenish the region's underground aquifers.

Background

Groundwater over exploitation, a serious problem across India, is particularly acute in the South Indian state of Tamil Nadu. Lack of regulations regarding sinking of wells in the same aquifer, growth of water-intensive commercial crops and subsidized electricity for pumping water have reduced the availability of ground water. R. Balasubramanian, from Tamil Nadu Agricultural University, examined the connections among climate, water and farm incomes since irrigation is a critical climate adaptation strategy.

The impact of climate on groundwater

Balasubramanian assessed the impact of climate variables on groundwater availability and the impacts of climate and groundwater levels on farm income using weather, crop and ground water data covering a period of 40 years (1971-2010), 11 districts and 1,740 wells. Study findings show that increased groundwater extraction in recent decades has negatively impacted the groundwater table. While increases in rainfall positively influence the ground water table, increases in maximum temperature have a negative effect. *A temperature increase of 1°C will likely reduce the region's water table by about 0.60 meters, requiring an increase in 100 cm of rainfall to offset this effect.*

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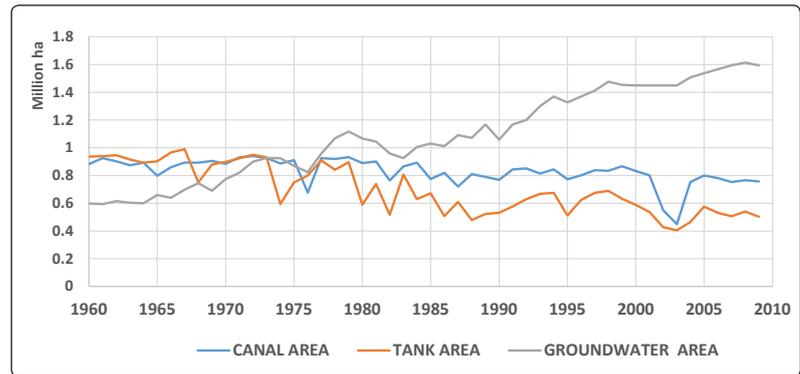
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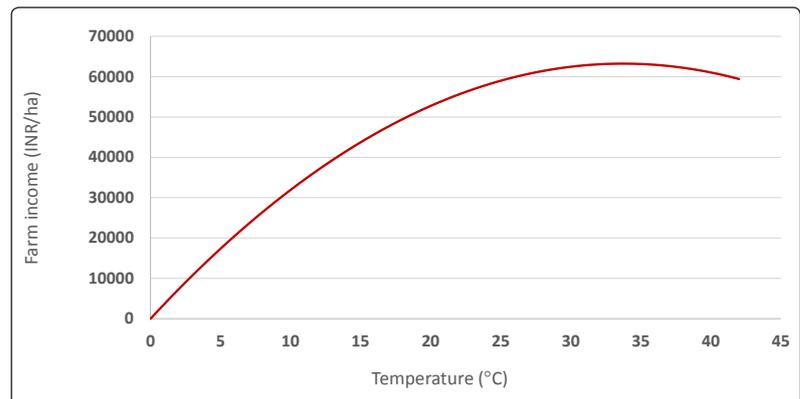
Figure 1: Tamil Nadu has seen a decline in tank and canal irrigation and an increase in ground water use in agriculture during the last 50 years.



Climate, groundwater and farm incomes

The study indicates that free electricity and the increasing availability of ground water during the period 1971 and 2010 have contributed to increases in farm incomes in Tamil Nadu. Temperature, on the other hand, increases farm income at certain levels and then, as temperature further rises, decreases income.

Figure 2: Temperature has an inverted U-shaped relationship with farm income, with income decreasing at temperatures higher than a threshold temperature of 34.31°C. In the panel dataset with 440 observations covering 40 years, this threshold temperature has already been breached in 61 cases. Thus, with increases in temperature, we cannot expect a steady growth in farm income unless farmers adopt other strategies.



While there is a positive relationship between the government's policy to provide free electricity to farmers and farm incomes, there are social costs associated with this policy. When wells fail as a result of over-used aquifers, large farmers with financial resources are likely to continue to drill deeper wells or new wells. However, small and marginal farmers, who cannot afford new or deeper wells, are likely to suffer.

Recommendations

Agriculture in Tamil Nadu needs to be temperature proofed. This would require:

- Farmer-led initiatives that reduce evapo-transpiration and increase irrigation such as micro-irrigation, soil mulching and zero tillage practices.
- Public policies that incentivize adoption of water-saving crops and technologies.
- Public and private investments in groundwater recharge programs such as percolation ponds, recharge wells and farm ponds.
- Regulations related to sinking of new wells, especially deep bore wells.
- Pro-rata electricity pricing and/or volumetric restrictions on pumping in exchange for increased public investments/subsidies for water recharge and water conservation.

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