Water Management and Resilience in Agriculture

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Water management requires multiple levels of policy action. The problem is not a shortage of water, but the absence of proper mechanisms for its augmentation, conservation, distribution, and efficient use. Water management should be given number one priority in agricultural policy, particularly to prevent drought, minimise the risks due to drought and build a climate-resilient agriculture.

Agriculture in India is the largest source of livelihood for working people although its share in the gross domestic product (GDP) has declined over time. In the last three years, the story of agriculture has not been good with an average growth rate of less than 2%. Global and domestic prices of commodities have come down. Deficit rainfall for two years in a row has affected crop production and farmers' incomes.

Green revolution strategies in the 1960s and 1970s had benefited farmers and the country. One criticism was that it benefited only those cultivating a few kinds of crops in a few regions. Different strategies are needed to spread development of agriculture to rain-fed areas and to protect farmers from weather fluctuations and natural disasters like droughts. Water is the leading input in agriculture and a major policy concern in the 21st century. This article examines water management strategies needed for drought mitigation and increasing climate-resilience, including soil moisture management. Specifically, it examines issues and policies for improving effectiveness in canal irrigation, water use efficiency, and strategies for climate resilient agriculture.

Irrigation

Since independence, India has invested significantly in irrigation infrastructure, particularly canal irrigation. The Pradhan Mantri Krishi Sinchai Yojana (PMKSY), introduced by the present government, is in the right direction. However, the strategy in irrigation development has been focused on increasing water supplies, and has neglected efficiency of use and sustainability (Vaidyanathan 2006, 2010). Because the government heavily subsidises both canal water rates and the power tariff for drawing groundwater, much of this water is either used inefficiently or overused. Areas of reforms needed in irrigation are: increasing and prioritising public investment, raising profitability of groundwater exploitation and augmenting groundwater resources, rational pricing of irrigation water and electricity, involvement of user farmers in the management of irrigation systems, and making groundwater markets equitable (Rao 2005).

To begin with, we elaborate on issues of canal irrigation. Even as there has been high investment in canal irrigation, the net area irrigated by canals is shrinking. Governments have significantly raised plan expenditure on irrigation and flood control since independence.

The outlays on major and medium irrigation rose from Rs 376 crore in the First Five Year Plan to more than Rs 1,65,000 crore in the 11th plan, which was cumulatively Rs 3,51,000 crore (GoI 2012). A study of 210 major and medium irrigation projects by a Delhi non-governmental organisation (NGO) that used data from the Ministry of Agriculture showed that after investing Rs 1,30,000 crore, between 1990–91 and 2006–07, these projects were irrigating 2.4 million hectares (ha) less than before (Shah 2011). The 12th plan working group indicates that there has been massive time and cost overruns. The average cost of overruns for major irrigation projects is as high as 1,382%.

A study by the Indian Institute of Management Lucknow on Accelerated Irrigation Benefits Programme (AIBP) shows that state governments were finding it difficult to collect water charges from farmers, and were financing the recurring costs of irrigation. It also had an adverse impact on the sustainability of irrigation systems in terms of water use efficiency and equity. The study also indicates that more than 50% of the farmers were willing to pay extra charges for assured supply (GoI 2010). It is known that present water rates cover less than 10% of the operation and maintenance costs (O&Ms) under canal irrigation. In general, water pricing is very low for canal irrigation, while we have best practices in water pricing in urban areas, where around 50% of O&Ms are covered. Water pricing should at least cover a major part of O&Ms to ensure that an irrigation system is sustainable.

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Institutional factors are key, and must be addressed to improve efficiency of canal irrigation systems. Mere increases in water pricing may not result in financial sustainability unless institutions are in place to recover water charges (Reddy and Dev 2006). Maintenance and management of canal systems through the participation of user societies is expected to contribute to an efficient and equitable distribution of water resources. Reforming institutional structures in favour of participatory irrigation management (PIM) and water user associations (WUAs) have to be strengthened. Currently there are 56,539 WUAs managing 13.16 million hectares of irrigated land (NITI Aayog 2015). Only 15 states have enacted PIM Acts. However, successful functioning of WUAs is reported only in a few projects in Maharashtra, Gujarat, Andhra Pradesh and Odisha. Initially, the experience of WUAs in Andhra Pradesh was encouraging, especially in terms of providing irrigation to tail-end farmers. Another notable development was that works were executed by WUAs themselves at lower cost instead of getting them done by contractors. But the vested interests lost no time in adjusting to the new situation by presidents of the WUAs acting as contractors. In strengthening the PIM and WUAs, the only long-term solution is awareness building and promoting participatory monitoring and evaluation.

Water Management

India has had successive droughts in the past two years. Nine states—Andhra Pradesh, Telangana, Karnataka, Maharashtra, Madhya Pradesh, Chhattisgarh, Odisha, Jharkhand and Uttar Pradesh—have declared a drought this year (2015–16). There is a need for strategies in the short and long term to mitigate the adverse effects of droughts. It is clear that better and more efficient management of water resources is necessary for India to achieve "more crops per drop." We need a different approach for rain-fed areas.

A study by Raina (2012) highlights the need to have a paradigm shift in knowledge, policy and practice for rain-fed agriculture. This study also advocates the need to shift from conventional "production per hectare" thinking as the sole measure of performance to an approach that can integrate livelihoods (agriculture and rural non-farm), availability and access to food, ecosystems, and human health. According to Raina (2012), the interventions for the new paradigm are: "(a) enhancing soil health and productivity; (b) raising rainwater productivity (soil moisture management and protective/supplementary irrigation); (c) revitalise common pool land and water resources; (d) seed system; (e) farm mechanisation; (f) conservation agriculture and production systems (rice, millets, soybean, cotton, etc, based) enhancement (adopting integrated soil, crop, water, nutrient and pest management); (g) strengthening livestock; (h) fisheries in rain-fed water bodies; (i) crop insurance/price support/including PDS systems; and (j) institutional development." This is a comprehensive list for an integrated approach, and this can be a framework for management of soil moisture in rain-fed agriculture.

"India uses 2–3 times the water used to produce one tonne of grain in countries like China, Brazil and the United States. This implies that with water use efficiency of those countries India can at least double irrigation coverage or save 50% water currently used in irrigation" (NITI Aayog 2015: 9). NITI Aayog mentions adoption of drip irrigation as one of the mechanisms for efficiency. Damodaran (2016a) indicates that investments in three components, namely, ponds, rural electrification, and drip irrigation are needed for enhancing water efficiency. Drip irrigation can cover 10 times the area covered under usual flood irrigation.

In spite of several benefits, the coverage of the area under drip irrigation has remained small with less than 5% of net sown area. What are the reasons for this low coverage? The high initial capital cost is considered to be one of the biggest obstacles to adoption of drip irrigation. Therefore, alternative financial mechanisms should be explored to fund this purpose. The present subsidy system is not effective. There are alternative subsidy implementation models (Palanisami 2015). Some of the measures needed are reducing the capital cost, restructuring subsidy programmes and effective (quality) extension networks for promoting drip irrigation (Reddy and Dev 2006). It seems Andhra Pradesh (AP Micro Irrigation Project) and Gujarat (Green Revolution Company) models have shown significant progress while other states have not been able to emulate them due to poor governance (Palanisami 2015). Promoting rainwater harvesting and drip irrigation can be important strategies for drought proofing.

Climate Resilient Agriculture

Agriculture is the sector most vulnerable to climate change. Consistent warming trends and more frequent and intense extreme weather events such as droughts have been observed. There is a need for effective climate resilient agriculture (CRA) in India. Three main issues are discussed here.

First, there is a need for diversified cropping systems in view of climate-related risks. For example, cultivation of pulses can be an important strategy for CRA. Pulses are legumes which improve soil fertility. Thus, diversification to pulse cultivation can lead to a win–win situation in terms of attaining self-sufficiency and raising soil fertility. This year, 2016, is the international year of pulses. The M S Swaminathan Research Foundation has initiated a programme of promoting the concept of "Pulse Panchayats":

> The first such panchayat is in Ediyappatti village, Tamil Nadu. Such Panchayats will result in the origin and growth of pulse revolution symphonies, just as Seed Villages and National Demonstration did in the case of wheat 50 years ago (Swaminathan and Kesavan 2016: 128).

Concerned over stagnant pulses output, the government announced a "three-pronged strategy focusing on yield, insurance and price (YIP) which can help in boosting domestic output and attain self-sufficiency" (PTI 2015). Three-fourths of the total area under pulses are in the states of Madhya Pradesh, Maharashtra, Rajasthan, Gujarat, Andhra Pradesh, Karnataka and Uttar Pradesh. Pulses are grown largely in rain-fed areas as only 16% of area is irrigated. Diversification to pulses is thus a good strategy for CRA, particularly in rain-fed areas.

Second, there is crop insurance which can be used as one of the strategies for CRA. In this context, the recent introduction of Pradhan Mantri Fasal Bima Yojana (PMFBY) by the central government is in the right direction. There are many features in the new crop insurance scheme which makes it different from earlier schemes. It is also likely to succeed because of the new features. In the previous schemes, premiums were high and coverage in terms of sum insured was inadequate. The new scheme corrects these two problems. It also broadens the definition of risk to include yield losses, preventive sowing, and post-harvest losses. Farmers now have to pay a uniform premium of just 2% for all kharif crops, 1.5% for rabi and 5% for horticulture crops. The gap between the actual premiums and the rates payable by farmers would be fully met by the government. Earlier, in 2013–14, the average sum insured per hectare was just Rs 18,464. This was far below the gross value of output (GVO) for many crops. In the case of paddy, all-India average GVO was Rs 47,160 in 2013–14 (Damodaran 2016b). Therefore, the sum insured was less than half of GVO in the earlier schemes. PMFBY will rectify this problem and put the sum insured closer to GVO. It has been mentioned that the new crop insurance can be a game changer if the conditions of low premiums and the sum insured covering the GVO are met along with quick claim settlements with mobile and satellite technologies (Damodaran 2016b).

Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA) can be another instrument for drought proofing and CRA. A study by the Indian Institute of Science (Esteves et al 2013) quantified the environmental and socio-economic benefits of works implemented under MGNREGA, and assessed their potential to reduce vulnerability of agricultural production and livelihoods of the beneficiaries. Agricultural and livelihood vulnerability indices developed showed a reduction in vulnerability due to implementation of works under the MGNREGA and resulting environmental benefits. A study done at the Indira Gandhi Institute of Development Research shows that 87% of the works exist and function, and over 75% of them are directly or indirectly related to agriculture (Narayanan et al 2014). These works included land levelling (10%), wells (77%), farm ponds (9%), bunding (12%), irrigation channels (5%) and trenches (5%). A majority of the water works on common lands comprised check dams, followed by bunds and dykes. MGNREGA thus can help as an important strategy for CRA.

The third issue relates to the role of research and extension system in promoting CRA. Research leads to the development of climate resilient technologies and extension system promotes these among farmers. There have been some initiatives recently. For example, the National Initiative on Climate Resilient Agriculture (NICRA) was initiated in 2011 by the Indian Council of Agricultural Research (ICAR). The project aims to enhance resilience of Indian agriculture to climate change and climate vulnerability through strategic research and technology demonstration. The research on adaptation and mitigation covers crops, livestock, fisheries and natural resource management. The project has made a significant initial impact and was well received in most of the districts.

> Technologies such as on-farm water harvesting in ponds, supplemental irrigation, introduction of early-maturing drought-tolerant varieties, paddy varieties tolerant to sub-mergence in flood-prone districts, improved drainage in water-logged areas, recharging techniques for tube wells, site specific nutrient management and management of sodic soils, mulching, use of zero till drills were enthusiastically implemented by the farmers in NICRA villages across the country (ICAR 2016).

More research and extension services are needed to have effective CRA, particularly in the current environment of droughts and climate risks.

As Swaminathan (2010) mentions we need, among other things, both organic farming and green agriculture for resilience and sustainability. "Green agriculture techniques could also include the cultivation of crop varieties bred through use of recombinant DNA technology, in case such varieties have advantages like resistance to biotic or abiotic stresses, or other attributes like better nutritive quality" (Swaminathan 2010). Abiotic stresses, such as drought and salinity, and climate change, pose major challenges for crop productivity. Parida and George (2015) discuss broad molecular mechanisms of plant abiotic stress tolerance and outline the biotechnological advances aiding plant abiotic stress research. Stress tolerance seed varieties have to be developed. This is one of the important strategies for climate resilient agriculture.

Conclusions

Conflicts over water are a grim reality today. Interstate disputes and conflicts over water at farm level are expected to increase over time. The problem is not due to a shortage of water resources, but due to the absence of proper mechanisms for its augmentation, conservation, distribution, and efficient use. Water management should be given number one priority in agricultural policy, particularly for drought proofing and to face risks due to droughts. The main strategy should be to increase water productivity, that is, "more crops per drop." Conservation of surface and groundwater have become imperative. Water use efficiency can be increased significantly in Indian agriculture. Multiple approaches are needed for this purpose. MGNREGA-created assets would be useful for drought proofing. Drip irrigation is one of the important mechanisms to improve water efficiency. Diversification, crop insurance, research, and extension services can become important strategies for climate resilient agriculture.

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