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Water management in agriculture: Issues and strategies in India

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Abstract

Water the critical resource of agriculture, has not been well managed in India, despite the country being an agricultural powerhouse. It has some 195 MH of land under cultivation of which some 62 per cent is rain-fed and 37 per cent, irrigated. Agriculture uses 85 per cent of the water resources with low efficiency. The rain-fed area is the critical area of cultivation with the largest concentration of rural poverty spanning several agro ecological regions. Water management is related to three important challenges in the agricultural front today namely raising productivity per unit of land, reducing poverty, and responding to food security needs. In the light of the new call to achieve "more crop per drop", this paper discusses pertinent issues related to irrigation in India and the strategies and arrangements to address water scarcity for irrigation. The study finds that problems are largely institutional, structural, and administrative. Overcoming them is crucial for agricultural development in general and water management in particular.

Keywords: Agriculture; India; Management; *Pani Panchayats*, Water

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1. Introduction

"Irrigation is everything in India; water is even more valuable than land", remarked Sir Charles Trevelyan decades ago. "If the monsoon fails, there will be lockout in agricultural industry" remarked Wolff. Today the general acceptance is that the problem is not shortage of water but one of its poor management, i.e. utilisation, augmentation, and conservation. The country is endowed with 183 million hectares of cultivable land, 115.6 million farming families, 400 million of annual precipitation, and a conducive agro-climate for cultivating a variety crops. About two-thirds of the country's population work in agriculture and feed over 1000 million people every day. Yet majority of farmers are under the clutches of poverty, debt and hunger (Hans, 2010). Micro studies on poverty in rural areas cannot keep out irrigation as an explanatory factor. For instance Gurunathan (2008), applying linear regression technique for estimating the strength of irrigation in determining rural poverty in the state of Tamil Nadu (for 37 years from 1964 to 2000) found that rural poverty can be reduced by 1.54 per cent through an increase of one hectare of groundwater irrigation for very thousand rural population. Study by Hans (2007) in Belthangadi and Mangalore taluks of Dakshina Kannada District, Karnataka using chi-square method revealed that as households move up from below poverty line to higher income levels they are in a better position to availability and accessibility of irrigation infrastructure. In many cases, the average income per household almost doubled when irrigation was utilised.

Indian agriculture even now is heavily dependent on the monsoons. Nearly 70 per cent of the net sown area is rain-dependent. Problems of Indian agriculture are intricately linked to per-capita availability of water in a cost-effective manner. This fact has to be viewed in the context of 2007 that was earmarked as "Water Year" by the Government, as also the general crisis and contemporary challenges in agricultural sector. Even a non-farm activity like insurance is penetrating the irrigation sector and we now have rainfall insurance and re-insurance in India. Demand for food is increasing but vast majority of lands remain fallow during dry season. This is so in more than half of the arable land (Zaman 2009). Water problem is a triple problem – problem from supply side, from side and from quality angle.

By the year 2030, India needs to produce 60 per cent more rice with much fewer resources. To keep up the momentum of growth, a careful economic valuation of inputs including irrigation is of considerable importance (Kiran, et.al 2009). The use of major resources of the earth like water has to be guided by the principles of optimum and scientific utilisation, both as individual commitment and international agreement (Hans and Jayasheela 2010; Singh 2010). Despite rapid strides in high-tech agriculture and commercial/corporate farming, sustainable agriculture and livelihood security will largely be decided on the natural resource – base, use and conservation. With this in mind the objectives of this paper are:

- to present the problems and challenges in the waterfront for Indian agriculture;
- to highlight areas that need to be addressed for better water management; and
- to examine some initiatives in India to save water,

2. Extent and Effects

Irrigated agriculture is limited only to 46 per cent of the cropped area in India, but it contributes nearly 56 per cent of the agricultural output, and about 60 per cent of food grains production comes from irrigated area

(Nagdev, 2012). Efficiency or deficiency in farming is largely related to water – rainfall or irrigation. It is true for productivity improvements through area expansion as well as through combined inputs (irrigation, fertilisers, plant protection measures etc.). Even the entrepreneurial ability in farm operations is water-linked. No doubt under modern farming irrigation is one of the inputs in integrated farm management. Total Factor Productivity criterion of farm efficiency places adequate importance on irrigation to explain variations in yields and technical efficiencies across crops and across farms. For instance, a study of paddy farmers in the state of Andhra Pradesh by Raju (2004) revealed that the non-availability of assured irrigation leads to low-level usage of fertilisers too and in turn, low yields.

3. Irrigation scenario

India has irrigation potential of 139.89 hectares of which 108.3 m ha (i.e. about 77 per cent) has already been utilised (see Table 1). The average annual per-capita availability of water is estimated to be about 1,829 cubic metres at the national level. This is expected to decline to about 1,341 CUM by the year 2025 and 1.140 CUM. by the year 2050, owing to the increase in population. The per-capita storage capacity in India is only about 207 CUM. as compared to 1,111 CUM in China. Out of the total water supply, the share of irrigation at present is about 80 per cent. This is likely to go down to 73 per cent by 2025.

Table 1. Water Resources of India

Geographical Area	328 m ha
Culturable Area	185 m ha
Rainfall	4000 cubic km
Utilisable Water Resources	1122 cubic km (including Resources 432 cubic km from Groundwater)
Ultimate irrigation potential	139.9 m ha

Source: S. M. Mendhekar and M. L. Chalakh, Technical Digest, issue 6

As water is vital not only for increasing output of varied crops but also for sustainable employment and income in the agricultural sector, proper planning and management of this resource is very essential. Creating appropriate infrastructures and adopting suitable management practices will help augment the utilisable water resources and improve the efficiency of the facilities.

4. Strategic issues

There a global threat to water resource, not just in terms of climate change but also model of valuation and distribution. For instance, in Chile, water is no longer a public good; it has become a capital good, left to the discretion of speculators and is separated from the land. The result? Water is sold as a market good at high

prices. The small farmers are now almost a species in extinction, replaced by seasonal workers. These are some of the visible effects of the crisis in rural Chile, 50 years after a land reform which postulated that "the land is for those who work it." Now, in order to tackle the crisis, the grandchildren of the land reform – environmental and social activists – are proposing an alternative i.e. a new land reform to reclaim water as a public good, at a time when a persistent drought is affecting much of Chile. The situation is so acute making it necessary to use tanker trucks to distribute water in some low-income neighbourhoods in cities around the country. Commodification and privatisation of water led to the imbalance between human rights, environmental integrity and corporate profits. Now the people are thirsting for structural reforms to bring new market rules and uphold human rights including water access and sanitisation (Milesi, 2017; Larrain, 2012). Such a situation has already arrived in India. Water scarcity is rampant, often resulting in crop failure, poverty, social conflicts and farmers' suicides (an average of 15,000 annually). India, being a signatory to the World Trade Organisation (WTO), it is under pressure to open its market to the globalised economy. So, the impoverished farmers will certainly need assistance which is much more than financial. across the dry land states of Gujarat and Rajasthan, social workers from the Sadguru Foundation created several village-level cooperatives that in turn setup a number of SHGs, lift irrigation groups, horticulture groups, mil vendors groups etc. These productive groups are asset and job-creating and at the same time work as social networks of civic associations known to confront poverty, resolve social disputes and provide opportunities for community development (Agoramoorthy and Hsu, 2015).

Keeping in mind both utilisation and conservation aspects of water 'efficiency' parameter is the key strategic factor. Inefficiency limits capability and reliability. While this is a physical issue, we have some economic issues too. The financial manifestations of current investment and water pricing policies have their deleterious economic consequences on the production front. A shortage of water, which may be seasonal, multi-annual or secular, is a threat to a wide range of economic activities – municipal water supply and water-based sewerage, water-intensive industries and agriculture, hospitals, mines, power stations, shale-gas production, hotels, etc. It is possible to make the Irrigation Departments autonomous and self-financing through increased water charges, improving collection rates and developing instruments to capture private sector investments in development and management (Dewangan, 2016). Subsidised water rates sap farmers' interest to opt for the tenets of water use efficiency and conservation. Millions of dollars spent on irrigation-subsidies, have led to more water use, not less. This has led to fall in water tables – ranging from 15 per cent to 75 per cent, say the scientists. Further, we have institutional issues like weak organisation base and delivery mechanisms for water, allied inputs and extension services (Mendhekar and Chalakh, n.d; World Water Council, 2015; Nixon, 2013).

India has been experiencing successive droughts in the past several years. Nine states – Andhra Pradesh, Telangana, Karnataka, Maharashtra, Madhya Pradesh, Chhattisgarh, Odisha, Jharkhand and Uttar Pradesh – have declared a drought in the year 2015-16. All these point to the need for strategies in the short and long term to prevent droughts, mitigate the adverse effects of droughts, and ensure a better and more efficient management of water resources. Building a climate-resilient agriculture is the need of the hour. (Dev, 2016).

5. Challenges and opportunities

One of the most important challenges both in waterfront and food front is that of climate change. The term "global climate change" refers to the rising temperature of the earth due to an increased amount of carbon dioxide (CO_2) and other greenhouse gases (GHGs). The phenomenon and presence of climate change has created more intensity in the uncertainty of water availability, making it difficult to optimise actions and their timings (OECD, 2014).

Natural resources have become vulnerable. Agriculture in India is in a peculiar situation of growth with vulnerability. A significant part of the annual variation in India's GDP growth over the past century is attributable to yearly variations in rainfall. Rise in the sea level and depletion of potable water as well irrigation potential are serious concerns. Estimates predict that with increase in temperature by 2080-2100 the probable loss in crop production is 10-40 per cent (Hans, 2011; Hans 2012). Green House Effect is a challenge to green revolution today.

In several coastal areas of the country a new problem is rising. Sand mining is causing the water table has gone down and due to this farmers have been increasing the horse-power of their motors, again with repercussions on cost and economic performance of irrigation and cultivation (Selvakumar et.al, 2008).

Substantial progress in irrigation has been made through programmes and policies such as Command Area Development Programme (1974-75), Accelerated Irrigation Benefits Programme (1996-97), National Water Policy (2002) and so on. Yet the major problem in irrigation continues to be the under-utilisation of potential, particularly of major and medium irrigation projects.

The outlays on major and medium irrigation rose from Rs376 crore in the First Five Year Plan to more than Rs1,65,000 crore in the Eleventh Plan, which was cumulatively Rs3,51,000 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 Rs1,30,000 crore, between 1990-91 and 2006-07, these projects were irrigating 2.4 million hectares (ha) less than before. The Twelfth Plan working group indicated that there had been massive time and cost overruns (Dev, 2016). Added to this is the sensitive issue of user-charges. Lack of thorough knowledge of scarcity-value of water to its user is an obstacle in its efficient use. Political interferences, shortages of electricity etc. are also affecting the working of Water (*pani*) *Panchayats*.

6. Lessons, suggestions and conclusion

Apathy and administrative constraints are making agriculture weary. A multi-pronged strategy is needed to improve water-management system and practice in India.[1] Every farmer and farm-based organisations should implement this. Central Government as well as the state governments should ensure and enhance

[1] Water resource management is the activity of planning, developing, distributing and managing the optimum use of water resources. It is a sub-set of water cycle management. Ideally, water resource management planning has to regard to all the competing demands for water and seek to allocate water on an equitable basis to satisfy all uses and demands (Shinde, 2015).

incentives to invest in adaptation of new methods of water saving, harvesting etc. particularly to meet uncertainties of weather and global climate changes. Even the innovative "participatory public delivery system" should be encouraged for water management in general and underground water in particular. The underlying principle should be one of "least cost" according to the objectives of effectiveness, economic efficiency and equity. As stated by the then President of India, His Excellency Shri Pranab Mukherjee, "Strategic partnerships for adoption of best practices and to maximise benefits through technology transfer have become more important today.

India, which had witnessed a Green Revolution in the Sixties, is now moving towards an "Evergreen Revolution", recognising the positive role that information technology can play as powerful catalyst for sustainable agricultural development. India's strategy centres on the Action Plan for Information and Communication Technology (ICT) for Agriculture, which has been operational since 1995."[1]

People associated with agriculture and allied activities should be recognised as resource management communities with awareness and positive attitude towards an "integrated approach to the utilisation of natural resources" – soil, water and bio-diversity. This approach should not be an adhoc one, but a strategic collaboration for sustainable ecosystems, rural livelihoods and food security (Bunning, n.d.). Moreover, it has to be strong in its quantitative and qualitative dimensions. Irrigation has to be developed in terms of area coverage as well as conservation. Dissemination of time-tested technical know-how regarding water use, re-use and replenishment as well about drought and disaster management should be made available eve to small and marginal farmers. Research in labs should be dovetailed with field experiments to cater to felt-needs of farmers and to enrich the experiences.

Knowledge sharing is going to be another important sub-sector in this scheme of things in the coming days. The Central Water Ministry has – in this connection – called for active participation of all stakeholders.

Participatory Irrigation Management (PIM) – along with the Water Users Associations (WUAs) – has been conceived as the thrust area in the effective irrigation management by involving and associating the farmers in planning, operation and maintenance of the irrigation system in India. So too the Irrigation Management Transfers (IMT) Programmes which states are keen about (Mahapatra, 2006). Progressive involvement of farmers in water management has yielded desirable results in terms of equity, efficiency and economy.

It has already sounded on a research programme of farmers' participatory action in 5000 villages to promote "more crop and income per drop" of water, training of water-masters in each *Pani Panchayat*[2] and wider dissemination of know-how to the user-level through electronic and print media. *Pani Panchayats* that in 1972 came to save many famers during the severe drought in Maharashtra and also became very popular

[1] From the Speech by the President of India, Shri Pranab Mukherjee at the inauguration of the Asia-Africa Agri-Business Forum, 05-February-2014. Reproduced in "Food Security: Asia-Africa Agribusiness Partnership", *The African Executive*, Issue 461, 19-26 February, 2014.

[2] *Pani* in Hindi means water. *Pani Panchayats* are water councils at the grassroots level viz., the villages. Pani *Panachayats* are in a sense water users' associations. These are funded by state governments and consist of all the farmers within the command of a minor or sub-minor canal, or of a Lift Irrigation Point. It will have a bank account of its own. The rights and responsibilities of the Pani Panchayat will be governed by an Agreement between the Pani Panchayat and the state's Department of Water Resources. In 2016, the International Year of Pulses, the M.S. Swaminathan Foundation has come up with a new concept called "Pulse Panchayats". This shows how we can reinforce water schemes with crop schemes towards integrated farm management

in Orissa should be revitalised in all states of India. Similarly Karnataka's programmes such as *Jal Nirmala* (clean water), *Jalarakshana* (water protection) and *Namma Bhumi Namma Thota* (our land, our garden), Gujarat's aquifer mapping exercise (under MGNREGA), Rajasthan's *Jal Chitra* (water map) and other initiatives must bring in harmony between people and the environment. There should be not be any clash of interests here. Huge and largely successful programmes like MGNREGA and the National Rural Livelihood Mission (NRLM) can be linked with many small yet locally viable and sustainable water management programmes. Such efforts will also strengthen local governance and participatory management. More and more collaboration of related ministries with the civil society can thus, initiate a paradigm shift in rural development in general and water management in particular, i.e. a shift away from narrow engineering construction approach to demand driven participatory approach (Likhi, 2014).

Study by M.L. Jat and others conducted in Bhilwara district of Rajasthan during the year 2011-2013 to assess the economic feasibility of refinement renovation of a traditional water harvesting structure under *Rastriya Krishi Vikas Yojana* (National Agriculture Development) project revealed that the average number of irrigations in one ha increased from 1.8 to 3.86 after renovation of existing and crop diversification index increased from 0.432 to 0.782 and 0.432 to 0.659 during and seasons, respectively. Increased water resources and improved technologies increased the productivity by 28 to 48.5 per cent in both the seasons. On an average, 54,499 annum was obtained after one year of renovation of with an average B: C ratio of 2.52 against total expenditure of 35,859. Besides, about 251 to 403 man-days employment was generated as indirect benefit due to water resource development and implementation of improved crop production technologies. The average cost of water storage in the renovated was found to be 6 m , whereas, a net return of 19 m was realised by utilising the stored water for irrigation to crops and fish during the first year of study. Renovation of existing *nadies* (rivers) increased ground water recharge by 15-41 per cent (Jat et.al, 2016). Lessons such as these are inspiring no doubt but emulation in more and more districts of the country is what we are eager about.

Strict enforcement of laws to prevent indiscriminate sand mining, and injudicious use of electricity etc., can save a lot of water without adversely affecting the crop production and productivity. Damage control exercises should be taken up for implementation without wasting any time. This is in the interest of all resources, including labour. For instance, enhanced land and labour productivity due to better water management can lead to higher real wages too. Yogindra Alagh (2011) has estimated that if land augmentation emerges with success of the interrelated issues of water management, cropping intensity can rise by 0.5 per cent annually and in the decade 2010/2020, real wages would rise by 7 per cent additional or 27 per cent in total and rural-urban inequality would go down.

Educating the farmers has to be at the top of the agenda of agricultural development in general and water management in particular. While IT and BT need to be promoted on a large scale, they should be made 'farmer-friendly'. In the light of the recurring drinking water scarcity also in several parts of the country, water management for both irrigation and drinking purposes would receive urgent attention. Choice of techniques for optimisation of resources should be crystal clear to all concerned. Public and private investments will have to be stepped up for this national cause. Therefore, policies and programmes for irrigation development in the future have to be 'focused' on increasing per-capita availability of water; cost

and time reductions of irrigation projects; rationalisation of rates; better maintenance of works and sound management of natural resources coupled with HRD of farm-managers.

Water-saving and water-use efficiency schemes and strategies such as Awareness campaigns on Water, Sanitation and Hygiene (WASH), Training programmes on Sustainable Agriculture (SA) and Water Use Efficiency (WUE), and rainwater harvesting, water recycling etc. which are already functional must be become "best practices" of all water users. It is heartening to note that citizens' initiates are also forthcoming in a positive way. For instance, the "Next drop" started by Anu Sridharan as a platform between citizens and the government has helped solve the water problems of the residents in Hubli, a town in Karnataka.[1] Similar case is that of Uddhav Kedkar of Shivni village (Maharashtra). These eco-saviours, fighting like warriors are the change-makers, the Global Indians who have acted locally.

In the tsunami-hit lands of Andaman, Several NGOs (e.g. Voluntary Health Association of India, Nehru Yuva Kendra, Nandi foundation, Tata Institute of Social Sciences etc.) actively participated in enhancing livelihood security of the affected people. They took up 'cash for work' programme and did desiltation of water bodies, clearing of fields from damaged crops, strengthening of river bunds and so on. The rescue, rehabilitation and reassuring measures helped agriculture to revive (Hans, 2011).

Rational management of water needs strong pro-democratic and environment-friendly systems in place. Further they need to be integrated with best farm practices. No doubt, this is going to be a daunting task given the fact that climate change will heighten the need to anticipate water shortages worldwide (Jaeger, 2017). There are clear challenges with definite choices. The most difficult challenge is to make the best choice. Water can save us. We can also save water. Preaching is good, but practice makes us perfect.

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[1] Next-Drop provides ICT infrastructure as a cost effective way to manage and monitor water distribution systems. It has an Interactive Voice Response system (IVR). The data is processed through backend technology. The information is disseminated to citizens and utility decision-makers in real time. Residents receive text messages with the date and time when water will arrive. Engineers receive reports when water delivery is delayed. All of this is in real time using basic handset phones. Its Co-Founder/Chief Executive Officer Anu Sridharan, was recently selected to the Forbes "30 Social Entrepreneurs Under 30" list for her work with Next Drop Inc. holds a While at the University of California, Berkeley Anu's research focused on the optimisation of piped networked systems in developing economies. Next-Drop is now a movement in urban India.

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