Addressing Agricultural Water Management Challenges in the Twelfth Plan: Some Pointers

M. Dinesh Kumar, A. Narayanamoorthy, Nitin Bassi and V. Niranjan*

INTRODUCTION

India wants to be self-sufficient in food and “food secured”. Therefore, it is imperative for national food security that we need to grow sufficient food within the country. At the same time, for domestic food security, we need to sustain economic growth to raise the income levels and purchasing power of the poor people (Kumar, 2003). Irrigation has contributed significantly to boosting India’s food production and creating grain surpluses, which is used as drought buffer. On the other hand, agriculture remains as the backbone of India’s economic growth, in spite of the major structural changes that the economy is undergoing (Government of India, 2008). Several studies in the past have indicated that agricultural growth, especially growth in foodgrain production negatively impacts rural poverty (Ghosh, 1996). After Ravallion (1998), rural poverty is correlated with relative food prices, which is affected by fluctuations in food supply (Ravallion, 1998).

Recent studies also show that in the 1990s, there was no change in rural poverty ratio, while urban poverty was reduced by 10 per cent as compared to 1980s (Datt, 1999). This coincided with the period, which recorded stagnation in growth of primary sector, at 2.47-3.66 per cent (Government of India, 2008). The growth rate in production of food grains also dropped to 1.2 per cent during the 1990s from 2.3 per cent in the 1980s (Datt, 1999). All these lead to the unquestionable role that irrigation can play in stabilising food prices, and alleviating rural poverty, provided effective institutional interventions are in place (Chaturvedi, 2000). Owing to the fact that the net area under cultivation and also area under food grains remains more or less saturated at the macro level (Government of India, 2002), irrigation is the key to enhancing agricultural production, and thereby sustaining economic growth. Nearly 70 per cent of India’s workforce depends on agriculture as the primary occupation (Government of India, 2008, p.3). Irrigated agriculture remains the largest absorber of rural labour force, and therefore impacts on the livelihoods of millions of rural households, while its impact on the farmer households is more direct.

*Executive Director, Institute for Resource Analysis and Policy (IRAP), Hyderabad, NABARD Chair Professor, Department of Economics and Rural Development, Alagappa University, Karaikudi (Tamil Nadu), Senior Researcher, IRAP, New Delhi, and Research Officer, IRAP, Hyderabad, respectively.
In order to ensure food security on a sustainable basis, three concerns need to be addressed. They are: adequate supplies of irrigation water to sustain the growth in agricultural production at the national level; water security for poor farmers to grow food for subsistence; and adequate economic incentives for farmers to maximise their production from the available land and water with least environmental consequences. In India, a lion’s share of diverted water is used for irrigation. The capacity to augment the existing irrigation potential, through conventional technologies, is fast reaching the limits (Kumar, 2010). The irrigated areas are increasingly facing the threat of land degradation and productivity decline (Kumar, 2003). On the other hand, the demand of water from sectors is growing by leaps and bounds. This coupled with widening gap between overall demand and supplies would severely limit water availability for producing food for the growing population (Kumar, 2010). On the other hand, the poor small and marginal farmers face several constraints in adopting agricultural technologies and agronomic practices, which are needed to maximise productivity of land and water (Kumar, 2003).

The paper critically looks at the plan allocation for agriculture and irrigation in the Eleventh five year plan vis-a-vis its potential for driving growth in the agriculture sector, in the light of what has been achieved during the Tenth plan period against the allocation in these sub-sectors. It then suggests the technological and institutional interventions for managing water to enhance the productivity and sustain growth in the agricultural sector in future.

II

STRATEGIES FOR AGRICULTURAL GROWTH AND FOOD SECURITY DURING ELEVENTH PLAN: A CRITIQUE

The Eleventh Plan strategy of inclusive growth rests upon substantial increase in the plan allocation for agriculture, and irrigation and water management. The allocation for agriculture and allied sectors (at 2006-07 prices) is Rs. 54,801 crore. For irrigation and water management is Rs. 3246 crore. Since irrigation is a state subject, there is a major contribution from state plan allocations, to the tune of Rs.182050 crore. In addition, the contribution from schemes such as Accelerated Irrigation Benefit Programme is Rs. 47,015 crore (Government of India, 2008, pp.42-62). Hence, the total plan allocation for irrigation is Rs. 232311 crore. This is far higher than the allocations during the Tenth plan. For instance, the total expenditure during Tenth plan period for irrigation and flood control was only Rs.84,692 crore. Similarly, in agriculture and allied sectors, the plan expenditure was only Rs.19,175 crore (Government of India, 2008).

But, in spite of the substantial increase in plan allocation for agriculture and irrigation, agricultural growth rates have not shown any indication of pick up. While the growth rates in sectoral GDP was 2.47 per cent during the Tenth plan period (Government of India, 2008, Table 1.1, p.4), during the first two years of Eleventh
plan period, the average growth rates was only 3.0 per cent. In addition to the expenditure under agriculture, irrigation and flood control, there has been substantial investment under the National Rural Employment Guarantee Scheme (NREGS), which was started in 2006-07, since 2007-08 when it was first implemented in all districts of the country. Barring construction of roads, a large chunk of the infrastructure created under NREGS have potential positive implications for irrigation and rural water management (Bassi and Kumar, 2010) and therefore agriculture and allied activities.

But, the recent analysis shows that the NREGA interventions cause more negative welfare effects than positive ones, the most important among them being artificial scarcity of agricultural wage labour and unprecedented increase in wage labour rates. As noted by Bassi and Kumar (2010), in naturally water-scarce regions, indiscriminate construction of water conservation structures such as digging up of new ponds, construction of check dams and de-silting of existing tanks in villages is causing negative impacts on the overall water economy of the river basins in which they are falling. After Kumar et al. (2008), this is the result of the reduced inflows into large reservoirs, meant for irrigation, domestic and industrial purposes, downstream; and poor economic viability of individual water harvesting structures with very high costs per unit volume of harvested water, owing to low annual rainfalls, high inter-annual variability in rainfall and rainy days which causes disproportionately higher variability in run-off, high potential evaporation, low infiltration rates and poor groundwater storage potential in these regions (Kumar et al., 2008). The land based NREGA interventions lack proper scientific planning based on the hydrological considerations, and technical supervision of the work execution impacting on their overall effectiveness (Bassi and Kumar, 2010).

III

TECHNOLOGICAL INTERVENTIONS FOR SUSTAINABLE AGRICULTURE PRODUCTION

3.1 Technologies to Change the Trajectory of Irrigation Development

There are several regions, which have abundant groundwater supplies such as Assam, parts of Bihar, Orissa, West Bengal and Jharkhand (Government of India, 2008). This region accommodates the largest number of poor people in the country (Shah et al., 2000). The groundwater resources in these regions largely remain under-utilised in spite of the fact that public irrigation facilities are very poor (Government of India, 2008). With the conventional abstraction structures and mechanisms, the trajectory of development of groundwater resources in the region is most likely to be quite low. In order to change the trajectory of development, these regions need simple technologies that involve very little capital investment, and that can absorb the surplus labour force. This way, India can boost the rate of growth in groundwater development, which otherwise would remain slow, if the conventional technologies are pursued due to economic constraints (Kumar, 2003).
Treadle pump, a manually operated pump, require very low capital investments, while being much more energy efficient than traditional water lifting devices such as Denkul and Shena. The pump, which costs in the range of Rs. 1000 - Rs. 1400, is highly suitable for millions of poor farmers in the region who have postal stamp sized holdings. It can provide them the water security, essential for their livelihoods. In eastern India, adoption of treadle pumps lead to expansion in irrigated area, cropping intensities, enhanced crop outputs and yields, and significant rise in income from farming, while farmers move from subsistence agriculture to wealth creating irrigated farming practices (Shah et al., 2000; Kumar, 2000b). Studies conducted in Orissa also throw enough hard empirical evidences to show that pump adopter households enjoy greater food and nutritional security (see Kumar, 2001 for details). Treadle pump irrigation ensured increased output from irrigated agriculture, more importantly vegetables. The surplus production, which is sold in the market, brings in cash income from farming. This enables the households to purchase other essential commodities, which ensured better access to food supplies both in terms of quantity and variety (Kumar, 2000b). Another aspect of household food security is the nutritional value of the food consumed. As Kumar (2000b) found “The introduction of TP has directly contributed to growth in vegetable production from farms”.

In addition to treadle pumps, effective rural electrification, easy access of farmers to farm power connections, and availability of credit facilities/subsidy for purchase of pump-sets would improve the access of small and marginal farmers to groundwater irrigation through two different routes. First, increasing number of pump owners would reduce the monopoly power of pump owners, who otherwise charge exorbitant hourly rates for irrigation, thereby lowering the irrigation charges (Kumar, 2007). Two, instead of water purchase, with more farmers opting for power connections and electrification of their shallow wells, groundwater irrigation becomes cheap for a larger constituency of farmers.

3.2 Technologies to Increase Crop Per Drop

So far as harnessing more and more water from the natural systems is concerned, technologies have their limits. The next option available to enhance food production is to improve the efficiency of use of water (Kumar, 2010). Worldwide, micro irrigation (MI) technologies are promoted to save water and get increased efficiency of water use in agriculture. There are several technologies, which help the farmers not only save irrigation water, but also increase crop yield. While micro irrigation systems have seen a relatively rapid adoption rate over the past one-decade in India, the overall adoption level is still quite low. Drip and sprinkler irrigation systems cover less than 6 per cent of the global irrigated area, and in the case of India, they cover 3.88 mha, with 1.46 mha under drips and 2.42 mha under sprinklers.

But, these technologies have great bias. For farmers to take full advantage of them in terms of water saving, they should install them for large fields. However, in
areas (states) where power pricing is dependent on the pump horsepower, both the capital cost of the pumping per unit area and the operating cost per unit area will be higher for resource poor farmers who adopt the system for smaller areas. The farmers who adopt the system for larger area can bring down the cost per unit area significantly (Kumar, 2003; Kumar, 2009). These systems involve high capital investments. Further, installing these systems for small fields would increase the cost per unit area. Also, the maintenance requirements for these irrigation systems are quite high. The drip system, which is the most water efficient of these technologies, is most suitable for horticultural plantations from the point of view of cost effectiveness. Thus, they are best suited to the resource rich, large farmers, who can spare part of their land for horticultural crops, and can wait for 3-4 years for returns. Another important issue involved in the adoption of pressurised irrigation systems is the lack of enough economic incentives. In many Indian states, where depletion problems are encountered, groundwater resources are abundant, only power supply is limiting the farmers’ access to groundwater. Examples are alluvial areas of North Gujarat, Punjab, western Uttar Pradesh and Haryana. These are the situations where the groundwater supply potential is higher than what the available power supply could deliver (Kumar, 2009).

The large static storage of the aquifers permits the farmers to keep pumping water, even though it is at the cost of excessive draw down. This is because of the following facts. First, either the cost of electricity for pumping unit volume of water is extremely low or the marginal cost of energy for pumping is zero. Second, there are no limits on the volumetric pumping by well owners, and well owners do not pay for water (Kumar, 2003; Kumar, 2009). Since pressurised irrigation systems need extra power to run, the well output could drop with the installation of the system. As the farmer is already utilising the power supply fully, the total water output from the well would drop. Thus, the farmer will not be able to cash in on the benefit due to water saving in the form of increased area under irrigation. Therefore, the only economic opportunity available with pressurised irrigation technologies is yield increase. However, the ability to secure higher yield through water saving devices depends heavily on the management practices, including agronomic practices (Kumar, 2003).

Nevertheless, the situation would be drastically different in hard rock areas facing depletion problems. In those areas, currently farmers are not able to utilise power supply fully due to shortage of water in wells. In such situations, the pressurised irrigation systems could benefit the farmers by enabling him/her to run the pump for longer hours, maintain the same level of total well output and irrigate larger area. Water saving technologies have recently been developed to suit the requirements of many millions of the poor, small and marginal farmers in the country. They are the mini sprinkler systems and micro tube drip systems (Kumar, 2003; Kumar, 2009).

One important factor which limits the adoption of MI technologies is the small area under crops that are amenable to these technologies (Kumar, 2009). MI systems
are most suited to fruit crops, vegetables, tubers and flowers. The area under these crops is still low in India, with fruits accounting for 4.96 mha, vegetables 6.76 mha and flowers 1.16 lac ha (Government of India, 2008, p.17). But, the water saving impact of MI systems depend on a variety of factors, viz., crop type, type of MI technology, soil type, climate and geo-hydrology. Water saving is likely to be higher for widely spaced crops, under sandy soils and semi-arid to arid climate, with deep groundwater table, with drip or trickle irrigation (Kumar, 2009). That said, the central funds being allocated for subsidising MI irrigation systems is a miniscule in comparison to what is required to boost MI adoption in the country. A significant chunk of the funds being utilised for NREGA in naturally water scarce regions, particularly the water conservation, drought proofing activities, should therefore be re-allocated for subsidising MI systems to have a significant impact on water use efficiency in crop production and overall agricultural productivity.

IV

INSTITUTIONAL CHANGES FOR CHANGING THE TRAJECTORY OF WATER USE AND PRODUCTIVITY IN AGRICULTURE

4.1 Promoting Equity and Productivity in Water Use

The growing competition and concomitant conflicts between different sectors are the major issues that need to be addressed in water allocation. The fundamental challenges are: promotion of economically efficient uses, while adequately compensating the agriculturists for the losses they suffer due to transfer of water to other efficient use sectors; and, equitable access to water from canals and groundwater within the agriculture sector. Saleth and Dinar (1999) point out that concerns in the water sector, which once revolved around water development (and quantity), now revolve around water allocation (Saleth and Dinar, 1999). Markets and regulations can be sought as instruments for water allocation (Frederick, 1992). But, both markets and regulatory approaches are likely to fall short of satisfying all these criteria for efficient and effective water allocation (Frederick, 1992). The enormous geographic and temporal diversity in water supply and demand situations suggest that no single institutional arrangement is likely to be preferred in all instances (Frederick, 1992). While Howe et al., (1986) have argued that markets meet all the criteria for effective water allocation better than any likely alternative, this holds true for Indian situations (Kumar, 2003).

The absence of well-defined property rights regimes is a major source of uncertainty about the negative environmental impacts of resource use, leading to inefficient and sustainable use (Kay et al., 1997). This has been apparent in the case of both groundwater and canal water supplied for irrigation. In the Indian context, many researchers in the recent past have suggested establishment of property rights as a means to build the institutional capability to ensure equity in allocation and
efficiency in use of water across sectors (Kumar, 2000a). But, again if the rights are allocated only to use water, it can create incentives to use it even when there is no good use of it (Frederick, 1992). Therefore, water rights have to be tradable (IRMA/UNICEF, 2001; Kumar and Singh, 2001). Establishing privately-owned, property rights that are tradable is critical to establishing conditions under which individuals will have the opportunities and incentives to develop and use the resource efficiently, or transfer it to more efficient uses (Frederick, 1992).

Empirical evidences collected on the functioning of groundwater irrigation institutions in North Gujarat show that under a system of fixed volumetric water use rights, farmers prefer to grow highly water efficient crops (Kumar, 2005 and 2010). Tradable private property rights need to be enforced for groundwater and water supplied from public reservoirs for irrigation. In the case of groundwater and canal water supplied for irrigation, as individuals enjoy access to the resource, the private property rights for individual users are envisioned. For markets to function efficiently, the full benefits and costs of transfer should be borne by the seller and buyer. Generally, this is not possible due to the third party effects of water transfer. Allowing the user to transfer only the consumptive portion of the water he/she uses can reduce the third party effects in regions that are dry. The government will have to play a great role in reducing the third party effects of water transfers. Similarly, government has to invest in protecting the ecological and environmental services that are affected by water transfers (Frederick, 1992).

Fixing norms for allocation of volumetric water rights across individual sectors, viz., agriculture, industry and domestic use, should involve considerations such as physical sustainability of the water resource system and environmental sustainability. The total water allocated from any region/basin, therefore, should not exceed the difference between annual renewable freshwater and the ecological demand, or the utilisable freshwater whichever is less. Going by such norms, the regions, where water resources are abundant by nature such as the eastern part of Uttar Pradesh, Bihar, Orissa and West Bengal, the volumetric water rights of individual sectors and users, especially farmers would be very high. In these regions, land availability would continue to be an important factor in deciding the returns from agriculture (Kumar, 2003). The farmers will, therefore, have to choose crops, which are more water intensive and which would encourage intensive use of the same piece of land. In states like Bihar and Uttar Pradesh, water rights would not mean much for a large number of cultivators, who have marginal holdings or no land.

In such situations, the allocation norms in agriculture need to be carefully designed, if equal opportunities are to be given to all types of cultivators to improve their own farm economies. In water allocation, the food security needs of the families could be given priority rather than the farm size. This will result in disproportionate allocation of rights in favour of the small and marginal farmers. This can induce interlocked land, pump and water markets, where in the rich well owning farmers will offer pump services to farmers who do not have their own irrigation sources, and can,
in return, use a portion of their water rights. This will force the rich well owners to charge less for their pump irrigation services they provide, thereby promoting greater equity in access to groundwater in these regions. They may also enter into sharecropping arrangement with landless. A good economic opportunity lies for the landless, small and marginal farmers in transferring water in bulk to water scarce regions, or cities and industrial areas, which are concentrated points of large demands for water, as they are likely to have excess water. Physical conditions for transfer of water from rich areas to water scarce areas exist in many regions (Kumar and Singh, 2001; Kumar, 2003).

4.2 Encouraging Efficient Use of Water in Agriculture

4.2.1 Pricing of Irrigation Water

In spite of the recommendations of the second irrigation commission, state irrigation bureaucracies have failed to hike water charges that make economic sense due to the potential social and political ramifications such measures can create. The failure has its roots in the absence of institutional capability to improve the quality of irrigation services and correctly monitor the water use, lack of institutional arrangements at the lowest level to recover water charges from individual farmers, and enforce penalties on free riders. A few successes have been seen in areas where PIM programme is implemented, where farmers have shown the willingness to pay more for the irrigation services to the Water User Associations.

The recent past has generated significant debates over the usefulness of irrigation water pricing as a way to regulate water demand, with some arguing for (Tsur and Dinar, 1995); and some others arguing against pointing out shortcoming at both theoretical and practical levels (Perry, 2001). There are three major, and important contentions of those who argue against pricing: (1) they question the logic in the proposition that “if the marginal costs are nil, farmers would be encouraged to use large quantities of water before its marginal productivity becomes zero, consuming much more than the accepted standards and needs” (Molle and Turral, 2004); (2) the demand for irrigation water is inelastic to low prices, and the tariff levels at which the demand becomes elastic to price changes would be so high that it becomes socially and politically unviable to introduce (Perry, 2001); (3) there are no reasons for farmers to use too much water, which can cause over-irrigation (Molle and Turral, 2004).

However, as noted by Kumar (2010), these arguments have weaknesses. What is the most important issue is in linking irrigation charges and demand for water (see Perry, 2001). Merely raising water tariff without improving the quality and reliability of irrigation will not only make little economic sense but also would find few takers. As returns from irrigated crops are more elastic to quality of irrigation than its price (Kumar and Singh, 2001), poor quality of irrigation increases farmers’ resistance to
pay for irrigation services they receive. Therefore, the “water diverted” by farmers in their fields does not reflect the actual demand for water in a true economic sense, so long as they do not pay for it. In other words, the impact of tariff changes on irrigation water demand can be analysed only when the water use is monitored and farmers are made to pay for the water on volumetric basis. The above arguments also lead us to the conclusion that the rates for canal water can be increased to substantially higher levels, provided the quality of irrigation water is enhanced. But, water pricing for irrigation can impact the poor farmers adversely, if pitched at higher levels (Frederick, 1992). One of the ways to reduce the negative impacts on access equity is to introduce progressive pricing system. An appropriate pricing structure for water followed by a clearly recognised private property rights and good quality irrigation service could help achieve the desired effect of pricing changes on demand management. It also means that if positive marginal prices are followed by improved quality, the actual demand for irrigation water might actually go up depending on the availability of land and alternative crops that give higher return per unit of land. This is because the tendency of the farmers would be to increase the volume of water used to maintain or raise the net income (Kumar and Singh, 2001). Hence, water rationing is important to effect demand regulations in most situations (Perry, 2001).

4.2.2 Pricing of Electricity in the Farm Sector

Many researchers have suggested rational pricing of electricity as a potential fiscal tool for sustainable groundwater use in India (Moench 1995; Saleth, 1997). Many argue that flat rate based pricing structure in the farm sector creates incentive for farmers to over-extract it as the marginal cost of extraction is zero. However, empirical evidence does not seem to suggest any impact of the cost of extraction on the use of groundwater for irrigation in water scarce areas (Kumar and Patel, 1995), and in areas where water charges reflect the scarce value of the commodity (Kumar, 2005). The policies with regard to water and electricity pricing are guided by strong political economic considerations (Moench, 1995). But, the recent past has seen some remarkable success in introducing metering and charging power tariff based on the actual consumption in Gujarat. In Punjab, the farmers have been crying foul over deteriorating power supply, which is supplied free, and instead were demanding good quality power supply with a price.

Studies carried out in Mehsana district of north Gujarat and coastal Saurashtra on diesel and electric well commands show that control over watering will have greater bearing on the net returns from irrigation than the cost of irrigation. This means that the desired impacts of changes in the pricing structure of electricity on economic efficiency of irrigated crops can be realised only if the quality of power supply is ensured (IRMA/UNICEF 2001). Kumar (2005) and Kumar (2009) showed that unit pricing of electricity influences groundwater use efficiency and productivity positively. It also shows that the levels of pricing at which demand for electricity and
groundwater becomes elastic to tariff are socio-economically viable. Further, water productivity impacts of pricing would be the highest when water is volumetrically allocated with rationing. These evidences build a strong case for introducing pricing changes in electricity supplied in the farm sector. One of the arguments against price change is the higher marginal cost of supplying electricity under metered system, could reduce the net social welfare as a result of reduction in: (1) demand for electricity and groundwater; and (2) net surpluses the individual farmers could generate from cropping. Another argument against using pricing is that for power tariff levels to be in the responsive region of power demand curve, prices are often too high that it may become socially unviable. The analyses questioned the validity of these arguments.

Kumar (2005) showed that higher demand reduction in groundwater and electricity would be achieved if volumetric rationing of energy/water were done coupled with induced marginal cost of using energy/water. Further, the effectiveness in implementing pricing policies would depend heavily on the ability to supply high quality in rural areas and meter its use, levy the charges without default, prevent thefts, and penalise free riders. But, in areas with abundant and shallow groundwater, especially in eastern India, the electricity pricing structure should be such that it encourages greater exploitation of groundwater (Government of India, 2008). Nevertheless, even full cost pricing of electricity might work out to be cheaper for farmers, as the depth of pumping is low in these regions.

V

CONCLUDING REMARKS

Promotion of low cost, energy efficient water harnessing technologies such as treadle pumps, through supply of information, materials and services, can not only change the trajectory of water resource development in the country, but also enable the poor farmers in the agriculturally backward eastern and north-eastern parts of our country, access irrigation water. This will create millions of micro farm enterprises with sustainable utilisation of water resources in the water abundant regions. Low cost, water saving technologies will enable the poorest sections of the communities to practice irrigated agriculture with very limited water in water scarce regions. Land based interventions for drought-proofing, water harvesting and artificial recharge under NREGA should be planned carefully, involving hydrological and economic considerations, so as to improve the overall water economy and to reduce the negative welfare effects on the society. In naturally water scarce regions, where such interventions are likely to create negative welfare effects, the funds should be earmarked for providing subsidies for agricultural interventions such as micro irrigation.

Institutional reforms in the water sector, covering enforcement of establishment of private and tradable water rights in groundwater and water supplied from public
reservoirs, can together bring about significant increase in farm outputs with reduction in aggregate demand for water in agriculture. It will also bring about more equitable access to and control over the water available from canals and groundwater for producing food and to ensure household level food security. This has to be complimented by volumetric pricing of can water, and pro rata pricing of electricity in the farm sector with improved quality and reliability of the supplied power.

REFERENCES


