Groundwater Irrigation versus Surface Irrigation

M DINESH KUMAR, A NARAYANAMOORTHY, O P SINGH

This response to "Will the Impact of the 2009 Drought Be Different from 2002?" (EPW, 12 September 2009) says that many of the arguments in the article proposing groundwater as India's prime adaptive mechanism in times of drought are flawed and lack scientific support and that surface irrigation systems make a remarkable contribution to drought proofing in India. As such, balanced development of surface water and groundwater is an urgent need.

M Dinesh Kumar (*dinesh@irapindia.org*) is at the Institute for Resource Analysis and Policy, Hyderabad, A Narayanamoorthy is at the Centre for Rural Development, Alagappa University, Tamil Nadu and O P Singh is at the Department of Agricultural Economics, Banaras Hindu University, Uttar Pradesh.

This is in response to the article "Will the Impact of the 2009 Drought Be Different from 2002?" by Tushaar Shah et al (EPW, 12 September 2009). Though Shah and his co-authors have touched upon many pertinent issues relating to well irrigation and its positive impact on drought mitigation, many of the arguments appear to be either flawed or lack scientific veracity due to lack of supporting data.

The first issue is concerning energy rationing versus unlimited power supply. Shah et al (2008) predicted elsewhere that 18-20 hours of power supply to agriculture in Gujarat provided now, instead of the previous eight hours of power supply, would help the state to achieve bumper crop production. The basis for this argument is that Gujarat had received four consecutive good monsoons, and the state had done good banking of groundwater through check dams. While good monsoon during the past three to four years had benefited groundwater in the region through increased recharge, some regions in the state have been experiencing groundwater over-draft during the past 30-35 years. The huge groundwater storage deficit in the alluvial north Gujarat cannot be compensated by four years of good monsoon. Even today, farmers there are pumping water from a depth of 400-500 feet.

There are only two regions in Gujarat which can support 18-20 hours of power supply. These are: the alluvial central Gujarat and alluvial parts of south Gujarat. This is because the alluvial aquifers there are continuously recharged by canals of major schemes such as Mahi and Ukai-Kakrapar. These lead us to the point about "groundwater banking" which the authors argue for throughout the article. For groundwater banking, two conditions have to be fulfilled: sufficient amount of surplus water is available in the regions of intensive groundwater use and the aquifers should have sufficient storage capacity. As semi-arid and arid regions with intensive groundwater use have limited uncommitted surface flows (Kumar et al 2008), the first condition itself remains unfulfilled. Still, the authors argue for recharging of aquifers using local runoff.

The authors have eulogised check dam scheme of Gujarat government as "wise" investments, responsible for the impressive performance of agriculture in that state. But, there are enough scientific evidences to prove that these interventions are creating negative effects on the ecology, rather than producing any positive impacts on improving the region's water situation. The reasons are: (1) the surface water resources in the region's basins are over-appropriated through a large number of medium (nearly 100) and minor irrigation schemes in years of normal and deficit rainfall; and (2) in very wet years, the hard rock aquifers do not provide any space to store the additional runoff underground as wells in the region overflow during high rainfall years. Therefore, in normal and drought years, these check dams only reduce the flows into d/s reservoirs. In wet years, the water remains on the surface eventually evaporating during the monsoon season itself due to high potential evaporation (ibid). Obviously, these mini reservoirs cannot provide any inter-annual storage to benefit during droughts.

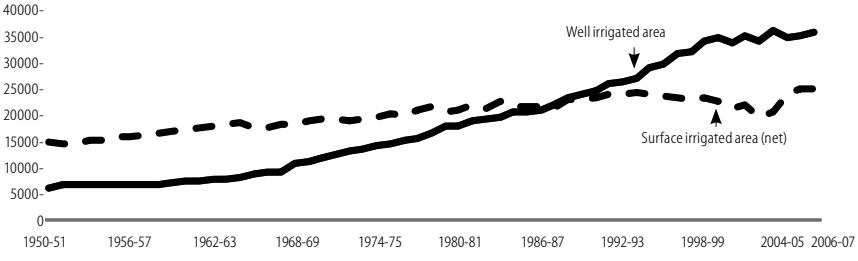
Historical Impact of Droughts

The authors attribute the reduced impact of the 1987 drought in comparison to the one of 1966 to the expansion in well irrigated area, and underplay the role of canal irrigation in stabilising India's agricultural production. First of all, it is not appropriate to relate 1987 with 1966 as the level of adoption of agricultural technologies at the two time periods were entirely different. Second, many of the large surface irrigation schemes in India were also built during the late 1960s, 1970s and 1980s with proportionate increase in surface irrigated area. During the period

from 1965-66 to 1984-85, the net irrigated area by canals alone had increased by 5.3 mn ha.

The potential utilised from surface systems today stands at 42.45 mn ha, whereas that of wells stand at 38.55 mn ha (Planning Commission 2008). Needless to say, there will be differences when one takes into account the actual irrigated area. This is because water from surface systems is increasingly used for growing highly water-intensive crops such as paddy and sugar cane, violating the cropping pattern suggested for the canal commands, and considered for planning of the respective schemes. Also, there is large-scale diversion of water from surface reservoirs for urban water supply. Today, nearly 91% of the water supplies in large cities in India with a population of more than one million people come from surface reservoirs (Mukherjee et al 2009). Still, the above figures are indicative of the potential contribution of the two systems in terms of volume of water supply.

Figure 1: Net Surface and Well Irrigated Area in India (1950-51 to 2006-07, in 000 ha)



The authors' prediction about the effect of this year's drought is rather strange. They argue that the effect of drought in winter can be reduced significantly, and in fact more production could be achieved through increasing energy supply, but simultaneously state that the rain-fed paddy output of kharif would drop significantly. The underlying argument is that more groundwater could be pumped during winter to save the wheat crop. If that is the case, the same groundwater, which the authors presume will be there for the winter crop, could as well be used to irrigate the "rain-fed" paddy. Normally, any meteorological drought will translate into a hydrological drought with resultant negative impact on groundwater recharge, thereby affecting winter crop also.

Again, it is futile to make predictions about the impact of the drought on the basis of the rainfall deficit for a country like India where there is a huge spatial variation in mean annual rainfall (from 100 mm to 11,000 mm). So is the attempt to attribute the differential impacts to factors like the presence or absence of a particular source of irrigation and power supply. What matters is "when the drought hits and where".

Groundwater Banking

The authors argue: "However, by themselves, dams and canals have proved increasingly useless during droughts. And few dams have carry-over storage to proof against droughts." Here, the authors contradict their own statement about the drought-proofing impact of reservoirs, "...but command areas of reservoir-based systems are even better off as some of the reservoir storage would last even when rivers dry up" (page 13, para 5). The authors extend their concepts of "managed aquifer recharge" to the hard rock areas of peninsular India, but do not propose how water for recharging could be made available. The fact of the matter is that all south Indian river basins, except the Godavari basin, are either "closed" or on the verge of closure with no uncommitted flows in normal years which can be used for recharging (ibid). The idea of recharging wells during years of good monsoon simply does not work due to the reasons mentioned earlier.

The only way to sustain well irrigation in the hard rock peninsular and central India is through providing exogenous surface water during lean season. This would not only help reduce groundwater draft, but also augment the recharge through return flows from irrigated fields and canal seepage. The canal commands of coastal Andhra Pradesh, south Gujarat and Maharashtra, which are still "safe" for groundwater exploitation, are illustration of this phenomenon.

Is Surface Irrigation Declining?

The authors lament the "dismal" performance of canal irrigation schemes in India, and stress giving impetus to well irrigation. However, the data do not seem to support their argument (Figure 1). The net area irrigated by surface systems has steadily increased during the past five and a half decades and peaked in 2006-07, in spite of a minor short-term decline observed during 1993-94 and 2002-03. The decline was due to many factors. Three of these are: lack of adequate investments for new schemes (Planning Commission 2008), droughts and increasing diversion of water from reservoirs to urban areas. Sustaining well irrigation growth is a matter of concern, as 15% (839) of the blocks/talukas/mandals in the country are over-exploited; 4% are critically exploited and 10% (550) are in the semi-critical stage (Government of India 2005), and these regions contribute very significantly to India's well irrigation.

Hence, it can be concluded that droughts cannot be mitigated only through well irrigation. Surface irrigation systems make a remarkable contribution to drought proofing in India. Therefore, the need of the hour is balanced development of surface water and groundwater.

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