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POLICY BRIEF - 34

Key issues facing the Irrigation Sector in Karnataka: Some Policy Interventions

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Introduction

Karnataka is one of the most water starved states in India and is characterized by highest concentration of drought prone area. With all the available supply of surface and groundwater in the state (761 TMC), only 34 % of the gross cropped area is irrigated leaving bulk of the area under dryland agriculture relying on monsoon. Thus, the demand for irrigation water is increasing, as irrigation is very critical input for enhancing agricultural productivity and farmer's income. Since agriculture is the major consumer of surface and groundwater (90 %), the biggest challenge is reducing the consumptive use of water in agriculture so that the saved water could be optimally utilized to bring more area under irrigation.

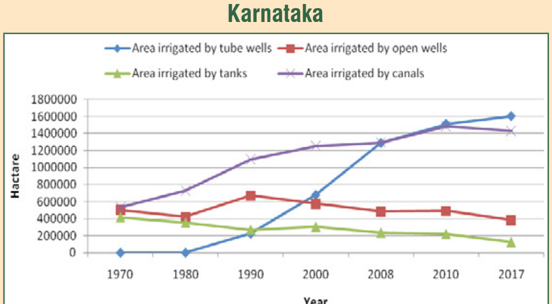
Focus

Given the climate change scenario and increased demand for water from competing sectors, promoting most efficient, equitable and sustainable use of water becomes the priority of policy focus. In this regard, the trends in the growth of different sources of irrigation and the key issues facing irrigation sector are analyzed along with policy interventions. This policy brief is based on analysis of relevant data including intensive reviews.

Trends in the growth of different sources of irrigation

An analysis of irrigation profile of Karnataka since 1970's indicates that the proportion of area under canal irrigation is getting stagnant and also falling gradually, while the proportion of area under bore-well irrigation has been rising sharply (Fig 1). On the contrary, the area under tank irrigation has been rapidly falling and exhibited a negative growth rate. The trends indicate over dependence of agriculture on bore-well irrigation.

Fig 1. Trends in Different sources of irrigation in Karnataka

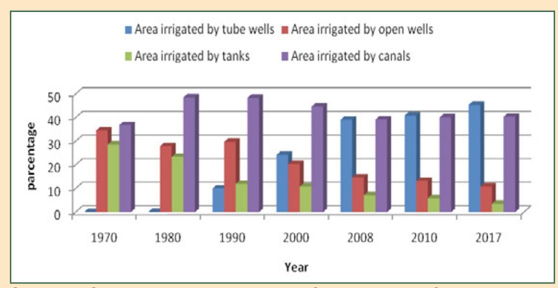


Source: Data drawn from Directorate of Economics & Statistics, 2017-18

Changing share of different sources of irrigation

As evident from the Fig 2, out of the total irrigated area in the state, around 56 % is from groundwater and the remaining is from canal and tank irrigation. Thus, the share of groundwater often referred to as minor irrigation, its share has exceeded the share of major irrigation (canal). Over the years, the share of bore-well irrigated area is increasing while open well irrigated area is drastically reducing. Similarly, the share of canal irrigation has declined marginally from 49 % to 40 %, while the share of tank irrigation was around 29 % during the 1970's and this steeply reduced to around 4 % during 2017. Thus, there is a heavy pressure on groundwater extraction for agriculture use leading to overexploitation of the fragile resource.

Fig 2. Changing share of different sources of Irrigation in Karnataka



Source: Computed from Annual Season and Crop Reports, Directorate of Economics & Statistics

Major Issues in Surface Irrigation

1. **Large widening gap between irrigation potential created and utilized**

   As evident from the Fig 3, the government expenditure on major and medium irrigation projects surged sharply since 2009 towards creating additional potential. But the net irrigated area remains more or less stagnant during this period. Thus, the increase in expenditure is not in commensurate with the increase in area under irrigation. The potential created in major and medium and minor (surface water) is around 31 lakh ha, while utilized area is around 16.4 lakh hectares (WRD, GOK, 2017). Thus, there is a substantial gap between potential created and utilized. It is to be noted that creating one hectare of irrigation potential through major and medium schemes costs around Rs 7.51 lakh at 2016 prices; obviously, the cost per hectare of potential utilized will be much higher. Since Command Area Development Authority (CADA) is not showing impressive performance due to low funding and other reasons, the gap is continuing.

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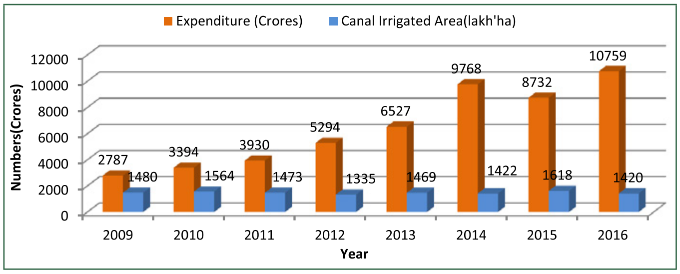
Fig 3. Year wise Expenditure on Irrigation sector and Area irrigated by Canals



Source: Computed from the Annual Reports, Water Resource Dept, GOK

2. Poor water management resulting in inefficiency

The irrigation practices followed in the canal irrigated area are still dominated by traditional methods like flow or flooding. In these methods, about 60% of water is lost in conveyance, evaporation, percolation & seepage. Studies indicated that canal irrigation water use efficiency is hardly 30 percent,(Rudrapur 2013, Gulati and Banerjee, 2016). It was estimated that around 70% of the irrigation water is wasted in irrigated commands depriving the dry areas for irrigation (Envi Stats, India 2018). There is disproportionate use of water between head and tail end regions leading to inequity in water distribution. In addition, paddy and sugarcane crops alone consumearound 74% of total agricultural water in the state starving other crops from irrigation. The designed cropping pattern based on volume of water available in the reservoir is hardly followed in the command. The coverage of improved irrigation technologies like micro irrigation is yet to reach, as water is highly subsidized and its scarcity value is ignored. Further, reckless use of water in the irrigated commands has led to environmental problems like salinity, alkalinity and water-logging (Chinnappa & Nagaraj 2007) imposing additional costs to ameliorate.

3 The scarcity value of water is ignored

In agriculture, water is neither priced nor valued properly. In comparison with surface water, groundwater is relatively expensive and thus farmers are motivated to invest on micro irrigation technologies in response to economic scarcity. But in case of canal water, the price of surface water is not reflecting the economic scarcity. Hence there is no incentive for adoption of smart irrigation technologies. Since water is underpriced, there is a tendency by the farmers to use water sub-optimally.

4. Poor revenue generation from the existing water rates

As surface water is virtually subsidized, the revenue generation from water rates has been extremely low not even covering the operational cost of supplying water. Further, water is not charged on volumetric basis or marginal cost of supply. Thus, incentive to use watermore judiciously is lacking. Many studies have indicated that the prevailing irrigation charges for different crops in India neither promotes use efficiency nor cost recovery reflecting poor performance (Nagaraj et al, 2003, Gulati and Banerjee 2016). Over the years, revenue generation from water charges has been shrinking and the proportion of working expenditure devoted towards O and M is also declining resulting in poor maintenance of the irrigation infrastructure.

5. Low adoption of improved water efficient technologies

Studies indicated that improved irrigation technologies like micro irrigation (MI), aerobic rice, SRI methods not only save substantial volume of water but also enhances productivity. For instance, aerobic rice technology saves >50% of water, but aerobic rice is not popular. Water saving through MI varied from 12% to 84% in vegetables, 23 to 100% in fruit crops and in other crops like sugarcane, 60%, cotton 60% and groundnut 40%.While, productivity increase varied from 12% to 47% in case of vegetables, 23 to 90% in fruits, 33% in sugarcane, 25% in cotton and 66% in cottonas against the conventional practices (Kumar et.al 2008, Kumar and Palanisami, 2010). Despite multiple benefits from MI, the adoption level is extremely low due to lack of reliable supply and timely scheduling of water. The digital tools in monitoring, managing and efficient use of water through automation are not reflected in canal irrigated areas. Majority of the farmers are showing disinterest in adopting most efficient methods of irrigation, since they are expensive and having binding constraints. The productivity per drop of water is low in command areas as against controlled irrigation in case of bore-wells (Gulati and Banerjee, 2016). Even with irrigation reforms by including Participatory Irrigation Management (PIM) and Water Users Associations's (WUA) turned out to be a fiasco and did not yield desirable outcomes in improving economic efficiency of water use.

6. Lack of coordination between Departments

The water resource department controls water in the reservoir but seldom made attempts to measure water applied volumetrically for irrigation. They are more focused on new infrastructure development than improving efficient water delivery, management and maintenance of existence infrastructure. Further, several spill over projects are still pending without completion leading to cost escalation. While, the agricultural experts are more concerned about implementing improved package of practices for augmenting productivity, as water distribution is beyond their purview. Thus, there is lack of outreach from both the departments in quantification of water requirements and efficient use of water.

Key issues in Tank Irrigation

Decline in the importance of tank irrigation

The state had around 40,000 irrigation tanks with a command area of about 6.84 lakh ha spread across 32000 villages during 1980's. This reflected the necessity and prominence of tank irrigation in Karnataka. However, due to siltation, poor maintenance, changes in land use and land cover and encroachment in the catchment, reduction in inflow of water, lack of participation by the community and gradual erosion of traditional community institutions, the tanks have been degraded and actual irrigated area got reduced to about 2.40 lakh Ha which is less than 35% of designed command.

Reduction of number of tanks

There has been reduction in the number of tanks from 40,000 to 36,508 as well as sharp reduction in the area irrigated over time. There are estimates (Govindaiah 1994) indicating that of the total tanks, around 31% are defunct and about 80% of these tanks are medium and small. These percentages are only indicative, and the actual proportion of defunct tanks may be much higher than reported in different areas of Karnataka. The declining trend is the cause of concern for sustaining the groundwater use and in restoring the ecological functions of the tank.

Heavy siltation

Heavy silting of tanks is a common problem across all tanks in the state (Chandrakanth & Romm 1990). Though, de-siltation of irrigation tanks was a traditional institutional mechanism involving all the households in the village, the practice has been discontinued by the farmers. This is due to inter alia; 1) reduction in the cattle population in the villages posed a major constraint for silt transportation 2) high opportunity cost of silt transportation 3) acute scarcity of labour 4) silt application involves additional cost and farmers not being able to recover the additional cost from the modest returns realized from dry land agriculture.

Declining public investments on maintenance of tanks

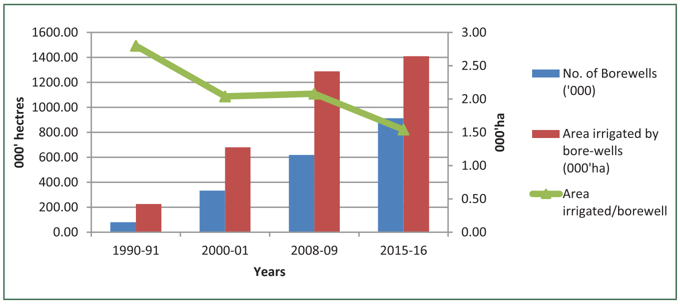
Lack of adequate funds as well as interest in operation and maintenance of tanks are the key factors for dismal performance of tank irrigation. There has been increase in expenditure over the years in absolute terms towards operation and maintenance from 1959 to 1970. The increase in outlay on O and M per ha was marginal till 1978-79. After 1980, the investment almost remained stagnant. The real investment per ha of tank command in 1970 was Rs 180 and it rose to Rs 361 in 1980 and remained stagnant till 1985 and thereafter reduced to Rs 324/ha over the years, thus from Rs 150/ha of command area in 1970 to Rs 304/ha of command area in 1989.

Key Issues in Groundwater

Groundwater overexploitation

Groundwater exploitation in the state is highly skewed, exploiting more intensively in semiarid districts of North and South interior Karnataka. Though the trend in the growth of number of borewells as well as area irrigated by borewells is increasing (Fig 4), the area irrigated per bore-well is drastically declining from 2.8 ha to 1.54 ha/bore-well. The growth in bore-well witnessed a remarkable growth rate of 10.7% per annum from (1990-2016) creating a profound impact on groundwater resource extraction. The stage of groundwater development in the state is around 65%. However, in over exploited area it is around 125% as against 87% in critical areas implying distorted development. Currently, more than half of the state's cultivated area is under critical to over-exploited category (Suresh Kumar 2019). Overall, in 45 Taluks groundwater is overexploited, 8 Taluks are in critical and 26 are in semi-critical. In semiarid districts like Kolar, Chikkaballapur and Chitradurga the borewell depth has increased alarmingly from 800 ft to 1500 ft depth with 20 HP IP sets that require more power. The average investment on bore-well in Eastern Dry Zone is around 2.5 lakhs, while that in Central Dry Zone, it hovers around Rs. 1.1 to Rs. 1.36 lakhs (Kiran Kumar, 2019). The adverse impact of over exploitation of groundwater is more pronounced in the districts of Kolar, Chikkaballapur, Bangalore rural, Tumkur, Chitradurga, Belgaum in terms of high failure rate of bore-wells, drastic fall in the groundwater levels & increased usage of power (Suresh Kumar 2019). Due to overexploitation of groundwater >3 lakh dugwells have dried, shallow bore-wells have completely failed and discharge in the deep bore-wells decreasing (Krishna Raj and Chandrakanth 2016). With deepening bore-wells and increased depth, the quality of groundwater has been deteriorating.

Fig 4. Trend in number of borewells and area irrigated per borewell in Karnataka



Source: Computed from Annual Season and Crop Reports, Directorate of Economics & Statistics

Drastic fall in the groundwater table

On an average, the water table has dipped by 24.6 per cent (from 8.20 to 10.20 meters) implying that water table is declining at a rate of 0.3 meter per annum. The situation of water table depletion is alarming in the over-exploited areas where around 40 per cent decline in water table has been observed during same period with a rate of depletion of 0.6 meter per annum. (CGBW, 2017). Due to drastic fall in water table, extraction cost of groundwater has increased around 15 to 30 percent of the total cost of cultivation of crops which is not accounted by farmers (Chandrakanth, 2015). Further, majority of the resource-poor farmers (small and marginal) either have lost or losing access to water.

Usage of poor-quality high-power IP-sets and its implications

An energy audit of 10% sample of the functioning pump-sets indicated that 91% operate with <30 % efficiency (USAID 2006). Thus, replacing inefficient pump-sets with efficient pump-sets has potential to save energy up to 45%, further with drip irrigation 75% reduction in energy. Since ISI quality IP-sets are more expensive, majority of the farmers are using sub-standard high-powerpumps to lift water from deeper bore-wells leading to colossal wastage of power. Further, due to poor quality of power supply farmers are incurring more operational and maintenance expenditure on repairs of IP-sets.

Substantial investments on coping mechanisms

In response to groundwater scarcity, the farmers are resorting to different coping mechanisms to manage groundwater through drilling new wells, deepening existing wells, rain water harvesting for recharge, adoption of drip irrigation system, sprinkler irrigation, investment on improved storage structures, conveyance, shifting cropping pattern, buying water. These coping strategies involve substantial forced investments ranging from Rs 0.5 to 1 lakh due to reciprocal externalities. Thus, there have been manifestations of both physical and economic scarcity of groundwater.

Policy Interventions

1. **Technological options to save water**: Since the market-based approach of pricing water is not pragmatic, as it is more of political-economic issue we need to explore technology-led options to reduce the demand for water. According to the Comprehensive Water Management Index (CWMI) report, adopting Micro irrigation (MI) techniques can save roughly 20% of groundwater used annually by irrigation in India. Evidence shows that up to 40% to 80% of water can be saved and water use efficiency (WUE) can be enhanced up to 100%, in a properly designed and managed MI system compared to 30-40 % under conventional practice (Kumar 2008). By improving water use efficiency in crops like sugarcane, maize and cotton substantial amount of water could be saved. Wherever paddy is grown improved technologies like SRI (System of Rice Intensification) and aerobic method of growing paddy should be encouraged. For sugarcane cultivation, make MI compulsory through sugar mills and link to NABARD for additional financial assistance. Further, MI should be promoted not only as water saving but also as a productivity augmented technology. Thus, scaling up improved irrigation technologies on large-scale results remarkable savings in water.

2. **Efficient water management and delivery:** There is an immense scope to improve water management excellence by introducing innovative measures through CADA and WUAs. In addition to modernizing canal networks, volumetric measurements of water should be introduced to make accountability of water used at Nigam level. Demonstrate the tangible benefits of efficient irrigation management methods including the use of precision technologies like sensor networks tensio meters and weather data. Reforms are required to transform the WRD and special irrigation institutions to accelerate the project delivery, minimize the cost escalation and ensure the irrigation potential created is put to efficient use. Introduce incentive structure that improves water use efficiency and strengthen cross-sectoral water governance.

Rehabilitated tank under World Bank grant by JSYS (2010-11) facilitating groundwater recharge in Bommanahalli, Chikkaballapura district

3. **Focus on demand side management of groundwater:** This aims at minimizing irrigation requirements through improving efficiency. Shifting towards low water intensive crops like oil seeds, pulses and millets greatly reduces water demand and these crops are less resource intensive and relatively more profitable. In water scarce areas growing of sugarcane and paddy should be discouraged and shift to water abundant regions. Make compulsory the adoption of micro irrigation for groundwater irrigation with both state and central government's financial support.

4. **Rainwater harvesting for groundwater recharge:** While supply side of groundwater is being addressed by the State through schemes such as holistic approach of watershed development and tank rehabilitation. Thus, credible actions are necessary for demand and supply management on individual and community basis. Farmers should be educated regarding on-farm groundwater recharge in addition to recharge efforts at the community level. Thus, Government initiatives in watershed development and rejuvenating irrigation tanks in the drought prone districts towards rainwater harvesting should continue with expanding investments.

5. **Augmenting supply through new projects**: This needs liberal investments on the irrigation sector towards increased supply creation and storage. Though the share of tank irrigation has been shrinking over the years due to degradation of tanks, its revival is extremely important from the viewpoint of sustaining well irrigation, drinking water for livestock and other ecological and environmental needs.The Government plan to supply KC Valley treated sewage water into Kolar and Chikkaballapur tanks to improve groundwater recharge is laudable, but its long-term environmental effects need to be assessed.

6. **Improving efficiency of I-P sets:** Adopting energy efficient I-P sets not only saves power but also minimizes the annual repairs and maintenance cost. Thus, the existing I-Psets need to be replaced with ISI rated energy efficient pump-sets for which viable financial mechanism need to be created. The quality of electricity supply in rural areas needs to be improved. Further, farmers need to be encouraged to use solar pump sets to reduce dependency on electricity and provide subsidy liberally to buy solar pup-sets.

7. **Enhancing productivity per unit of water**: Diversification of high value less water intensive horticultural crops along with best technology package need to be promoted so that the net return per unit of water can be maximized. This needs both public and private investment to develop a value chain on a cluster basis. Promoting SRI method of cultivation of rice in head reach not only saves water but also enhances productivity.

8. **Government programmes towards enhancing irrigated area**: A comprehensive flagship programme to promote precision farming, the PMKSY has been launched keeping in view the importance of water and its judicious use in agriculture. The PMKSY aims at consolidating all existing irrigation schemes to provide "end-to-end" solutions in the irrigation sector. This has 4 components viz., Accelerated Irrigation Benefit Programme (AIBP), PMKSY (har khet ko pani), PMKSY (per drop more crop) and PMKSY (watershed development) that need to be up scaled in order to reap the benefits to a large number of farmers.

Conclusions

With emerging climate change, the demand and supply gap of irrigation water in the state will continue to swell and this need to be addressed through demand and supply interventions. The current method of flow irrigation needs to be replaced by modern irrigation practices/methods mainly to improve efficiency in water use as well as to cut down water losses. Capacity building of water users to shift to more water efficient production methods can avert the scarcity situation. Pricing of water is a sensitive issue hence focusing on technological solutions is crucial with creating irrigation literacy. Improving water governance through monitoring and enforcement of water management measures through PIM and water user's association will improve the water delivery system. Researchers seldom made attempts to measure water applied for irrigation considering both canal and bore-well water volumetrically. In addition, water has been treated as a free good and most studies concerning cost of cultivation exclude cost of water used for irrigation, relegating water use efficiency. Further, there is lack of concordance among research, irrigation-extension, and private-public participation for sustainable management of water resource. Thus, strengthening cross sectoral water governance is crucial for better coordination.

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