WATERSHED MANAGEMENT THROUGH FOUR WATERS CONCEPT: A KEY TO SUSTAINABLE RURAL DEVELOPMENT

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ABSTRACT

Climate change induced change in rainfall patterns is well evidenced across Indian landmass. Insufficient availability of water for irrigation due to erratic monsoon and dwindling groundwater levels pushed farmers and rural economy towards anxiety. Despite huge investments most of watershed programs failed to yield desired results. Applying the technique for four waters concept offers not only cheap and sustainable alternate of providing sufficient water for irrigation, but also measures to conserve the soil moisture and protection against soil erosion. Many successful case studies have already proved it to be one of the best watershed management techniques but also mold rural economy towards sustainability.

***Keywords** : watershed management, sustainable rural development*

INTRODUCTION

Indian being an agrarian economy, agriculture and allied sectors are major source of employment for two-third population[*Cassen*, 2016]. Supply of rains being seasonal due to its monsoonal characteristics, for sustained agriculture growth availability of water remains the most critical input (Vinaya et al., 2017; Patel and Chauhan 2015). It makes managing and best utilizing water resources, particularly surface water a higher priority task. Therefore, right from first Five-Year Plan expansion of irrigation has been a key strategy in the development of agriculture in the country. According to India's National Register on Large Dams (NROLD, 2009), there are about 4711 completed large dams and another 390 are under construction. The paradigm of dam projects created irrigation potentials, generated electricity and offered provision of adequate quantity of water for domestic and industrial uses. These dams and other irrigation projects helped India's surface irrigation potential to increase from 22.6 Million Hector (mha) in 1951 to about 90 mha[*Symle et al.*, 2014]. However, irrigation through dams remain on the mercy of monsoon rains, therefore according to the World Bank[*Symle et al.*, 2014], only about 35% of total agricultural land in India was reliably irrigated in 2010. The total arable land in India is 160 mha, remaining land depends on groundwater for irrigation. Despite huge expenditures in creating irrigation infrastructures like, large and medium scale dams, anicuts, barrage, canals and minors, the India agriculture sector is under duress, due to lack of timely supply of water, inter-sate water disputes, continuous droughts and declining groundwater levels, decline in soil fertility and soil erosion etc.

According to Central Ground Water Board (http://www.cgwb.gov.in/faq.html) in India, the availability of surface water (690 BCM) is greater than groundwater (398 BCM). However, owing to the decentralized availability of groundwater, it is easily accessible and forms the largest share of India's agriculture and drinking water supply.Easy accessibility of groundwater and uncertain monsoon pushed farmers to depend on groundwater. About 89% of groundwater extracted, is used in the irrigation sector, making it the highest category user in the country[*Siebert et al.*, 2010]. In result India has the world's largest groundwater well equipped irrigation system. Due to over-withdrawal of groundwater, India is fast moving towards a crisis of groundwater depletion and contamination[*Kulkarni et al.*, 2015]. In a World Bank report on watershed development in India, it is argued that according to recent estimates, the rising demand for water along with further increase in population and economic growth can result in about half the demand for water in the country being unmet by 2030. It implies that India's water

availability in the future is predicted to be bleak if proper steps are not undertaken to deal with the management of the available water resources.

India has long history of watershed management and communities have evolved many innovative techniques for harvesting rainwater, in tanks and small underground water storage structures. Since 1980's Central and respective State Governments took up amelioration measures by utilizing traditional water management practices and initiated projects for rainfall and runoff harvesting by building small check dams and tanks, and groundwater recharge structures etc. through thousands of watershed programs. Since then every year 100,000 smillion are spent on watershed projects and integrated watershed management. There are, however, no reliable, comprehensive data to judge the performance and impact of these projects. Various indicators and benchmarks for watershed management suggest that most watershed projects have not been successful. Some have even failed to provide water for domestic uses, others have overlooked pastureland development and soil-moisture conservation practices, and many have failed to arrest land degradation and improve groundwater levels.Instead rate of soil erosion doubled between 1980s and 1990s[*Singh et al.*, 1992]. Most of these project focused on creating concreate structures for rainwater harvesting and arresting runoff at downstream regions. Upstream regions, prone for higher erosion rates were mostly ignored. Eroded sediments silted downstream reservoirs and reduced the storing capacity of dams, thus reducing the prospective benefits to be ripped by downstream area.

THE ALTERNATIVE APPROACH

During late 1990s T. Hanumantha Rao a Chief Engineer from Irrigation Department of Andhra Pradesh developed an innovative method of watershed management, known as "four waters concept", which provides a comprehensive mechanism for rainwater harvesting by arresting surface runoff right from upstream areas, which in-turn helps in increasing groundwater levels and to retain soil moisture[*Perni*, 2008]. This technique is developed by adopting the proven aspects pertaining to five scientific disciplines namely; agriculture, soil conservation, groundwater, surface water and geo-engineering. It is done by ten types of excavation works and four vegetative activities. There is no cement–based work, like concrete, masonry, plastering, check dam etc., anywhere in the watershed. Excavation works include creation of mini percolation tanks (30 to 40 nos. in a watershed), sunken gully pits, continuous contour trench strictly along contours, boundary bunds, contour bunds, percolation tank at head of gully and sub-surface dams. Vegetative methods pertain to raising cover crops (green manure) during Rabi and post Kharif seasons, tree plantations in all uncultivated lands and on all boundaries of fields, vegetable cover for gully slopes etc.

Despite being innovated in India this concept was first adopted in Nampi Project in Hebei province of China[*Shen and Wolter*, 1992] and later in 7100 watersheds in Andhra Pradesh between the years 2000 and 2004. Recently Government of Rajasthan has adopted this techniques for 295 blocks in 33 districts with a rainfall above 450mm and 93,000 harvesting structures were created in first phase. In all cases "four waters concept" has showed 100% success in achieving the desired results as it provides a scientific and practical approach to develop a watershed using rainwater, soil moisture, groundwater and surface water to derive maximum benefits.

ADVANTAGE

In most of watershed development programs construction of dams and other irrigation structures means permanent loss of fertile land however this technique does not require people to be displaced and land to be acquired as water is stored in tanks for few weeks to few months to allow water to percolate and keep soil moist. According to T. Hanumantha Rao Through the Four Waters Concept, groundwater can irrigate three crops at a meagre cost of 15,000 per hectare, whereas establishing a new major irrigation project in India costs about 800,000 per hectare and provide water for only one irrigated dry crop during the rainy period of the Kharif season,". It is evident as in Jahalawar district of Rajasthan around 9,000,000 has been spent to coverabout 350 hectare land through this technique. Besides, annual maintenance requirements are minimal and not expensive. Most of the works involved in implementing this techniques can be executed by farmers directly without contractors or engineers, however under the direction of experts.

Results suggest that this approach has not only been successful in arresting the trend of depleting water tables year after year but also resulted in increase the water table levels appreciably over the period of time. It also helped remarkably in reducing soil erosion and improving soil moisture contents and thus resulted in higher crop yields. It means significant reduction in power consumption charges for agricultural pumping. With this technique it is possible

to provide irrigation for about 40% of the cropped area in the semi-arid tropics of India through recharged groundwater alone. In many cases, the streams in the watershed area which were once dry during non-rainy season were found to have spring flows. Improved groundwater level also allow insustaining agricultural activities during drought years. This technique also helped large tracts of saline-alkaline soils to reclaim and to cultivate lands which were previously unsuitable for irrigation due to groundwater salinity in Nampi region[*Howsam and Carter*, 2003].

CONCLUSION

Indian subcontinent is experiencing both long course of drought and increased severity and frequency of extreme weather events[*Goswami et al.*, 2006] as a result of climate change, simultaneously. Crop failures are forcingfarmers under stress. Data suggest that in last two decades more than 3 lakh farmers (about 11 % of all suicides) have committed suicide and about 25% of suicide seems to be because of various farm-related reasons such as failure of crop and debits burdens[*Panagariya*, 2008]. It is difficult to predict and mitigate extreme rain events, however fighting drought is possible by making water available for agriculture and domestic use. This technique not only helps in improving the availability of water resources but reduced coast of infrastructure and irrigation save farmers from undesired debits. At the same time it allows governments to extend financial benefit to farming community in form of crop insurance and investments in agriculture research and technology.

REFERENCES

http://www.cgwb.gov.in/faq.html

Cassen, R. (2016), *India: population, economy, society*, Springer

Goswami, B. N., V. Venugopal, D. Sengupta, M. Madhusoodanan, and P. K. Xavier (2006), Increasing trend of extreme rain events over India in a warming environment, *Science*, *314*(5804), 1442-1445

Howsam, P., and R. C. Carter (2003), *Water Policy: Allocation and management in practice*, CRC Press

Kulkarni, H., M. Shah, and P. V. Shankar (2015), Shaping the contours of groundwater governance in India, *Journal of Hydrology: Regional Studies*, *4*, 172-192

Panagariya, A. (2008), *India: The emerging giant*, Oxford University Press

Perni, V. (2008), Management of the four waters at micro level by considering the social and economic backwardness for sustainable development using remote sensing & gis, paper presented at 37th COSPAR Scientific Assembly

Shen, F., and W. Wolter (1992), Managing the" Four Waters", an innovative concept of modernization (mimeo), *IPTRID/World Bank, Washington, DC*

Siebert, S., J. Burke, J.-M. Faures, K. Frenken, J. Hoogeveen, P. Döll, and F. T. Portmann (2010), Groundwater use for irrigation–a global inventory, *Hydrology and Earth System Sciences*, *14*(10), 1863-1880

Singh, G., R. Babu, P. Narain, L. Bhushan, and I. Abrol (1992), Soil erosion rates in India, *Journal of Soil and water Conservation*, *47*(1), 97-99

Symle, J., C. Lobo, G. Milne, and M. Williams (2014), Watershed Development in India: An Approach Evolving through Experience

Patel, Niraj G. and Chauhan, N. M. (2015). Watershed Management by Tribal Farmers of Navsari District of South Gujarat Through No-Cost and Low-Cost Technologies. *Guj. J. Ext. Edu.*, 26(2): 234-240

Vinaya Kumar, H. M., Shivamurthy, M., and Lunagaria, M. M. (2017). Impact of rainfall variability and trend on rice yield in Coastal Karnataka. *Journal of Agrometeorology.* 19 (3): 286-287

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