Role of Water Resources Management in Economic Development

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India is experiencing a high average annual economic growth of 7.28 per cent since 2002-03.[1] The growth is not only supported by consumption of fixed capital (man-made capital), but also by natural resources.[2] Apart from goods and services, production and consumption processes also generate pollution and wastes which are deposited into the environment (air, water and land). In addition to direct use as inputs, environment acts as a sink of wastes and assimilates the pollution load. If pollution load exceeds the assimilation capacity of the environment (air, water and land), it causes environmental degradation (air and water pollution, soil (land) degradation). The unpaid ecosystem services of the environment (e.g., pollution assimilation) as a factor of production and the depletion and degradation of some natural resources (like air, water and soil pollution) are not accounted into the present System of National Accounts (SNA); as a result it is difficult to understand the actual *environmental debt* of Indian economy.[3] In other words, the contribution of natural resources like water (both depletion and degradation) in GDP is not accounted and hence, it could limit the potential to achieve high economic growth in the long run (by posing constraints on availability of water and/or various ecosystem services) and/or economic development (by imposing costs (public health) on society in terms of water pollution). If pollution abatement is not matched with equivalent level of production and/or consumption activities, it could result in large scale water pollution. The costs associated with water pollution are borne by the society,[4] in terms of public health costs (costs associated with mortality and morbidity due to water pollution)[5]and loss of livelihoods due to environmental degradation (water pollution and land degradation). Apart from public health concerns, the loss of livelihoods due to environmental degradation is a serious concern for developing countries like India where a large section of the population still depends on primary activities (agriculture, animal husbandry and fisheries) for livelihoods (Mukherjee and Chakraborty, 2012). In India, growing population and rising demands will further enhance the dependence on environment both as a source of natural resources and as a sink for wastes. Apart from local environmental impacts, climate change induced vulnerability of 300 million coastal population of India, temporal and spatial variability of monsoons, retreat of glaciers and so

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on could be detrimental to our socio-economic development.

It is not only water security which influences the achievement in economic growth and human development, but also the level of use of water in different sectors; condition of the water environment; and technological and institutional capacities in water sector (Kumar et al., 2008). Kumar et al. (2008) show that improving the water situation, vis-à-vis improved access to and use of water, institutional capabilities in water sector and improved water environment, through investments in water infrastructure, creating institutions and making policy reforms, can support economic growth of a nation. However, the study also shows that economic growth is not a pre-requisite for solving water related problems. Instead, countries should invest in water infrastructure, institutions and policy reforms to achieve human development and sustain economic growth. Further analysis shows that in hot and arid tropical countries, the investment in large water storages had helped support economic growth. Moreover, it seems to reduce malnutrition and incidence of child mortality.

In the *Global Risks Report 2016*, World Economic Forum (2016) lists water crisis as the largest global risk in terms of potential impact. There are several dimensions of water scarcity – physical, economic and environmental (related to water quality). Increasing population pressure, large scale urbanisation, rising economic activities, changing consumption patterns, improving living standards, climate variability, expansion of irrigated agriculture and changing cropping pattern towards water intensive crops are among the major drivers for rising demand for water. Ever-increasing demand for freshwater in the last few decades and large scale temporal and spatial variations in availability and demand are among the major causes for water scarcity. The origin of water scarcity is the geographic (spatial) and temporal mismatch between freshwater demand and availability. The impact of water scarcity can be measured in terms of social, environmental and economic impacts. Annual assessment of water availability cannot capture variability within the year and therefore underestimates water scarcity and corresponding social and economic impacts (Mekonnen et al., 2016). High water scarcity prevails in areas with high population density or the presence of much irrigated agriculture or both. In the Ganges basin of India, water consumption and water availability are countercyclical, with water consumption being the highest when water availability is the lowest (Mekonnen et al., 2016). According to a recent estimate, based on monthly water availability during 1996 to 2005, globally four billion people face severe water scarcity at least for one month of the year. Of these 4 billion people, one fourth (1 billion people) live in India, whereas half a billion people in the world face severe water scarcity throughout the year. Of this half a billion people, 180 million people live in India. This underlines the severity of the problem in the Indian context.

Crop choice plays an important role to mitigate water scarcity in arid and semi-arid regions. Farmers' access to information on water availability and any probability of drought prior to sowing the crops could help them to choose the right crops to mitigate the impacts of water scarcity. The diversification of the livelihood basket could be the best option for adaptation.

Being the largest user of water, water scarcity impacts the irrigated agriculture substantially. Depending on severity of the scarcity, impact on agriculture varies. Any fall in agricultural productivity or crop failure in the extreme situation leads to loss of livelihoods for the farmers. However, water scarcity induced impacts on livelihood is not uniform across all farmers. It depends on mitigation and adaptation capacity/ strategy of the farmers to absorb any volatility in water availability as well as socio-economic situation of the farmers. Crop choice plays an important role to mitigate water scarcity in arid and semi-arid regions. Farmers' access to information on water availability and any probability of drought prior to sowing the crops could help them to choose the right crops to mitigate the impact of water scarcity. The diversification of the livelihood basket could be the best option for adaptation. Famers who do not depend on agriculture alone for their livelihoods could adapt to water scarcity. Fall in income in agriculture spreads across all sectors of the economy through backward and forward linkages. If the impact of

drought is severe, then it would lead to inflation driven by rise in food prices. Water scarcity results in rising income disparity which leads to reduced demands for manufactured goods and services. In the long run, it may lead to general economic recession.

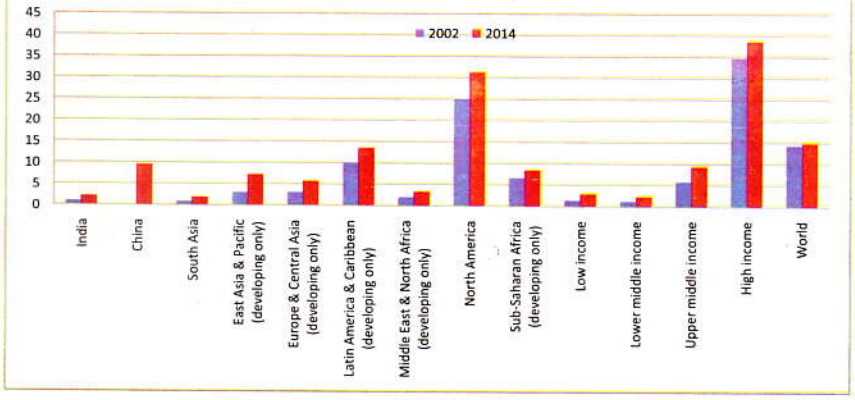
Impact of water scarcity on manufacturing and service sectors will differ depending on their water intensities. It is expected that in the manufacturing sector, water intensive industrial activities like textile bleaching and dyeing, leather processing, food processing and beverages, pulp and paper industries will bear the maximum impact of water scarcity. In the service sector, maximum impacts will be on hospitality (hotels and restaurants), medical services (hospitals) and construction/ real estate sector. In textile bleaching and dyeing clusters in South India, water is purchased in tankers from surrounding villages. Though the industrial use of water is very low when compared to agricultural use, the disposal of industrial effluents on land and/or on surface water bodies make water resources unsuitable for other uses. By avoiding cost of pollution abatement, which is a private cost, manufacturing units could transfer the cost to the society at large by not following prescribed standards for industrial effluent disposal. It results in pollution of ground and/ or surface water (Mukherjee and Nelliyat, 2007).

Access to safe drinking water is vital for human well-being (UNDP 2006). Achieving universal access to improved water supply and sanitation (WSS) facilities by 2030 is one of the Sustainable Development Goals (SDGs) (Goal 6), which aspires to, 'Ensure availability and sustainable management of water and sanitation for all' (UN, undated). Pollution from both point and non-point sources make water resources unsuitable for drinking. Thus, environmental sustainability of safe sources of drinking water for future generations is at stake. People exposed to polluted drinking water are vulnerable to various water borne diseases. Costs associated with mortality and morbidity of water-borne diseases is high. To avoid the potential health hazards (morbidity and mortality) associated with consumption of polluted water, government and/or households invest in various pollution avoidance activities – by investing in water treatment, source substitution, or by purchasing bottled water. It is mostly the poor and marginal section of the population who suffer the most, as they cannot afford to protect themselves from the impacts of pollution, as neither have they had access to supplied water nor, can they afford to invest in water purification.

Large scale diversions and withdrawals of water in the upstream of rivers leave little fresh water available for the downstream uses. Not many perennial rivers have adequate fresh water flow during summer to maintain the desired environmental flow (or ecological flow) for sustaining basic ecosystem functions (services) – e.g., groundwater recharge. Interdependence of surface water and groundwater is vulnerable to disturbance of river ecosystem and it leads to large scale depletion and degradation of water. In many parts of India, groundwater level is falling at an alarming rate. Adoption of water intensive crops (e.g., sugarcane, paddy) throughout the year, low investment in surface water based irrigation system, unreliability of canal water supply, political interference in distribution of canal water, and elite capturing lead to increasing dependence on groundwater for irrigation. Reckless pumping of groundwater over the year, encouraging rainwater harvesting and watershed structures at the upstream which leave little water available for downstream lead to fall in groundwater level (Srinivasan and Lele, 2016; Patel et al., 2008). Myopic approach in water resources management by withdrawing public investment from surface water based irrigation system; encouraging irrigated agriculture and groundwater based irrigation system by providing free electricity are among the primary causes of the present scarcity of water. Adoption of irrigated agriculture and shifting cropping pattern in favour of water intensive crops reduces adaptive capacity of agriculture to water scarcity.

Now the key questions that emerge are – a) do we need production of so many water-intensive crops (e.g., paddy, wheat, sugarcane), and allow them to rot in open fields or exports at throughway prices? and b) since many parts of India are grappling under severe water scarcity, shall we continue with our present pricing of water? Water use efficiency is very low in India and our overall water productivity, as measured by constant 2005 US$ GDP per cubic meter of total freshwater withdrawal, is much lower than the world average and it is also lower than the corresponding

Figure: Water productivity, total (constant 2005 US$ GDP per cubic meter of total freshwater withdrawal)



Data Source: The World Bank's World Development Indicator Database.

figures for developing countries in Latin America and Caribbean and Sub-Saharan African countries. In the absence of full cost pricing of water (e.g., production and distribution cost, resource cost, environmental cost, scarcity value), it cannot promote water use efficiency and therefore, water productivity will remain low in India.

Like scarcity, floods also have substantial economic impacts. Apart from large scale loss of crops and property, livestock and human lives, it results in morbidity due to water borne diseases. There is hardly any systematic study to forecast floods across river basins in India. Furthermore, there is hardly any study to estimate economy-wide impacts of floods. The economic, social and environmental costs of floods may not be lower than the cost of constructing flood mitigation infrastructure. Limited storage capacity of our reservoirs and dams, climate variability and high inflow of water during monsoons lead to floods. Urban floods has become a recurrent phenomenon in Indian cities. In many cities, there is no storm water management infrastructure separate from domestic wastewater (sewage and sanitation) infrastructure. Moreover, our existing wastewater infrastructure is under stress and not adequate to handle (collection, transportation, treatment and disposal) all the waste water generated in the city. Negligence in management of natural drainage channels and traditional water storage structures like rainwater tanks and wetlands further aggravate the problem (Sharma et al., 2015). Storm water is a valuable freshwater resource and if managed properly, it could reduce dependence of cities on water supply from far away sources. Water footprint of our cities is expanding very fast and in most of the cases, it is far away from the cities (Mukherjee et al., 2010). Recent blocking of water supply from the Munak canal (in Haryana) and large scale water scarcity in Delhi shows how cities are dependent on far away sources to meet day-to-day water needs.

The concerted attempts to secure and maintain water sustainability, however, needs to take note of not only the existing challenges, but also the emerging concerns. Some of the concern areas, the effects of which will increasingly be faced in India, includes, emerging challenges of inter-sectoral allocation of water, rising conflicts due to diversions of water (from distant sources) to cities and industries, restoration of ecological flows of the rivers for reviving basic ecosystem services, conservation and protection of water resources (e.g., river basin management), protection of local sources of drinking water both for rural and urban areas to meet the demand for water supply,growing urbanization and water pollution, minimization of environmental impacts of development projects (e.g., industry, mining, infrastructure and urban development), controlling pollution from non-point sources and emerging pollutants (e.g., residues of pharmaceuticals and personal care products, perfluorinated compounds) and climate change induced impacts on environment and natural resources, etc.

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End Notes

1 Growth rate of GDP (at factor cost) (at 2004-05 prices) (RBI, 2014)

2 The present System of National Accounts reports the consumption (depreciation) of fixed capital (man-made) and it has gone up from 10.63 per cent to 13.13 per cent of GDP (factor cost) during 2002-03 to 2013-14 (RBI, 2014).

3 "Environmental debt refers to the accumulation of past environmental impacts of natural resource depletion and environmental degradation, owed to future generations." – OECD (undated)

4 By avoiding costs of pollution abatement, polluters transfer a huge cost to the society in terms of polluted air, water and degraded forest and soil.

5 For example in India water-borne diseases annually put a burden of USD 3.1 to 8.3 billion in 1992 prices (Brandon and Hommann 1995). A recent study conducted by the Water and Sanitation Programme (WSP) of the World Bank estimates that the total economic impacts of inadequate sanitation in India amounts to Rs. 2.44 trillion (USD 53.8 billion) a year - this is equivalent to 6.4 per cent of India's GDP in 2006 (WSP undated). ❑

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I am an avid reader of Yojana I must say that this is a magazine worth praising, with excellent content. The magazine not only keeps us aware of the current government schemes and programmes,but also supplements our knowledge on pertinent issues.I wish to thank the team for the sincere efforts they put in. The articles on manifold burning topics are thought provoking and enlightening. I request you to include some topics such as social evils-dowry system, female infanticide, corruption prevalent in India, the eradication of which is the need of the hour. Some issues related to national sanctuaries, biosphere reserves, natural calamities can also be added. *Saundarya Sinha*

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Thanks once again

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