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Water Scarcity in India: Measures to Improve Food Security and Poverty Alleviation

We never know the worth of water till the well is dry. ~Thomas Fuller, Gnomologia, 1732

India has a land mass of 3.29 million sq. km with diverse topography and climatic conditions, which vary from tropical monsoon in south to temperate in north. Its terrain have upland plain (Deccan Plateau) in south, flat to rolling plain along the Ganges, deserts in west, Himalayas in north. India is endowed with a network of rivers and blessed with snow cover in the Himalayan range that can meet a variety of water requirements of the country. India forms around 2.4 percent of world area and has 4% of the freshwater supply available to the world. Of the total water supply, 86% is used in agriculture, 6% in industry and 8% for domestic use (Report of the Steering committee on water Resources for 11th five year plan, 2007-2012).

Despite this favorable disposition, India is currently in dire water situation. The per capita availability in India fell to 1820 m^3 in 2001 and is expected to fall to 1140 m^3 in 2050, which will be below the water stress level of 1700 m^3 (Report of the Steering committee on water Resources for 11th five year plan). Given the wide variations across the country, water stress already exists in many parts. More than half of India does not have adequate drinking water (Bouguerra, 2006). 62% of rural households in North do not have a water supply in or near their homes (Mid-term Appraisal of 10th five year plan, 2005). Consequently, in some rural areas the water crisis is so severe that women have to walk 16 km (roundtrip) every day on average to reach the nearest water source (McNaughtan, 2009). It has been estimated that 71 million rural households spend about 102 billion hours per year, amounting to 4 hours per day, to collect water from outside their home (Mid-term Appraisal of 10th five year plan, 2005), which otherwise could have been spend supplementing family income that is extremely low. Whereas, an American household consumes 3000 liters a day an Indian household has only 25 liters a day (Bouguerra, 2006). Making matters worse is water quality - in 63% urban households and 28% rural households the water is sanitized (Mid-term Appraisal of 10th five year plan, 2005). Deprived of safe drinking water, a million and a half people die every year, majority in rural areas, as a consequence of water borne diseases, such as a diarrhea and related disorders (Bouguerra, 2006).

Besides the *shortage*, the *uncertainty* of water availability has increased as the groundwater is depleting. India is the largest user of groundwater – providing 80% of rural population their domestic water supply, and satisfying more than 50% of India's irrigation needs (Report of the Steering committee on water Resources for 11th five year plan). Due to increased pollution in rivers, more reliance for irrigation has fallen on underground water. Recent surveys show that water tables have fallen due to over-exploitation in most states by over 20 feet per year (Pearce, 2004). Farmers are using modified oil-drilling technology to reach water by drilling as deep as 1,000 meters in some locations (Brown, 2004). NASA's Ground Recovery and Climate Experiment reported that between August 2002 and October 2008, the Punjab-Haryana region, the breadbasket of India, lost 109 km^3 of groundwater (Rodell et al., 2009). Consequently, rain-fed areas have increased and now constitute about 60 percent of net sown area (Report of the Steering committee on water Resources for 11th five year plan), which are characterized by high uncertainty and low levels of productivity. The colossal impact of the changing water situation on the Indian lives is best captured by Yardley, "India's new economy may be based on software, services and high technology, but hundreds of millions of Indians still look to the sky for their livelihoods" (2009).

Rising socio-economic struggles due to water scarcity

"With 1,000 tons of water required to produce 1 ton of grain, food insecurity is closely tied to water security" (Brown, 2004, p. 10). Emerging from the shortage and uncertainty of water availability is the hydrological poverty in India, a situation where there is not enough drinking water and water to produce enough food. Consequently, two unfortunate socio-economic struggles towards sharing the scarce water resource have arisen within India.

1. Struggle for water between cities and rural areas, where cities always win (Brown, 2004), often depriving farmers of irrigation water and thus adversely impacting their livelihood. Without adequate supply of water, poverty has become more widespread and extreme in rural India (Bouguerra, 2006), where 70 percent of the Indian population lives (CIA Factbook, 2009).

2. Struggle for water in rural India between large and subsistence farmers, where the large farmers always win due to their economic, social, and political might. This has left a large body of subsistence farmers below the poverty line to which we turn next.

Impact of water scarcity: plight of subsistence farmers

Agricultural sector employs 52% of the Indian population and contributes only 17% of GDP, which implies that the per capita income in this sector is extremely low. Furthermore, this sector is marred by high income inequality due to the iniquitous distribution of land - 50% of farmers own less than 0.5 hectares, 19% own 1-2 hectares, 16% own 2-4 hectares, 11% own between 4-10 hectares, and only 4% of farmers have 10 or more hectares (Report of the Steering committee on rapid poverty reduction and local area development for the 11th five year plan, 2007-1012). In this report, the government of India acknowledges that uncertainty and scarcity of water availability have acted as a catalyst to the iniquitous land distribution in creating poverty in India, "Rain-fed areas in the country accounting for 60 percent of the cultivated area are home to majority of our rural poor and marginal farmers. These areas are characterized by high incidence of poverty, low education and health status, high distress in farming sector, and vulnerability to a variety of high risks" (p. 28). The impact of water scarcity on poverty is further substantiated in another study by Bouguerra (2006), where he found that 69% of people in India living in rural areas without agricultural irrigation are poor, compared to 26% in irrigated areas.

The hardest hit by the water scarcity are the subsistence farmers, who own less than 2 hectares with no access to irrigation technology that would allow them to enter high-value crop markets. These subsistence farmers constitute almost 70% of Indian farmers. Their average income is less than $19 per month (CIA Factbook, 2009), which feeds an average of 8 people in his household, including 3-4 children and the farmer's parents. Due to high income inequality in India, this income is far below the national per capita income of $60 per month. Consequently, some of these farmers and their families can only afford to eat one meal a day, and often go to bed hungry. In fact 50% of children in rural areas are undernourished (BBC article).

Majority of these subsistence farmers belong to scheduled castes, scheduled tribes or backward class that collectively accounted for 81% of the rural poor in 1999, considerably more than their share in the rural population (Report of the Steering committee on rapid poverty reduction and local area development for the 11th five year plan). These groups have very little economic, social and political clout to change local, state, and national government policies in their favor.

The meager income allows the subsistence farmer to feed on an inexpensive diet that is high on carbohydrates, but poor in proteins, fats, and vitamins. Consequently, women and children are typically underweight and often suffer from malnutrition related diseases. 50% of children living in rural areas are undernourished and are more prone to water borne diseases due to low immunity (Brown, 2004). Infant

mortality rates for scheduled caste, scheduled tribes, and backward castes are around 80, which is much higher than the national average. In addition, the nutritional status is worrisome. Over 40% of women in the scheduled caste, scheduled tribes, and backward castes have a body-mass index (BMI) of less than 18.5, which is seen as the cut-off for malnutrition (Report of the Steering committee on rapid poverty reduction and local area development for the 11th five year plan).

Though primary education has become compulsory in India, the reality is somewhat different due to lack of infrastructure and non-availability of teachers – most of the brunt is faced by the poor. For example, in the 15-49 age groups, when women have to make important life decisions, approximately 70% of women in scheduled caste, scheduled tribes, and backward castes are illiterate, which is much above the national average (Report of the Steering committee on rapid poverty reduction and local area development for the 11th five year plan).

Factors impacting water shortage

1. *Population growth*: Due to rapid growth rate, the current Indian population is 1.17 billion, which is about 15% of the world's population. India adds approximately 18 million people every year to this population, which puts tremendous pressure on water resources.

2. *Mismanagement of water resources*: There is virtually no legislation on groundwater usage. Anyone with initial capital to put a pump can extract water beneath their plot of land. The development and distribution of cheap electricity, which is heavily subsidized by the government, has triggered rapid pumping of groundwater and subsequent depletion of aquifers. The owners of these wells do not have to pay for this water, so there is no incentive to conserve or recycle it. Generally, the more water they use, the more they can produce, an incentive to overdraw. Industry applies the same logic, and rather than reusing the water used for cooling machines, they dump it back into rivers and canals, along with the pollution it has accumulated. In addition, there are major water mismanagement problems reflected in the fact that Indian canals lose 70% of their water before it can reach the consumer (Bouguerra, 2006).

Government response

Unlike the past 5-year plans where the focus was on new construction, the emphasis in the current 11th five year plan (2008-2012) is on completion, renovation, and modernization of existing projects to improve their efficiency. In addition, more work is being done to control floods and promote mass awareness on water reuse, water recycling, sanitation, etc. Ministry of Water Resources (Steering Committee report, 11th five year plan) cites other following measures:

- Under the directive of the Supreme Court of India, a Central Ground Water Authority has been constituted with jurisdiction over whole of India to regulate indiscriminate exploitation and to preserve and protect ground water.

- Focusing on micro irrigation development along with conjunctive use of surface and ground water, the government has started Accelerated Irrigation Benefit Program (AIBP) under which it has completed over 300 projects. The AIBP extends financial assistance to the States for creation of irrigation potential by completion of identified ongoing irrigation projects.

- The Command Area Development & Water Management program, which involves the farmer has resulted in the reduction of loss of irrigation water in the conveyance system and has further improved its efficiency at farm level while ensuring equitable distribution of water.

- The Ministry of Water Resources has constituted an Advisory Council on Artificial Recharge of Ground Water. In the first meeting held on 22nd July 2006, Dr. Singh, Prime Minister of India noted, "We have to minimize our water use – invest in science and technology to ensure that we can grow crops which use less water. In other words, find ways of valuing the crop per drop". To implement the suggestion a sub-committee under the chairmanship of Dr. M. S. Swaminathan prepared a report that recommended initiating 5000 Farmers Participatory Action Research Program (FPARP) throughout the country with the help of Agricultural Universities and other academic institutions. Working together the productivity and profitability of agriculture will be improved by generating synergy among water, crop, agronomic practices, soil nutrients, crop variety, etc.

- India has also taken up many World Bank assisted projects - all of them aimed at improving the efficiency of the existing water structures through modernization and rehabilitation.

- Harvesting rainwater is being encouraged for water conservation, as it provides increased water availability for both agriculture and drinking purposes. It recharges aquifers and groundwater and saves energy, besides reducing the possibility of flooding. Traditional rainwater harvesting is done by using surface storage bodies, such as lakes, ponds, irrigation tanks. In 2000, Andhra Pradesh government launched the 'Neeru-Meeru' project using traditional harvesting practices, which resulted in collecting additional 1.8 billion m^3 of water in drought prone and socially backward areas (Reddy, 2009). Many more such projects have been launched throughout India (Ministry of Water Resources). Earlier in 1995, the Government of India launched a 'Hariyali' development program comprising of wasteland-watershed integrated program, applying rainwater harvesting in desert areas. The program has been very successful as it also provides employment to landless and subsistence farmers, using their services to manage local water bodies and forests, thus conserving the environment.

- Pollution of rivers is a major problem. The subsurface Water Quality is degraded mainly due to natural reasons along with over withdrawal of water, insanitary conditions in rural and urban areas and increased application of fertilizers and pesticides. Monitoring of groundwater quality needs to be strengthened for parameters from pollution point of view. Consequently, the Central Pollution Control Board (CPCB) has established a network of monitoring stations on rivers across the country. The present network comprises of 870 stations in 26 States and 5 Union Territories spread over the country. The monitoring is done on monthly or quarterly basis in surface waters and on half yearly basis in case of ground water (Bhardwaj, 2005).

Recommendations: Population control

The government has adopted a voluntary approach to population control through spread of education, popularizing sterilization, increasing the use of different birth control devices, raising the minimum age of marriage, offering incentives in cash and kind, etc. However, this is the same approach since 1970's and has produced very slow and inconsequential results for the poor. The subsistence farmers continue to suffer from poverty, high illiteracy and high infant mortality (as pointed above), which are the leading causes of large families amongst them. The government needs to look into the Kerala (south-Indian state) model of population control that has achieved 1.7 fertility rate compared to 2.6 national average. Kerala model emphasizes education-employment-equality, which translate into high literacy rate, regular income, and more confident women. Besides education, it is crucial that fiscal, monetary, and growth policies be compatible with social sector requirements. These poor people should be brought together through social mobilization to form self-help groups; and with the help of credit support to diversify their

sources of income. Micro-credit, the scheme that has worked well in Bangladesh (Yunus, 2008) should be implemented in India.

Recommendations: Water management

1. Better access to irrigation will reduce the wide variation and instability in crop yields, thus reducing poverty (Bouguerra, 2006). The challenge therefore is to reduce rural poverty through participatory watershed development projects, reinforced by better water distribution, and water usage that would contribute to livelihood security. There should be greater involvement of people through Panchayats (village level elected bodies) in the management of irrigation system and the rural water supply. However, it has to be ensured that Panchayats have good representation of subsistence farmers and women, so that their interests are safeguarded in various decisions that may be taken at the local level. Mahila Gram Unnayan Samity (womens' self help groups) should also be involved actively in decision making to incorporate their viewpoints.

2. In already over-exploited areas, drilling needs to be closely regulated until the aquifer is recharged to the desired amount. These measures should be supplemented with artificial recharge measures such as the percolation tanks. People should be encouraged to harvest rainwater by having underground tanks for drinking water, and using traditional methods for filtering the water.

3. Surface water irrigation efficiency ranges between 25 and 40 percent in India (Brown, 2004). One of the ways to increase water efficiency of irrigation is to move from less efficient flood-or-furrow system to overhead sprinkler irrigation or drip system. Drip irrigation typically cuts water use in half. The drip system also raises yield because it provides a steady supply of water with minimal losses to evaporation (Brown, 2004). Government should provide financial help to subsistence farmers to install drip system.

4. India also needs to revisit its export policy as it faces food and water shortage. Currently, India exports grain and rice. Since it takes 1000 tons of water to raise one ton of grain (Brown, 2004), that is the amount of water exported with every ton of grain, which India can ill afford.

5. Desalination of water in the coastal regions is a viable choice that can be explored as the cost of this technology is coming down.

6. India should explore solar and wind energy as alternate to fossil fuel powered thermal plants, which require large amounts of water for cooling resulting in 7% loss due to evaporation; besides hot water returning to rivers is ecologically damaging (Brown, 2004). In addition the solar and wind energy have much lower *carbon footprint* as compared to thermal plants, thus addressing *global-warming* problems (Schreuder, 2009). Researchers have found that one degree Celsius increase in temperature in mountainous regions can substantially alter the precipitation mix between rain and snow, increasing the rainfall and decreasing the snowfall (Brown, 2004). The melting glaciers and shrinking snowfields of the Himalayas is a concern to India because this is where the major rivers in the region originate. As a result of the changing weather conditions, there is a runoff in the rainy season causing floods, and less snowmelt to feed rivers during the dry season, causing droughts (Report of the Steering committee on water Resources for 11^{th} five year plan). In addition, crop ecologists at the International Rice Institute in the Philippines and at the U.S. Department of Agriculture have jointly concluded that yields of rice, wheat and corn, the three main crops grown in India, typically fall by 10% for each 1-degree Celsius rise in temperature during the growing season (Brown, 2004). Falling crop productivity simply means more water usage for the same amount of production.

7. There should be greater information dissemination to educate and involve people to *recycle, reuse, and reduce* the water usage. It is estimated that the amount of recycled water could be between 103-107 km^3 if modern technology is correctly used (Kumar et al., 2005). It is estimated that 30% of water is wasted due to leakages and carelessness that can be prevented through better maintenance practices. Moreover, water prices need to be revisited to take into account its scarcity. Higher prices will encourage investment in water efficient irrigation technologies and also lead to water recycling and reduced water wastage.

Conclusion

Water, described as nectar, honey, source of life, protector of earth and environment, has always been given great importance in the ancient Indian culture. Considered as divine, the rivers were worshipped as Goddesses, for they would provide fresh water for drinking and for growing food. People were taught to treat water with great respect as wrong actions by individuals and society could harm the cycle of nature and its functions (Sharma). Education is crucial to instill proper respect for water and understand its exceptional importance for life. India can increase the amount of water available to meet its needs, so long as Indians do not lose sight of the basic fact that water resources are finite and learn to use them sensibly. They should reduce the extent of losses through leakages and evaporation, and grow plants that are suited to the local soil and climate. Recycle, reuse, and reduce should be the basis of a sustainable water use program along with revisiting the consumerist lifestyles that waste and pollute water resources. Each new million cars require paving of roughly 20,000 hectares of land, which translates to 50,000 tons of grain that feeds 250,000 people every year (Brown, 2004); besides adding to water scarcity through global warming through its carbon footprint. As the affluent Indians turn to the automobile, they are competing for land with those who are malnourished and hungry. Similarly, people need to be educated on their food consumption habits. People should be encouraged to reduce their animal protein intake, as it requires more grain to convert to meat, which means greater water consumption per pound of meat (Brown, 2004). There are innumerable such decisions that we have to make every day which ultimately have an impact on water scarcity and food security. Affordability should not be the only criteria of decision making; we should also consider the impact our decisions may have on millions of poor around the world.

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