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## India: National Response to Food Insecurity by Managing Water and Energy Resources

### Introduction

*“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;” – (Yardley).*

India is vastly diverse in topography, natural resources, climate and socio-political structure. It has 2.4% of the land area of the world, 4% of its water resources and supports 16.6% (1.17b) of the world’s population, of which 72.2% is rural (US Govt., CIA Factbook). India’s economy is based on agriculture and therefore the demand for water is about 80% of the total water available. According to the Planning Commission Report - May 2007, the two indicators of water scarcity i.e. per capita availability and storage capacity, are steadily declining since 1951, due to population explosion. India is fast becoming a water scarcity zone because of unwise and reckless usage, wastage and pollution of surface and ground water. Though the available water resources remain constant, almost 50% of the river basins have 38% lower water levels due to which 200 million people are already facing water scarcity.

India’s agriculture is mostly dependent on the snow-fed rivers of the north and the seasonal monsoons which account for 75% of the water demand. Thus, while the eastern parts of India suffer major flood damages, severe droughts may simultaneously affect the western states. According to the Central Water Commission’s report, the average area annually affected by floods is approximately 7.563 million hectares, affecting around 33 million people. Conversely, western India is plagued by droughts depleting the groundwater, and damaging perennial trees, plantations and orchards. Just this year, due to the vagaries of global climate change, the monsoons arrived 12 weeks late with 25% less precipitation than expected, causing acute water shortage and crop failure. (Yardley).

NASA’s Ground Recovery and Climate Experiment (GRACE) reported that between August 2002 and October 2008, the Punjab-Haryana region lost 109 km<sup>3</sup> of groundwater due to over-exploitation, an amount almost triple the capacity of Lake Mead, the largest man-made reservoir in the U.S. (Rodell). This issue needs to be dealt with seriously as it could lead to a collapse of the agricultural output and severe shortages of potable water. In some areas the water crisis is so severe that women have to walk 16 km per day (roundtrip) on an average to reach the nearest water source. (MacNaughtan).

Since 2000, India has become the 12<sup>th</sup> largest economy in the world. Unfortunately, this rapid economic growth has fostered population explosion, urbanization, industrialization and climate change, which has upset the balance between the supply and demand of water. This prompted Dr. Singh, the Indian Prime Minister, to comment, “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.” (Govt. India, FPARP).

### The Subsistence Farmer

The most affected by this water problem are the subsistence farmers, who also have poor education and little means of supplementing their income through other employment. A typical subsistence farmer in India has the smallest land holding of about 0.5 hectare (app. 1.2 acre). About 19% of farmer's land holdings are between one and two hectares, 16% are two to four hectares, and 11% between four to ten hectares. Only 4% of farms had ten or greater hectares. The average size of the farmer's family is 8 that include 3-4 children and the farmer's parents, all having to live on an average income of less than \$19.00 per month (US Govt., CIA Factbook).

The subsistence farmer's diet is usually very high in carbohydrates and poor in fat, proteins and vitamins. In central and western India the main cereal is wheat while in the eastern sector and along the coastline, rice is the staple diet supplemented by fish. Women and children often suffer from varying degrees of malnutrition-related diseases. In 2007, the under-5 mortality rate and Infant Mortality Rate for India were 72 and 54 respectively while the Maternal Mortality Rate amongst women of childbearing age was 450 per 100,000 live births, accounting for 20% deaths globally (UNICEF). These mother and child deaths are intimately linked to poverty and are mostly preventable.

Though Primary education has become compulsory in India, nearly 40% of first grade students do not complete school due to poor quality of teaching, high student-teacher ratios and non-relevant teaching methods. Due to this unsatisfactory education, many students who drop out after the sixth grade lack basic reading and writing skills. This adversely affects the subsistence farmer's life. Girls often stay home from school helping their mothers to fetch and carry water from long distances. Also, due to socio-economic pressures, the average age of marriage for girls is 17 years.

Apart from the population-education-poverty link, farming has also become very difficult due to environmental changes. These include drying up of river beds, rapidly dropping ground water level, and pollution of fields and rivers by fertilizers and pesticides. Costly high-tech seeds which often terminate the crop cycle, has pushed the already impoverished farmer to borrow money at very high rates (30%) from middlemen driving him to destitution and even death (Farooq).

### **Present Situation: Water**

According to the Ministry of Water Resources, on an average, the estimated value of per capita water availability is 1820 km<sup>3</sup> per year. Unfortunately this value is not translated to reality due to several reasons: a) over-dependence on monsoons leading to flooding or drought b) under-utilization of different schemes formulated by the government c) lack of application of modern techniques and software programs for weather forecasting d) lack of political will. Since Independence, the government's primary objective has been to harness water for irrigation and other multipurpose projects to increase both availability and accessibility of water. In the first 5-Year Plan (1951 -1956) water management was seen as part of agricultural production and emphasized raising of the net domestic production by 15% and the per capita income by 8%. Many irrigation projects were started during this period, e.g. the Bhakra and the Hirakud Dam. During the fourth 5-Year Plan (1969–1974), the then Prime Minister, Mrs. Indira Gandhi adopted Dr. Norman Borlaug's unique concept of a 'Green Revolution', to boost agricultural production by using genetically engineered seeds, modern machinery and fertilizers.

Following this period of bumper food production, focus shifted towards industrialization, education and poverty alleviation. It was not until the ninth 5-Year Plan (1997 – 2002) that the development of the rural sector and agriculture was again prioritized. The Regional Task Force (1996) and the National Water Policy (1987) were created, which called for both structural and non-structural measures. Presently, 4760 villages and 1040 towns are protected by 32,500 km of drainage

channels and 16,800 km of embankments. Flood forecasting and warning measures were begun in 1958, and now cover 62 major rivers and 157 stations in almost all flood-prone states (Govt. of India).

India is now in the eleventh 5-Year Plan (2008 -2012). Unlike the past Five Year plans where new constructions were emphasized, the thrust is now on completion of ongoing projects, renovation and modernization of the existing projects, mitigation of flood damages, and promotion of mass awareness on water-related issues. Presently, further dimensions such as micro irrigation development, conjunctive use of surface and ground water, are being added. Under the Accelerated Irrigation Benefit Program (AIBP), the government has so far completed 229 projects and another 90 projects are estimated to be completed by March 2007 (Govt. of India). Unfortunately, the declining trend in budget allocation for the Irrigation Sector and increasing gap between potential creation and utilization of water resources is a matter of concern.

According to the Ministry of Water Resources, the Command Area Development and Water Management (CADWM) program has proved to be very successful because it is a participatory program i.e., the farmer contributes 10% of the initial expenditure to be a beneficiary. In fact the Central government is planning to link the National Rural Employment Guarantee Act (NREGA) with the development of Minor Irrigation Schemes, particularly the Ground Water Schemes. Also, under the leadership of Dr. M.S. Swaminathan, the Farmer's Participatory Action Research Program (FPARP) deliberated an action plan, linking universities and research Institutes directly with the farmer. At present 5000 such programs are being implemented (Govt. India, FPARP). Also, the Indian Council of Agricultural Research (ICAR), an autonomous body under the Department of Agriculture and Research has been pioneering research in crop science, water and energy management since 1929. It supports 45 agricultural universities in India which are actively engaged in lab to field programs (ICAR).

*Pollution* of rivers due to industry and agriculture is another major problem in India. The government has reportedly spent \$3.5 billion for cleaning the Yamuna and the Ganga rivers, two of the greatest water resources for Northern India, by launching the Yamuna Action Plan (YAP) and the Ganga Action Plan (GAP). However, they failed because of lack of enough capital and infrastructure, inadequate planning and intermittent power supply.

*Harvesting rainwater* is now an important focus area for water conservation because it increases water availability and accessibility for both agricultural and drinking purposes. It also helps recharge aquifers and groundwater, decreases the possibility of flooding and also saves energy. Traditional rainwater harvesting is done by using surface storage bodies such as lakes, ponds, irrigation tanks. In May 2000, Andhra Pradesh launched the “*Neeru-Meeru*” (Water and You) project which used traditional harvesting practices to create an additional 18,000 lakh (1.8 billion) m<sup>3</sup> water-holding structures in drought-prone and socially backward areas (Reddy, A). In the Spiti area of Himachal Pradesh, diversion channels have been created to carry water from glaciers to villages. In Rajasthan, covered underground tanks have been constructed near many houses and villages. Bamboo rainwater harvesting in Meghalaya, using stream and spring water is so efficient that about 19 liters of water per day are transported through bamboo stems to irrigate farms. In 1995, the Central Government launched a wasteland – watershed development program - “*Hariyali*” (Greenery), applying rainwater harvesting techniques in desert areas. This program was initiated as an employment scheme for landless and subsistence farmer by using their services to manage local water bodies and forests thus conserving the environment (“Guidelines- Hariyali”).

### **Present Situation: Energy**

While developing the irrigation projects, the government laid emphasis on increasing the power and energy potential of the country. Before the 5-year Plans, the hydroelectric sector generated only 508 MW. Today, this sector generates 22,000MW i.e., 25% of the total power generated. By this, the dependence on coal powered energy has been reduced from 72% to 53%. A major feature of the (present) eleventh 5-Year plan is to raise energy efficiency by 20% by increasing investment in alternative energy by 12% (Reddy, S).

### **Future Tasks of the Government**

India's goal of becoming self-sufficient in water resources will require a well-planned, long-term strategy with an integrated approach. India needs to combine traditional systems with modern techniques, such as weather forecasting by satellite imagery and software programming, for conserving and managing water resources. The government should employ comprehensive management methods by also developing support systems e.g. improving quality of health for all, rural employment generation schemes, improved public distribution systems, and better banking rates and facilities for the farmer. Infrastructures and ongoing projects should be completed as quickly as possible to reduce international debt. Women and children should be supported through proper implementation of different schemes which are already in existence.

### **Specific Programs**

The problem of water and energy conservation is so complicated and widespread, that the government may not be able to solve it alone. A free-flow managerial system with adequate funding, dedicated NGOs and local communities like the "Mahila Gram Unnayan Samity"(Womens' Self-help groups) and the "Panchayats"(locally elected bodies) needs to be set up. This is particularly important in managing *Watersheds and Wastelands*.

In order to *protect aquifers and groundwater*, a generalized but effective policy promoting efficiency, equity and sustainability is necessary. Exploitation of groundwater resources has to be balanced by recharging the water. In already overexploited areas, drilling needs to be regulated until the aquifer is recharged to the desired amount. For example, in northern Gujarat the levels of many unconfined aquifers have been declining by 0.5 – 7.5m/yr due to over-exploitation by well digging, and can now only be recharged by importing surface water from the Narmada river. *Artificial recharge* measures such as percolation tanks exist, but need thorough cleaning to be useful again. Instead of leasing out the ponds and other water bodies to the farmer, the government should allow local communities to partly own the storage areas and also help them to develop those facilities.

India has proposed a long-term mega- scheme to implement *inter-basin water transfer* by linking northern rivers with the Peninsular rivers following the Chinese project of linking the Yangtze river to aquifers and ground water sources in the Jiangsu province. This concept has been utilized in the Periyar-Vaigai system, the Indira Gandhi canal and the Telegu-Ganga project.

The Government of India has improved flood management, but the efforts need to be more *focused and targeted* within a specified time frame. Keeping this in mind, India has been launching remote sensing satellites for flood & weather forecasting. India also needs to work closely with the six countries that share her borders and the rivers of the Indian subcontinent.

*Strategies to prevent Water pollution* and the restoration of ecological balance should be central to all water management plans. Highly polluted rivers need to be cleaned up with a determined and renewed effort. Some solutions that can be immediately implemented could be (a) increasing cost of fertilizers and pesticides (b) reducing toxic wastes by industries by replacement or

recycling (c) Imposing pollution taxes on industries as is done in the Netherlands, which reduced heavy metal pollution by mercury and arsenic in waterways by 99% (Harrington and Morgenstern).

*Recycling of water and reusing water* are other ways that can increase water availability. Intelligently using water e.g. by using water of poorer quality for cooling and fire-fighting should be an option for industries to lower water costs and energy usage. India is not presently practicing water-recycling on a large scale. If modern technology is correctly employed, it is estimated that the amount of recycled water could be between 103-107 km<sup>3</sup> per year (Kumar).

*Desalination of water* to serve coastal regions could also be a choice as is being done in Kalpakkam, and other parts of Tamil Nadu. Though the initial cost of installation is high and the water is being used for drinking purposes only, it may become one of the major thrust areas for obtaining good quality of water for irrigation also.

About 30% of water is wasted due to misuse, leakages and carelessness, which might be curbed by instituting proper water *pricing strategies*. In fact, Gujarat has already effectively enacted legislation restricting ground water utilization. Wastage can also be reduced using the *Sprinkler and Drip Irrigation Systems*. The water thus saved can be utilized to produce two crop cycles of winter crops like bajra, jowar and cash crops e.g. cotton, instead of the one cycle being produced presently. Financial support and technological knowledge should be provided to the farmers to utilize such modern techniques.

It is important to plan ahead to *mitigate the impact of climate change and global warming*. The government is now emphasizing a) developing climate monitoring programs b) mapping water demands in different regions and their effect on crop growth c) re-examination of water allocation policies and d) increased coordination between the government and various local organizations.

*Energy production has to cater to agricultural needs*. Investments in solar energy are up from \$18 million in 2007 to \$347 million in 2008, small hydro projects have grown about four-fold to \$543 million in 2008 while the use of bio-fuels fell by 80% from \$251 million in 2007 to \$49 million in 2008. India is expecting a 12% growth in renewable energy by 2012 (Reddy, S).

### **Role of the NGOs and World Organizations**

In 1986, the “*Tarun Bharat Sangh*” (TBS), one of the oldest NGOs, started the ‘Jal Biradari’ program based on reviving traditional water harvesting methods especially by building ‘Johads’ or small earthen check dams. For every \$2.00 invested, village economic production was raised by \$6.00. Till date, they have built 3000 water harvesting structures in 650 villages which now allows two crop seasons instead of one, reducing farmer migration to big cities by 80% in the Arvari river area. The fish population has also increased since the river has become perennial due to increased level of ground water.

The World Bank has loaned \$388.09 million for the first phase of River Linking project (Ken-Betwa). The bank is also facilitating two major groups, supporting decentralization – a) women’s self-help groups for livelihood projects b) user groups for the delivery of water and sanitation services. The bank has increasingly realized that linking service delivery systems and the Panchayats can bring about better results by promoting greater accountability, especially in the rural water and sanitation sector. For example, the Panchayats in Karnataka, Maharashtra and Kerala now have greater decision-making powers regarding rural water supply. Similarly, in the Chhattisgarh Rural Poverty project, the infrastructure component is being implemented by the Panchayats. It is also advising the central government to privatize water usage.

## Conclusion

Thomas Jefferson once said, "Every generation needs a new revolution", and it is obvious that the next revolution in India will be in water management, which, along with energy production will gain enormous importance in the coming years. Short and long-term measures need to be adopted immediately and implemented by the government. According to Ramaswamy Iyer, Retd. Secretary of Ministry of Water Resources, India, the four key areas should be: (1) crisis aversion by improving the socio-political system, (2) reduction of waste, (3) balancing the cost and benefits of 'Inter- Linking of Rivers'(ILR) projects, and (4) "Water Marketing", i.e. privatization of water services. Due to the large numbers (600 million approx.) of small farmers and the diversity of problems from region to region, it may be difficult to solve the problem of water scarcity and energy all at once, but it will provide a good platform for future development projects.

The Planning Commission has set the objectives of an increase in GDP to 10% and agricultural GDP by 4% by the end of the eleventh 5-Year Plan. To achieve this target, the government is focusing on poverty alleviation, improving education and health, betterment of women and children, infrastructure development and protection of environment. It is hoped that by the end of the eleventh 5-Year Plan, communication will improve dramatically due to the construction of all-weather roads to villages with a population of 1000 or more, and electricity supply to every village. This will help the farmers in remote areas to convey their produce to the cities and increase their income.

Water conservation and management should have been prioritized in the present plan but hopefully it will be taken up in the next (twelfth) 5-Year plan, especially due to the recent serious drought faced by India. The central government can take on more responsibility such as increasing and improving networking amongst the states, NGOs and village Panchayats for joint programs in education, health, irrigation and energy production. Research institutes should be involved in educating the farmers in modern intensive crop production techniques, in providing high yielding seeds and timely weather forecasting.

Summing up, India needs focused, determined and holistic efforts to achieve self-sufficiency and sustainability in water and energy, to maximize agricultural production and accomplish the Millenium Development Goals.

(Word Count: 3,252 Character Count: 17, 975)

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