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Comment

India's Water Future
Responses to ITP's Delphi Questionnaire

Nilkantha Rath

Under the theme of 'India's Water Future 2025/2050', the IWMI-Tata Water Policy Program (ITP) initiated a Delphi study to compile views of experts on how India's water economy would look like in 2050. This Comment is based on the detailed responses received by us from Dr. Nilkantha Rath.

Our questionnaire focused on three specific themes: [1] size, structure and habitat of India's demography; [2] future sources of growth in meeting irrigation and domestic water requirements; and [3] global techno-economic trends and India's water future. Dr. Rath's responses, however, transcended these boundaries and present a lucid overview of India's water economy and its potential future dimensions.

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India's Water Future
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Research Comment Based on Dr. Nilkantha Rath's Responses to ITP's Delphi Questionnaire

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The Delphi Exercise

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SUB-THEME 1: INDIA'S DEMOGRAPHY 2050: SIZE, STRUCTURE AND HABITAT

Questions

Our note outlined the projections made by several studies on the size of India's population in the coming decades including those cited by the National Commission for Integrated Water Resource Development (NCIWRD) in their report and the latest UN (2002) projections which were released after the report was finalized. We also talked about some recent literature which talked about the potential impact of HIV/AIDS including the work of Dyson and Hanchate (2000) and UN (1999a; 1999b).

- What is your opinion about India's future demographic trends?
- Would you rather tend to agree with any one of the projections already made or would your estimates be significantly different?
- How different would growth rates be across the country?
- Do you think HIV/AIDS would make a significant impact on the population?
- What, according to you, would be proportion of India's population in urban areas in 2050? Why?

Response

I am not a student of demography of India. My response is based on general knowledge and my understanding of the growth of population in India during the last half century, the changing rates of urbanization of the population, the birth rates in urban and rural areas, the practice of and attitudes to family planning, and the spread of medical facilities in the country.

[1]The research covered by IWMI-Tata Highlights and Comments is carried out with generous support from Sir Ratan Tata Trust, Mumbai under the IWMI-Tata Water Policy Program. However, this particular Comment is based on Dr. Nilkantha Rath's responses to our Delphi questionnaire on India's Water Future 2025/2050. We are grateful to Dr. Rath for allowing us to publish this for wider circulation as an ITP Comment. The research paper can be downloaded from the IWMI-Tata Website http://www.iwmi.org/iwmi-tata.

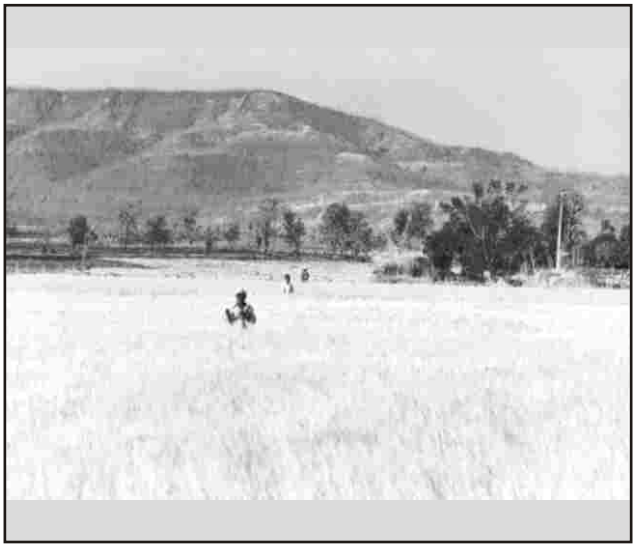
• Till 1940, the annual population growth rate in India was below 1 percent. In the decade of the forties, it became 1 percent but in the very next decade, it shot up to 2 percent, and continued at the level of 2.2 percent for the next three decades, after which there has been a decline. I do not expect the decline to be as fast as the rise.

• Over the next half century I expect a steady decline in the growth rate of population. I expect the average annual growth rate over the next half century to be a little less than 1 per cent a year, which will make the population of India roughly fifty per cent higher than what it was in 2001. This is consistent with the estimate by the Visarias (Visaria and Visaria 1996). This may be treated as the highest, since I do not expect the population to be higher than that by 2050. A more concerted effort during this period may result in a lower level of population than that by how much I cannot forecast.

Rapid urbanization and improvements in medical services even in rural areas will significantly impact future population growth. HIV may take the place of tuberculosis and malaria the present biggest killers but its impact will not be very significant as sooner or later, we will find a way to control it.

• The circumstances that will lead to the anticipated steady decline are as follows: Firstly, the rate of urbanization is going to rise steadily because of growing urban employment opportunities and the inability of agriculture to sustain the growing population even if agricultural technology becomes sophisticated over the years. This has been so till now and is sure to grow over the years. Urban rate of reproduction is distinctly lower than the rural rate and is going to be still lower in the years to come. There is growing tendency in the middle and upper classes to choose a one-child family, and this class is growing in proportion. The working class in urban areas is showing preference for sterilization after two children. With expanded medical facilities even the in-migrating rural families will follow suit. By 2050, I expect the urban population to be more than 60 percent of India's total population; more by how much, I cannot guess.

• Medical services in not only urban areas but also in rural areas are sure to grow significantly during the half century. At present, there is rather a despondency on that front. But it cannot last. And, failure of expanding effective medical services in rural areas will lead, in the short run to increase in death rate, thereby keeping the growth rate of population from rising. HIV is not the only factor likely to cause death. Today, tuberculosis and malaria are big killers. This will decline over the years. At the worst, HIV will take their place. But, sooner than later HIV control is going to be possible. The attitudes of people even in tribal areas to births and family size appear to have significantly changed, despite inadequate medical facilities. Extension of medical facilities over the coming years and decades is sure to have its impact.



Sub-theme 2: Future Sources of Growth in Meeting Irrigation and Domestic Water Requirements

Questions

Under this theme, we looked at four related issues. We talked about the growing importance of groundwater as a source for irrigation as well as domestic water supply citing recent studies (Shah et al. 2003; Londhe et al. 2004). We also talked about the future prospects and implications of micro-irrigation, desalination and waste water use in agriculture. Finally, we raised the issue of future sources of financing for irrigation.

- Which of the issues highlighted above would influence India's Water Future most; and how?
- What will be groundwater's contribution towards meeting our water needs in 2050?
- How widely acceptable will water saving technologies become?
- Can decentralized water harvesting add to India's utilizable water resources or would it only lead to a redistribution of benefits between upstream and downstream users?
- How much can desalination and waste water re-use add to our resource base; and at what cost?

Response

My formulations on this theme are based on my own studies in the past as well as those of some others. My study, in collaboration with Ashok Mitra, on this theme was published in Artha Vijnana in 1989 (Rath and Mitra 1989). I had also written a note on the proposed Linking of Rivers, which was published in the Economic and Political Weekly (Rath 2003).

• Two things are well known that the total water availability, both surface and ground water, is dependent on the precipitation in the region; and in India there is great regional variation in the potential availability of water. The Gangetic and Brahmaputra valleys as well as the big river deltas in the east coast and the plains on the west coast have adequate water, both surface and underground, for all purposes. It is only a question of arranging suitable methods of exploitation and controlling floods in order to facilitate use of water.

• The real serious problem is in the semi-arid and arid regions of peninsular India and above, or rather in the so-called dry agricultural regions of India. This spreads from Mohendergarh district of Haryana in the north through Rajasthan, western Madhya Pradesh, Saurashtra, Gujarat's non-coastal area, all of Maharashtra except the western coast, Telangana and Rayalseema regions of Andhra Pradesh, whole of inland Karnataka to the non-delta regions of Tamil Nadu. Here, the total potential water supply is inadequate for irrigating even 40 percent of the net sown area by the current pattern of use of irrigation water. The proposal to link the rivers, mostly of Himalayan origin, to the peninsular region and the arid areas of Rajasthan arises because of this.

• Two major questions that need to be examined in this context are: [1] What will be the cost of diverting water from the northern rivers to the south and the west?; and [2] Is the available water in the dry agricultural regions being used in the most economic manner? If not, what part of the total net sown area can be irrigated if the most economic method of irrigation is adopted? While the above questions are posed in regard to use of water for irrigation, which is and will continue to be the largest use of available water, questions relating to water supply to households and industries would also require examination.

• Let us first examine the first of the two questions posed above. The very limited information available for linking the rivers puts the total capital cost of the project at Rs. 5,60,000 crore, at present prices. One has no information about the time period over which this expenditure will be incurred. Questions have been raised about the source of this fund that it will mean one percent of the GDP every year (for how many years?), etc. I think that is the less important of the two sub-questions in this connection. The more important one is, what will be the annual capital cost of the water thus supplied to irrigate one acre of the least water requiring hybrid millet (Jowar) as an example of the capital cost of irrigation. Calculations show (See Rath 2003) that the capital cost for irrigating an acre of hybrid jowar will come to about Rs.4,000 a year. This excludes not only the inevitable changes in the initially estimated capital cost, but also the entire annual cost of supply and administration of the system. It is less important to talk about who will bear this capital cost the farmer or society. Even if it is a social cost, is this economical, and is there no less costly alternative method to achieve a large part of the social object involved? This takes me to the second and third questions.

The capital cost for irrigating an acre of hybrid jowar from waters transferred by the proposed interlinking of rivers will come to about Rs. 4,000/- a year. This excludes not only the inevitable changes in the initially estimated capital cost, but also the entire annual cost of supply and administration of the system.

• Is the manner of using water in irrigation in this region the most economical? The answer to this question involves a most elementary lesson in economics, which farmers understand without knowing any economics. In agriculture in this dry agricultural region, the factor in shortest supply is water, not land. Therefore, elementary economic logic as well as common sense suggests that the scarcest factor should be so used that the average (value) production per unit of the scarcest factor in this case, per acre-inch of irrigation water is the highest. Now, studies firmly establish that irrigation water from the flow irrigation projects in the Deccan is most uneconomically used (see Rath and Mitra 1989). The bulk (nearly 80 percent) of the flow irrigation water is used to irrigate sugarcane. And, the additional return per acre-inch of water used in sugarcane is the lowest (it is just about half the net additional income from many other irrigated seasonal crops grown in the region). The same is the situation elsewhere in the peninsular region. A research study carried out by the Madras Institute of Development Studies in the Periyar canal system showed that the lowest return to an acre-inch of water was from paddy, which used the largest share of canal water. The so-called dry irrigated crops yielded a much higher return per acre-inch of water, while using much less irrigation water per acre. I have no doubt that this picture will be repeated in every command area of the irrigation projects in the dry agricultural regions where the dominant irrigated crops are sugarcane and paddy.

• Therefore, if water is allocated to crops that yield the highest return per acre-inch of irrigation water in this region, four benefits will follow. One, the total additional annual income generated because of irrigation will at least double, or be even more. Two, the area provided with irrigation over at least two seasons in the year will be more than two to three times the area now actually provided with irrigation water. Three, a much larger number of farmers will be the beneficiaries of irrigation than at present (this will also bring much greater stability to agriculture of the region than witnessed now). Four, the Deccan survey showed that labor absorption, both hired and household labor, will be much higher than in the present sugarcane/ paddy dominated system. Thus, the economical system of irrigation is four times blessed.

I may at this point go into some detail about water distribution, though that may be strictly outside answers to the broad questions posed. For this economic use of water for irrigation, it will be necessary estimate the quantity of water to be supplied to an acre of land over the year, on the basis of the best crop systems with the highest additional income generation per acre-inch of irrigation water. This will fix the quota of water for every plot. Objection may be raised to this idea of fixing a quota of water per plot of land. It may be argued that it would be reasonable to determine this through price per acre-inch of water in the open market. I, however, consider this alternative as unhelpful, since farmers with small land holdings in the command area would bid high for water for sugarcane/paddy, since that will give them higher income from their limited land. In this situation, social and individual benefits will run in opposite directions.

• The above calculation is based on the present method of irrigation under the flow system, with only the assurance that every water course will technically carry the amount of water it is designed to discharge (which is not the case in most established flow irrigation systems). The drip system of irrigation has proved to be not only a very economical system from the point of view of water use, but also higher yielding in terms of crop output. But, the open canal system is not suitable for the drip system. However, the Israelis have now developed a method where the height of the reservoir for the drip need be no more than one metre. This opens up the possibility of redesigning the flow system such that water from the main canal or at the least from major distributaries is taken in pipes such that it can reach the drip's reservoir at the head

of the water course by gravity and the command area under the water course can be irrigated by the drip system. While this will make the method of transport of water more expensive, it will prevent loss of water in transit to a large extent and reduce the volume of water required for any crop to a significant extent. The administrative cost of supplying water to fields will also come down. In the final analysis, it will save scarce water for use in other areas.

• Till the time such drip system is introduced, it will be useful for farmers under the flow irrigation system to dig open or shallow tube wells at convenient intervals on the irrigated land, to recycle the seeped water for irrigation. Today, in most flow irrigation systems in the country, wells are located only outside the command area of the system to recycle seeped water from the command area. A large part of the seeped water in the command area is lost to farmers. Farmers' service associations taking over the management and distribution of flow water below the main canal can suitably devise suitable ways for recycling. This will economize the demand for water from the system.

• Such designs of distribution may in several instances lead to comparatively smaller dams. For, the feasible command area under the gravity flow system may require less water than is impounded in very large reservoirs. Pumping water from canals to higher level for flow irrigation is sure to be far more expensive than the extra cost of reasonably smaller dams.

• In the northern and coastal regions with adequate water potential, it is important to stress on conjunctive use of surface and ground water. In the big river deltas of the east coast like Mahanadi, Godavari, Krishna, Cauvery and many other not-so-big rivers, despite large flow irrigation projects and plenty of groundwater, there is no sign of conjunctive use of surface and groundwater. This is absolutely necessary not only for rational and economic use of water, but also to save the land from salinity due to excess water. It is a sad commentary on our thinking that in the continued controversy about irrigation water for the Cauvery delta; no one mentions the lack of conjunctive use of surface and groundwater there.

• Such a design does not mean that there will be no sugarcane or paddy in these areas. The basic approach is to calculate the most economic use of water and provide so much of water to every piece of land under command. Farmers need not and should not be directed to produce any particular crop in the season. They can grow whatever crop they wish to, subject to the availability of water. Recycling of groundwater can help some of them to grow water intensive crops like sugarcane or paddy. This is a matter that the members of the Canal Water Users Association will decide among themselves. The problem is to decide on what is to be done about sugar factories which use sugarcane produced by intensive use of canal water. The first point to note is that a large part of the sugarcane in such areas is supplied from well-irrigated sugarcane fields located near the canals. But more importantly reduced area under sugarcane in a particular region should lead to smaller factories that should produce only brown sugar. White sugar can be produced in centralized factories, running the whole year and owned by brown sugar producing factories.

• Let me turn to urban and industrial water supply. Today in most big cities, water supplied to households and industries is expensive treated water. In some cities there is no metering of water supplied to houses. The charge is fixed as a

percentage of the property tax, but unrelated to the quantity of water consumed. This leads to reckless use of expensive treated water not only by households but also by other types of users. I suggest that in every urban centre the way to rationalize use of water should be as follows. First, all households as well as other types of consumers should have meters fixed to measure the supply during the month. The water charge should be on volumetric basis. For a minimum quantity to an average household of five persons per month there should be a minimum fixed charge based on the cost to the municipality of supply of water. Any excess use should be charged at three or four times the minimum rate. In many cities, the municipality requires obligatory open space around the house and the housing complex. These houses or housing complexes should be required to treat the water from the bathroom and the kitchen to be processed in a couple of built chambers in the open space. This treated water may be used for gardening, washing of vehicles, and, if possible, for flushing toilets. Only the toilet water should be allowed to go directly into the city's drainage system. Even in this matter, the municipality should require housing complexes to have biogas plants in the premises, by diverting the night soil and other vegetable wastes into it, to use the gas for lighting or other purposes and the slurry for the garden, and not allow the toilet output to go into the city system. Factories should be required to treat the wastewater in their premises and let out only the excess into the city's drainage system. Industry's wastewater containing harmful chemicals must be treated before being let out into rivers or streams. This should be the way to regulate use of water in cities and towns. It will economize the use of expensive treated water, and discharge as little night soil into the rivers and streams or into the sewage treatment plants as possible. The additional cost for this will be minimal for households/factories and almost nothing for the municipality. Meter reading cost to the municipality will be recovered from users through water charges they pay.

• This scheme of use of surface and groundwater in the dry agricultural regions of India would lead to very economic use of water for all purposes and leave only a comparatively small proportion of the agricultural land un-irrigated. Frankly speaking, it is not necessary for all the cultivated land to be irrigated perennially. There are many horticultural crops that can and should be grown in these regions under un-irrigated condition, as has been the case in recent years. There are large areas that can also be under grass in order to sustain small ruminants like goats and sheep that are the most useful meat animals, supplemented by some milk production from them. Seen this way, one does not see a great need for diverting the Himalayan waters to the parched lands of the peninsula.

SUB-THEME 3: GLOBAL TECHNO-ECONOMIC TRENDS AND INDIA'S WATER FUTURE

Questions

Finally, we looked at four global trends which might significantly change our water future 2050. These included the new world trade regimes which India might face in the wake of WTO and GATT; prospective impacts of Climate Change on India's water resources; development and up-scaling of horizon technologies and practices such as the system of rice intensification (SRI) and the GM revolution.

- Will India continue with its self-sufficiency-in-food-production policy; even in the wake of liberalization of world trade?
- How real and significant will be the impact of Climate Change on water resource availability and use?

- Will the future GM technologies and practices like SRI help us produce much more food for the same amount of water?

- What kind of global system of governance will evolve to govern the GM revolution?

Response

I am stating below what I consider possible without any knowledge about the system of rice intensification (SRI), referred to in your note. As for other matters, I do not cite data in support of my contentions. These are official data, readily available from published sources.

• Since I expect the total population to increase by 50 percent at the most by 2050, cereal requirements would increase at most by 50 percent compared to the present. In fact, I guess, the requirement will increase less than that. In the first place, I expect the urban population to be at least 60 percent, possibly more, by that time. The urban per capita consumption of cereals is much less than the rural per capita consumption. Therefore, cereal demand will increase by less than 50 percent.

The demand for cereals will increase at a rate lower than the rate of growth of population. This is due to various reasons: [1] Urban cereal demand is lower and rapid urbanization would reduce overall demand; [2] NSSO data shows that per capita consumption has been declining; [3] Increasing disguised unemployment in agriculture; and [4] Less strenuous life-styles in both rural and urban locales would lead to further decline.

• The National Sample Survey data show that during the last two decades, overall per capita consumption and per capita consumption of the lower half of the population has been declining. This may sound strange. One possible reason is the less strenuous living and work in rural areas. Thanks to more accessible sources of water for domestic use, people in many villages do not have to trudge long distances for daily water needs. Traveling by foot from one village to another has become much less because roads have opened up and buses ply. In work fields, tractors have replaced bullock-drawn ploughs in many regions. Use of weedicides by rich farmers has reduced the rigorous manual work of

weeding. All these have led to less strenuous work for the household chores and for production. That must have led to less demand for energy input through food, mainly through cereals (For this and the following point, see Rath 1996).

• The demand for labour in the countryside has not kept pace with the supply of able-bodied persons for work. The result is two-fold: a growingly larger proportion of people, while staying in villages, is seeking work outside agriculture. Petty trades of a wide variety are attracting these people. Most of these are much less strenuous than routine farm work, demanding less energy input. On the other hand, less intake of cereals, the main source of energy, leads to lesser ability to put in strenuous hard labour. So, one finds more number of workers used for particular types of work now than before.

• Of these two sources of lesser demand for energy intake in terms of cereals, the first one is a stable one. The second may change with greater employment opportunities over time. But, with household and field work gradually becoming less strenuous, cereal intake is likely to decline. Thus, fifty years hence, the demand for cereals would have risen much less than the increase in population.

• Turning to the supply side of cereals, the first thing to notice is that a significantly large part of the traditional wheat and rice growing areas is not producing as much per hectare as other parts are doing. This is the case with the wheat growing areas outside Punjab, Haryana, Western U.P., and irrigated Rajasthan. In rice growing areas like Orissa, Chattisgarh, Madhya Pradesh, Bihar and Assam, per hectare yields are much lower than in other rice areas. This is sure to change in the years to come. The new rice technology tried out in Madagascar should hold out new hopes. Hybrid paddy, with much greater yields per hectare, is yet to be widely used. Extension of irrigation in the major rice and wheat growing areas, as well as adoption of new technologies are sure to increase the per hectare yield over the coming decades.

• During the last three decades, with extension of irrigation in the peninsular region and with more favorable prices, area under millets has steadily declined and has been replaced by oilseeds and cotton, and, where perennial irrigation has been introduced, by paddy and sugarcane. With the rational irrigation of the type discussed above, hybrid millets can come back to the scene as profitable rotational crops. Mixed cropping of jowar (or bajra)-groundnut or jowar (or bajra)-groundnut-cotton is more likely to be practiced in years to come in such irrigated tracts. All of this taken together holds out the possibility of supply of cereals running not far behind demand, in the long run. Any marginal shortfall can be made good by imports, without any great impact on international prices of cereals.

• Demand for domestic food self-sufficiency will lead to forcing farmers to grow cereals or offering very high support prices. This is self-defeating and undesirable from the farmers' point of view. There are instances of farmers in a whole *taluka* growing only groundnut under unirrigated conditions and buying their need of cereals from the market. I do not foresee a major change in proportion of land under cereal crops in times to come, nor a great shortfall of cereals as a result of that.

• The important point is the rational use of water. If this is seriously followed, by the state as a matter of policy and then by the farmers, I do not see any serious problems in agriculture in regard to water and food supply.

• This leaves the question of the waters of the Himalayan rivers and flood control there, which can lead to better surface and groundwater irrigation. This, however, does not require linking of rivers. In years to come, a part of this water, particularly in the north-east, will have to be impounded for hydel power generation. This will simultaneously help flood control.

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IWMI-Tata Water Policy Program

The IWMI-Tata Water Policy Program was launched in 2000 with the support of Sir Ratan Tata Trust, Mumbai. The program presents new perspectives and practical solutions derived from the wealth of research done in India on water resource management. Its objective is to help policy makers at the central, state and local levels address their water challenges – in areas such as sustainable groundwater management, water scarcity, and rural poverty – by translating research findings into practical policy recommendations.

Through this program, IWMI collaborates with a range of partners across India to identify, analyse and document relevant water-management approaches and current practices. These practices are assessed and synthesised for maximum policy impact in the series on Water Policy Research Highlights and IWMI-Tata Comments.

The policy program's website promotes the exchange of knowledge on water-resources management, within the research community and between researchers and policy makers in India.

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