India in 2050: Food Security through Water Security

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Recognizing the vital role that water security plays in securing lives and livelihoods, this article raises significant questions, which point to formulating policy and taking action that encourage small-holder farmers to contribute to food sufficiency… "Little drops of water make a mighty ocean"

India's per capita food grain availability has gone down since 1991 even though there has been a net addition of about 60 million hectares to agricultural land during the last half of the 20th century. Food production has gone up—rice production by about 350 per cent and wheat production by more than 800 per cent. The production of millets and pulses has, however, gone down to give space to wheat and rice.

With a largely rural (70 per cent) and agrarian (60 per cent) population, the state of agriculture and, more broadly, the state of the farm sector impacts the livelihoods of people hugely. The poor state of the agricultural sector is the main cause of rural poverty in India. Three-fourths of the rural poor depend on mono-cropped 'rain-fed' farming, a highly uncertain enterprise.

The productivity as well as the value of farm output in rain-fed regions is well below the sustainable potential and the national average although over half the region is sub-humid with over 900 mm of rainfall. Beyond some pockets, farming in rain-fed areas is mostly at subsistence levels. A very small fraction of the farmers produce enough to feed their families. Table 1 captures the trends of availability of food in the country.

Table 1: Per Capita Food Grain Availability

(Grams/Capita/Day)						
Year	Rice	Wheat	Other Cereals	Cereals	Pulses	Food Grains
1971	192.6	103.6	121.4	417.6	51.2	468.8
1981	197.8	129.6	89.9	417.3	37.5	454.8
1991	221.7	166.8	80.0	468.5	41.6	510.1
2001	190.5	135.8	56.2	386.2	30.0	416.2
2002	228.7	166.6	63.4	458.7	35.4	494.1
2005	177.3	154.3	59.4	390.9	31.5	422.4
2007	194.0	157.8	55.5	407.4	35.5	442.8

Source: http://agricoop.nic.in/statatglance

"The per capita availability of food grains and pulses has increased from 436 gm per day in 2008 to about 463 gm per day in 2011. As per the provisions of the National Food Security Bill, introduced in the Lok Sabha on 22nd December 2011, the annual requirement of food grains for targeted Public Distribution System and other food-based welfare schemes is estimated at 60.74 million tonnes. The food subsidy is to touch Rs 924.93 billion during the FY13." (India Infoline News Service 17:43, Aug 14, 2012)

In the past, food grain production could be increased by bringing more land under cultivation as well as by introducing high yielding varieties. There is no longer a possibility of bringing more land under cultivation. In fact, the competition for control over land is increasing, with industries and human settlements demanding more land. The per capita availability of agricultural land has continued to go down with the increase in population. The rate of decrease has been faster since the 1980s.

Table 2: Total Gross Cropped Area (in Million Hectares)

1950 – 51	1970 – 71	1990 – 91	2000 – 01
131.89	165.79	185.74	190.76

Table 3: Per Capita Agricultural Land Availability (in Million Hectares)

Year	Net Sown Area	Population (in Millions)	Net Sown Area Per Capita
1951	119	361	0.33
1971	140	548	0.26
1991	143	84	1.70
2001	142	1027	0.14
2051*	137	1600	0.085

(*The 2051 figures are projected. This is the year when India's population is expected to stabilize.)

The projected figure of the average per capita net sown area will actually vary from state to state. The more populous the state/area, for example, in West Bengal or Bihar, the less per capita (about 0.04 ha) net sown area it will have (1950 figure). The national projected per capita average of 0.085 ha means that each Indian will have just about 850 sq m of land to meet all the food and nutritional demands.

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In addition, there are some other biomass needs, for example, cotton and, in rural areas, fuel and fodder, which need to be taken care of from the same land. Assuming that (in 2050) 50 per cent of Indians will be engaged in farming and the rest will find engagements in the service and manufacturing industries, the actual farming population will have a per capita net sown area in the range of 0.08 ha (in high population density areas) and 0.16 ha (in low population density areas).

Depending upon the carrying capacity of different agro-climatic zones and sub-zones, this range will vary. For example, in arid zones and undulating terrains, the agrarian population density is lower, with a consequently higher availability of per capita net sown area, and in the Indo-Gangetic plains, in coastal areas and in pockets where big dam- and canal-based irrigation infrastructure has been developed, the agrarian population density is much higher.

Thus, as of now, the difference in per capita makes very little sense in terms of any economic benefit to the owner. A family that has 2 ha of land in an arid or undulating terrain could actually be poorer and economically worse and more vulnerable than a family that has 1 ha of land in the Gangetic plain or in the coastal belt.

The big question is, "Does the nation see and recognize the 160 million marginal/small-holders, who have a farm size in the range of 4,000 sq m (presuming a family would have five members, in high density areas) and 8,000 sq m (in low density areas), as a viable enterprise?"

Some social leaders and national planners in India have lost faith in small-hold farming as a model of development. They have more faith in industry and the service sector. Often, there is an argument for the consolidation of land into bigger holdings and for farming to be carried out by a smaller percentage of the population (as it is in developed countries).

Combining these two aspects, we need to think about: "Can these millions of small-holders take the responsibility and challenge of meeting the food grain demand for the growing population?"

The small-holders' viability depends upon the vision of the planners, policy makers, political parties and society at large. If they are left to themselves and the market is allowed to decide their future, there is little chance that they will be able to gear up their production systems to meet such a huge national challenge.

This gives rise to a bigger question. "What kind of a society do we want to see in India? Should we work towards a society where fewer entrepreneurs/'big-holders' (say 1.6 million, each owning about 100 ha of land) will be given the responsibility to manage most of the natural resources (ecosystems), with an understanding and belief that they will honestly shoulder the responsibility and feed a nation of 1,600 million people, or should we work to create a facilitating environment, in

which millions (160 million, each with less than one ha of land) of small-holder communities take the responsibility of not only feeding themselves but also ensuring supplies to another 160 million families, who are working in industry and the service sector?"

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The question about meeting the food grain demand is purely a technical one. It can be broken down to the elemental level of the demand on land and water and the technologies of production. Assuming that the population distribution (net number of persons demanding food from a defined geographical area) across the regions/states is not going to change much (even if migration increases), there will be a need to augment the yield of food grain everywhere.

Unlike today, India in 2050 will not be relying on a few 'Punjabs' to meet the food grain and other bio-mass needs of the entire country. Food grain (and other crops) needs to be produced in all available cultivable lands. We have to work out farming practices on the presumption that each Indian will have 800 sq m of farm land to meet all food grain, vegetable, fruit and oil seed demands (either as direct pulses or fodder/feed converted into animal protein). And today, with the widespread experience of high yielding crops, this is theoretically possible.

For the sake of calculation, let us use the case of the food grain demand at present. Let us assume that 50 per cent of the per capita available land is used for food grain, leaving the rest of the area for other crops. With the available technologies, each hectare could produce 5,000 to 10,000 kg of grain (rice/wheat). Thus, 400 sq m can produce 200 to 400 kg of food grain in four to five months (either in the *kharif* or in the *rabi* seasons). This is more than adequate to meet one person's annual requirement. Even if we were to assume that there will be a bad monsoon every three years, two years' harvest could meet the demand of three years.

Assuming that 50 per cent of the population (thereby 50 per cent of the families) will not be engaged in farming, their land will be available to the farming community. This raises the average farm family's holding size to 4,000 sq m. Thus, each farm family will have the capacity to produce enough to meet their family's demand and to supply to the market enough to meet another family's demand—the family that is not engaged in farming (but engaged either in industry or the service sector).

Thus, theoretically, it could be claimed that 160 million farm families can feed the entire country even in 2050. India need not depend on the import of any food grain. Similarly, it will be possible to meet the other demands for vegetables, oil seeds, etc. However, this will require a change in cultivation practices in the irrigated areas and more comprehensive natural husbandry practices in rain-fed regions. The challenge is to intensify crop production in every piece of available land under farming, which will be possible only when adequate water is available.

This leads us to a fourth set of associated questions: "Is there enough water? Can we, as a nation, meet the water demand of 2050?"

The situation is tough but not impossible. "... The average per capita availability of water, estimated at 1,600 cu m per year, is expected to fall to around 1,000 cu m per year by 2050, based on the current population projections.

The effects of climate change on the availability of future water resources are uncertain, but it is expected that the frequency of extreme events (floods and droughts) will increase." ('Water Security Challenges in India', Kapil Narula and Upmanu Lall, Columbia Water Center, Earth Institute, Columbia University)

With some prudent planning and application in the field, India can meet its food demand with its own production in 2050 for 1,600 million people, provided it commits to working on water security now

"What is the per capita water requirement of a farming family against this 5,000 (1000* 5) cu m of availability in 2050?"

One such rough estimation that requires an on-field reality testing across different agro-climatic zones is:

> Assuming that the most practised irrigation water use efficiency in Indian conditions—1 kg of wheat production would require 500 litres (or half a cubic metre) of water (Assumption: Yield 5000 kg/ha; irrigation: 4 times with 5 cm each). This means, if a person from the farming community consumes 500 gm of grain per day (182.5 kg/year), the annual per capita water demand for food grain production will be 91.25 or say 100 cu m. In the case of rice, the water demand would be at least double, say, 200 cu m. (This is a very conservative estimate because for rice, it could go as high as 3,000 litres/kg of rice; but as most rice in our country is grown in the rainy season, a minimum provisioning will help to have a higher predictable production by saving the crop from intermittent dry spells during the crop growing period). The corresponding land demand will be 365 sq m or, say, 400 sq m. As wheat is cultivated in winter, the losses will be higher because water received in the rainy season will need to be stored for a longer time. Let us assume that both rice and wheat have the same water productivity, requiring 1,000 litres of water per kilogram of grain. Thus, the per capita demand comes to 200 cu m, irrespective of the primary food crops. If the same person aspires to earn Rs 10,000 through vegetable cultivation, she/he will need to grow vegetables in about 10 cents/decimals (one decimal is about 40 sq m), or 400 sq m of land. This will require another 200 cu m of water (assumptions: 10 times irrigation @ 5 cm each).
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> In addition to this, let us add another 100 cu m of water for household use, including the water required to feed a couple of domestic animals, which are an integral part of the farming system. Thus, the per capita annual water demand for assured food and income comes to about 500 cu m. This does not provide for other losses (due to conveyance through open mud channel or percolation losses, depending upon what kind of harvesting structures are adopted). Assuming 50 per cent average efficiency of such a structure, each person will require 1,000 cu m of water storage, that is, 5,000 cu m for a family of five members.

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One can look at India's performance vis-à-vis two other countries, in terms of the average per capita water storage created (ibid.):

- United States: 1,960 cu m
- China: 1,100 cu m
- India: 200 cu m

This shows that India's planned effort to ensure water availability is much below the requirement. Further, when we consider millions of small-holders in rain-fed areas, it seems a herculean task to think and commit the required water security to all the small-holders.

When the per capita water availability at the national level is expected to reduce further because of further growth in every sector, the cross-sectoral competition for access to and control over water will also be accentuated, giving rise to a condition where the weaker sections of society (for example, the poor small-holder farming communities, tribal and other socially and politically marginalized) will face extreme difficulties to access water from common water resources.

This will warrant a much more pro-active stance on the part of the government to ensure that small-holders have access to minimum water requirements and help them realize the potential of their farms. Unless the government (planners/policy makers) works with a clear vision of seeing millions of small-holders succeed as food growers for the nation and are accordingly supported with assured water resources, this will not happen. When farmers are left to deal with the vagaries of nature year after year and often generation after generation, they too lose hope. The new generation of farmer children, who own a hectare of land, will not aspire to be accomplished farmers. They would rather opt for menial jobs as migrant or casual labourers.

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In the past (during the first few Five Year Plan periods), the government and society decided to adopt big industries as a model of growth and enhance the country's economy, pushing almost all cottage industries to perish. The national policy to promote industry has thrown out millions of small entrepreneurs (weavers, potters, blacksmiths and others) from their traditional livelihoods and most of the displaced craftsmen have crowded into the agriculture sector.

There is no doubt that industrial growth has created jobs; however, only a small fraction of the class of people, who were thrown out of their hereditary (self-employed) cottage industry based livelihoods, were absorbed in big industry and, over time, a new set of urban population replaced the rural artisan class. Industrial growth, urban growth and the associated consumerism have grown hand-in-hand and have caused irreparable damage to nature. Today, it is time to think of and not neglect small-holders in the farm sector.

Before proposing any particular stance to be adopted, it might make sense to refer to some of the Policies/Acts framed by the Government in the recent past. In the MGNREGA, the Food Security Act, the Forest

Rights Act, etc., the message is clear that, as a nation, we are committed to the safety and security of our weaker communities. At the same time, one can also see that there is no systematic and focussed approach to make a direct investment in the small-holders' farming system. The gap is particularly conspicuous in the case of water. The Food Security Act commits a definite quantity of food, the Employment Guarantee assures the availability of a certain number of days of employment, the Community Forest Rights Act gives some definite land resources that the community can access. But our government is yet to come up with a commitment to ensure access to a definite amount of water to the people.

However, it is worth mentioning here that the draft National Water Policy (NWP) talks about priority in allocating water for food security when it states, Water, after meeting the pre-emptive needs for safe drinking water and sanitation, achieving food security, supporting poor people dependent on agriculture for their livelihood and high priority allocation for minimum eco-system needs, be treated as an economic good so as to promote its conservation and efficient use." (Press Information Bureau, Government of India). The draft policy also mentions several principles that have guided the formulation of the draft.

Two basic principles that govern the draft NWP are that "Principle of equity and social justice must inform use and allocation of water… Water needs to be managed as a common pool community resource held, by the state, under public trust doctrine to achieve food security, support livelihood, and ensure equitable and sustainable development for all..." (Draft National Water Policy, 2012)

However, unlike other national policies such as food security and employment guarantee policies, there is no 'quantified provision' assured under this policy. At the same time, the concept of equity is subject to varied/ conflicting interpretations, depending upon the interest of the stakeholders. The task of implementing such a policy will become even more difficult if there were no policy statement to ensure some provision that is quantified (for example, XY cu m of water/capita, as it is done for food security or employment guarantee), to create an impact on the lives and livelihoods of the poor, as visualized by policy makers.

In the absence of any policy or Act on water security, a farmer/community, interested in creating water resources, is expected to mobilize MGNREGA, Integrated Watershed Management Programme (IWMP) or some such scheme. Why can't we have a water security policy that ensures that each small-holder family (of five members) will be provided 2,500 to 5,000 cu m of water (the actual feasible volume being worked out with a detailed agro-climatic analysis, depending upon a local feasibility analysis)?

The farmers, in turn, can commit to produce enough food grain to feed their own family and one more family. This approach to rural development through water security could actually help our country with sustainable food security and employment guarantee.

If we were to visualize the large number of small-holders (160 million by 2050) as food producers for the nation, the spirit of equity and social justice will have meaning, which will not be if we were to visualize an inefficient, below subsistence farmer. Thus, it is very important how the policy

makers and planners engage with the issues of water and visualize the future of farming communities and the Indian society of 2050.

How could we create such a broad-based water security? Approaches to such equitable water sharing at the local and the national level will need special care in designing the water resources. The challenge is not just in creating water bodies. At the national policy level, we need to know how much water should be ensured to our citizens. Also, the urban population will require less water to meet daily household demands than the rural faming population that needs water for household needs as well as for farming—to grow food for self and for sale in the market, thereby contributing to the national food security.

Approaches to such equitable water sharing at the local and the national level will need special care in designing the water resources. The challenge is not just creating water bodies

Even within the farming population, what should be the principles and norms for water resource creation and distribution? There are segments of the farming population, which are already in a position to produce marketable surpluses, based on the irrigation support and extension of other technological services sponsored by the government.

There is some awareness that more water should be made available to them because they are 'exporting virtual water' from their area/land/state to feed the population outside their area/state. And there is large farming community that is struggling to produce adequate food grain to feed its own families round the year.

The national policy needs to make clearer statements about the level of food security—local level (family level, village level, panchayat level), state level and national level. Planning for the national level or the state level food security may not take into account the needs of the farming community's food security. There might not be enough allocation and investment in the resources required to create water sources that will ensure supply of water at the farming household level.

Household-level food security demands a much more decentralized resource creation and investment policy, aimed at meeting the needs of the many agro-climatic and geo-physical conditions across the country. Widespread poverty in the farming communities, (particularly those considered to be rain-fed farmers, in spite of their presence in much higher rainfall areas than many irrigated areas) across the country today is the result of the lack of political will rather than technology.

The NWP needs to be sensitive to the influence and the impact it has on the large number of small-holders in the so-called rain-fed farming population, across different agro-climatic zones, particularly if we recognize them as potential food growers for the nation.

Depending upon the agro-climatic areas in which the farmers produce their crop, each family requires a definite volume (a range, based on how efficiently the water is used)

of water to meet the per capita food grain requirement. Each unit mass of grain/biomass production demands a specific amount of water to pass through the plant bodies for transpiration and associated evaporation from the field. A family will, therefore, require a definite volume of water to meet its own consumption requirements and more to produce the marketable surpluses, to earn cash to buy other necessary services or goods. There is need to assess this volume, and the National Policy should work to ensuring this.

Unequal access to water across geographies is often rooted in the evolution of civilization and the historical movement of the human race but local inequalities are often rooted in and determined by social and political power distribution

Geographical distribution and topographical locations of communities and their resources (habitats and lands in particular) give people a natural access to water. There are variations across geographies as well as within the same agro-climatic conditions. Unequal access to water across geographies is often rooted in the evolution of civilization and the historical movement of the human race but local inequalities are often rooted in and determined by social and political power distribution.

Even within democratic governance, inequalities are created by decisions made by national planners in the choice of technology and the allocation of resources. The discrimination in setting cost norms across the imaginary theoretical division of farmlands into 'rain-fed' and 'irrigated' is a distinct example of how national decisions have deprived some citizens of certain basic services that threaten their lives and livelihoods, and their aspiration to be respected farmers.

Policies to ensure an equitable share of water resources need the right emphasis on research, development and the application of the right kinds of technologies. A big dam downstream of a river would certainly deprive the people situated upstream, especially if they are not helped to harvest their water, where they receive it as rain.

As per *The Times of India* July 8, 2012 report: the construction cost of the irrigation projects in Maharashtra is among the highest in the country. The cost of irrigation per hectare incurred by the state is Rs 9.81 lakhs compared to the Rs 1.5 lakhs to Rs 2.5 lakhs limit mandated by the Central Water Commission. Whereas the cost of land treatment for land labelled 'rain-fed' is allocated at Rs 12,000 (Source: Outcome budget 2009–10; Department of Land Resources; IWMP). Such discrimination is made in policies with no clear scientific reasons. If we remove the artificial discrimination line between the rain-fed and the irrigated land, and Rs 1 to 1.5 lakh are made available on a per hectare basis, 80 per cent of the farmers of the rain-fed lands would enjoy the benefit of irrigation, achieve sustainable water and livelihood security, and realize the vision of 'equity and social justice' as reflected in NWP.

RELEVANCE AND SIGNIFICANCE OF THE APPROACH

Without any well-established standards, there can be no reference to verify how equitable the distribution and the use of

water is across various stakeholders/strata of society. In the past, there have been big river valley projects, to support agriculture in our country. Smaller water harvesting projects help smaller farmers. If the runoff water from the upstream areas is arrested in a dam before it reaches downstream, and is then guided though canals, it will irrigate farmlands and also feed industries downstream.

For instance, a woman has been harvesting a rice crop since 2005 in Pogro village, Purulia district, India. Every year, the crop has been failing because the runoff water from her land flows down to a dam through a river, to irrigate the land of another district downstream. When we asked her why she was continuing to harvest that crop every year even though it was failing, her brief response was that her husband had told her to do so.

This illustrates the desperate situation that small-holder rain-fed farmers, particularly women, face in India. When the rains fail, the farmers lose their crop and people migrate to urban centres in search of jobs. Sometimes, only the able-bodied male members migrate, leaving the farming to the aged and the women who, out of desperation, engage themselves in meaningless/non-remunerative activities. They often have no food to eat.

There is peculiar upstream-downstream dynamics being played out in this part of the world, which may be prevalent in other poverty areas as well.

Upstream Areas/Plateaus
Features: ◆ Undulating topography ◆ Rainwater runoff ◆ Soil erosion ◆ Low uncertain crop production ◆ Weak local economy ◆ Distressed migration ◆ Price of lands low ◆ Politically weak ◆ Pressure from states/MNCs to grab lands for mining, industry ◆ Yield water to fill big reservoirs made to benefit downstream

Downstream Areas/Plains
Features: ◆ Plain lands ◆ Receive runoff water and good soil from upstream ◆ Good and assured crop ◆ Vibrant local economy ◆ Get cheaper labour from upstream migration ◆ Price of lands high ◆ Politically organized and influences policy ◆ Use canal water to irrigate their lands

If one follows the rivers that originate in the central or the eastern Indian plateau and flow down either to the plains of the Ganga basin in North India or the coastal plains, one observes that the plateau (hilly and undulating terrain) is yielding its water and fertile top soil to the plains. This phenomenon leaves the farming system of the area poorer, impacting the local economy, making it weaker. People also migrate to find jobs in the plains. Thus, the plains not only receive the productive soil and water but also cheaper labour from the plateau, boosting their farm productivity. The government and the industry sector then find it easy to negotiate with the farmers on the plateau, to occupy those lands for mining and setting up factories.

However, if one takes a closer look at the rainfall data, it shows that the area never received less than 600 mm of rainfall between the months of June and October, and the average annual rainfall is 1,200 mm. About 50 per cent of this rainfall flows out as runoff. Millions of such small-holder farmers in rain-fed areas are forced to live miserable lives.

Such inhuman suffering is perpetuated because the society/state does not invest in improving farming conditions. There is a pattern; the state invests in areas where people are organized and politically strong; isolated tribal communities in remote areas and other weaker sections are left out for generations. As if there is no technology to improve their conditions! Even a small water harvesting structure to help each family preserve 1,000 cu m of water, of the 5,000 to 10,000 cu m of water each family receives in their own land, can help change reality.

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