Ecology and equity: key determinants of sustainable water security

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Abstract Trends in water consumption indicate that demand for water for household and industrial uses in developing countries could double as a proportion of total water demand in the next 25 years. Scope for expansion of water supply will, at the same time, be limited because development of irrigation and urban water supplies is becoming increasingly expensive, and often involves high costs in terms of environmental degradation and human resettlement. Without fundamental reform of water management, the rapid growth in urban water demand will require large transfers of water from irrigated agriculture, thereby threatening food security. Hence, water supply and demand should be managed in an integrated fashion, simultaneously considering all uses and sources. This will call for the establishment of community centred food and water security systems and national water trusts.

Once such systems and Trusts are established there could be a legally binding Global Water Convention on the model of the Global Convention on Climate and Biodiversity. The details of such a Global Water Conventions can be finalized at one of the future Stockholm Water Symposia. There are uncommon opportunities today for a water-secure world through synergy between technology, public policy and peoples’ participation.

Keywords Sustainable water security; Global Water Convention; ethics and equity

Introduction

Sustainable water security involves the availability of water in adequate quantity and quality in perpetuity to meet domestic, agricultural, industrial and ecosystem needs. The Stockholm Water Symposia series have clearly brought out that such a sustainable water security is feasible, provided everyone follows the underlying principles behind the following two statements of the great Indian leader and visionary, M.K. Gandhi:

• “Nature provides everybody’s need but not for everybody’s greed”,
• “Be the change you want to bring about”.

In recent years and months, many articles have appeared which warn humankind that water lords, water markets and water wars will become widespread in the 21st century. Cheyanne Church (2000) in an article titled “Water : a threat of war or an opportunity for peace” has discussed this issue in the context of international rivers particularly in the African Continent.

Distribution of water nationally and globally is unfortunately uneven and unequal. About 268 rivers flow across international borders and there are problems in the equitable sharing of water. Less than ten countries possess about 60% of the global accessible water. Even with reference to rain water, there is great skewness in both total rainfall and its distribution. For example, India receives most of its rainfall in just 100 hours out of 8760 hours in a year. If this water is not captured or stored, there will be no water for the rest of the year (Anil Agarwal, 2000). Where there is no equity in water sharing, there will be no cooperation in water saving (Swaminathan, 1999).

Compounding current difficulties is the prospect of changes in precipitation and temperature as a result of global climate change. There should hence be no further loss of time in developing sustainable global, national and village level water security systems. I would like to start with action at the local level.
Community Centred Food and Water Security System

The Community Centred Food and Water Security System developed by MSSRF has two major components. The first relates to the conservation and enhancement of natural resources, particularly land, water and biodiversity. A majority of the rural population depend upon on-farm employment for their livelihoods. The rate of growth in rural non-farm employment, which can provide opportunities for skilled jobs to the landless poor, is slow. An integrated strategy for fostering sustainable and skilled on-farm and off-farm employment is yet to emerge. This is the second major challenge, since only productivity enhancement based farming and improved post-harvest technology leading to value-addition to primary produce and the emergence of agro-processing and agri-business enterprises, can help to eradicate rural poverty and thereby end poverty-induced hunger.

A community led programme for the conservation and sustainable use of genetic resources, land and water, will need local level institutional structures which can be operated by local women and men with the help of micro-credit. In addition to a community based land care movement, the village community could organize the following four banks.

Field gene bank
This is particularly important in tribal and rural areas rich in agro-biodiversity. This will involve in situ on-farm conservation of land races and local varieties in all major crops. Fortunately, there will soon be opportunities for recognizing and rewarding community conservation efforts (mostly carried out by women) from National Gene and Biodiversity Funds.

Village seed bank
Non-availability of good quality seeds of the right varieties at the right time is often the most serious constraint in farming. Hybrid seeds are becoming important even in self-pollinated crops like rice. Therefore, village level seed banks will fill a felt need and at the same time provide remunerative livelihood opportunities.

Village water bank
There is great scope for community water harvesting, conservation and equitable distribution. Anil Agarwal (2000) has pointed out that even 100 mm rainfall falling on a 1 hectare plot can yield up to 1 million litres of water. Often our total rainfall figures are impressive but the distribution is highly skewed. Rain water harvesting and conservation are therefore essential for water security. Land and water care has to be institutionalized in every village. Where water availability is low, it will be preferable to grow low water-requiring but high value crops like pulses and oilseeds. It should be realized that land use decisions are also water use decisions.

Grain bank
Community grain banks confer multiple benefits like the availability of good quality staple grains in the village, prevention of storage losses and low transaction cost. Local grain banks provide the most cost-effective mechanism for ensuring timely supply of staple grains at affordable prices to the poor.

In addition to the care of the land and the conservation of water, genes, seeds and grains (Figure 1), the village community can undertake a systematic hunger-elimination strategy. Studies in Tamil Nadu, under a project sponsored by the Government of Tamil Nadu, have indicated that an effective community centred and controlled hunger-elimination programme can be implemented through concurrent attention to the following steps. The relative importance of these steps will obviously vary according to local socio-economic and
socio-cultural factors. The precise action plan will have to be developed by local communities on the basis of generic guidelines.

Who are the hungry?
The first step is to identify individuals in the village who suffer from endemic hunger (i.e., chronic under- and malnutrition). This is best done by the local population. Usually, the men and women without any assets and often with no education fall into this category.

Information empowerment
There are numerous schemes of national and international agencies intended for the poor. Quite often, the persons who ought to know about them, are ignorant of their existence. Wherever modern information technology (IT) can be introduced, an Entitlements Database giving information on all anti-poverty programmes, disaggregated by gender, age, class and special categories of under-privileged, can be made available. A Household Entitlements Card can then be prepared from such a database by each family. Information on how to access the different schemes will also have to be provided.

Protein-calorie deprivation
Under-nutrition caused by poverty is the major cause of malnutrition in our country. Suitable arrangements will have to be made under the Public Distribution System and the proposed rural Grain Banks to reach the hungry.

Hidden hunger
Hidden hunger arising from micro-nutrient deficiencies is a widespread problem. Iron deficiency anaemia among pregnant women has serious consequences in terms of the growth of the foetus. This problem will have to be addressed through the introduction of an Integrated Nutrition System, consisting of the essential use of synthetic nutrients and supplements, and the more extensive use of home and nutrition gardens consisting of appropriate horticultural remedies for the nutritional maladies of the village. Fortification of common salt with iodine and/or iron is one of the most effective methods of providing

Figure 1  Four banks within the Community Food and Water Security System
these much needed nutrients. The food-based approach to nutrition can be combined with feasible fortification procedures.

**Clean drinking water**

This, together with environmental hygiene, influences the biological absorption of food in the body. Diarrhoea and intestinal infection further compound the malnutrition problem. Hence, attention to safe drinking water and environmental hygiene will confer valuable nutritional benefits.

**Multiple livelihoods**

Economic access to food can be improved only by creating multiple livelihood opportunities based on micro-enterprises supported by micro-credit. Government should ensure that the country’s import and export policies in the farm sector help to strengthen and not erode the livelihood opportunities of the poor. The import and export policy document of Governments should be accompanied by a Livelihood Impact statement. Present policies are generally not conducive to the survival of micro enterprises which either depend upon export opportunities for their economic viability, or will have to compete in prices with commodities produced by mass production technologies.

**Special attention to women and children**

Almost every third child born in the country is characterized by low birth weight (LBW), as a result of maternal and foetal under-nutrition. This has serious consequences to the country’s future, since LBW children tend to become handicapped in brain development. Hence, pregnant and nursing mothers belonging to families living in poverty need urgent nutritional support. With over 40 million tonnes of wheat and rice in Government godowns, it should not be difficult to allot 3 to 4 million tonnes of grains for a special programme designed to ensure the birth of healthy babies, which have a chance to participate actively in this knowledge century. **Children for happiness** should be the goal of the Community Centred Food and Water Security System. There is also need to attend to reproductive health and the other steps needed to bring down IMR and MMR.

**Population stabilization**

By enabling local communities to prepare socio-demographic charters for their respective areas, greater awareness can be generated about the population-supporting capacity of their ecosystem. This will stimulate greater interest in the voluntary adoption of a small family norm. The socio-demographic charter helps school children to assess population in relation to water and food availability. The major components of a socio-demographic charter are:

- Health Security, including reproductive health and provision of user-preferred contraceptives
- Water Security
- Food and Nutrition Security
- Livelihood Security
  - On-farm employment
  - Non-farm employment
- Education Guarantee

**National water security systems**

Some of the urgent steps needed in the area of irrigation water conservation and sustainable use are:

- harvesting and conserving rainwater
promoting conjunctive use of river, rain, ground, sea and sewage water, in appropriate combinations
preventing unsustainable exploitation of the aquifer
ensuring efficiency, economy, and equity in water use through co-operative management of watersheds and command areas
regulating the expansion of water markets
introducing proactive measures to avoid water conflicts

Government pricing policies, particularly with reference to electricity for pumping groundwater, often result in inefficient and unsustainable exploitation of precious water resources. On the other hand, private ownership of groundwater resources leads to the emergence of water lords and water markets. A national policy relating to access to water for all should be designed in such a manner that, first, irrigation does not result in long-term harm to soil health and, second, gender and social equity in sharing the available water is ensured. Participatory management of irrigation water resources, including systems of rotational distribution of water, will help to foster the equitable and efficient use of water. Pricing policies should signal the inter-generational equity aspects of water use.

Irrigation has been an important factor in poverty alleviation in several developing countries. When water is available, there is not only crop security but also opportunities for multiple cropping, mixed cropping, and agro-forestry systems of land use. Irrigation has a multiplier effect on employment both at the production and post-harvest phases of agriculture.

Sewage and industrial water recycling, including their incorporation in conjunctive water use systems, will confer both public health and economic benefits. Ecological problems associated with unscientific water use including water logging, salinisation, and soil erosion are well known. Serious nutritional problems, such as arsenic poisoning due to the tapping of the deeper layers of the aquifer, have been reported both in West Bengal of India and in Bangladesh.

There are also serious environmental and social problems in several major multi-purpose irrigation projects. For example, the Three Gorges Dam over the Yangtze river will help to halt floods in the south of China and bring irrigation water to the northern part of the country. However, environmentalists have grave concerns about it. Similarly, the Narmada project in India, designed to provide drinking water to 40 million people and irrigate 1.8 million hectares (ha), will lead to the displacement of nearly 250,000 people and to inundation of 117,000 ha of land. It is obvious that every nation will have to carefully weigh the pros and cons of large multipurpose water projects and choose the ones that confer maximum social benefit with the least ecological harm. There is need for large numbers of professionals trained in Green Audit procedures with reference to irrigation projects.

Opposing unsustainable development alone is not enough; there must be equal emphasis on proposing sustainable options. This is going to be a major challenge of the 21st century.

Social access to water has several dimensions. Gender inequity is most grim in the case of drinking water, since women are invariably entrusted with the responsibility for fetching water for domestic use. Destruction of forests leading to the disruption of hydrologic cycles has adversely affected the nutrition and livelihood security of women.

Social cohesion and co-operation in the harvesting, storage, and use of water will help enormously to strengthen irrigation water security. In a recent study, Anil Agarwal and Sunita Narain (1997) illustrate the power of social action, characteristic of the past but fast vanishing now, with the example of Cherrapunji which, with an annual rainfall of 15,000 mm, faces acute water shortage during summer months, while Jaisalmer in the Thar desert, with an annual rainfall of 100 mm, has enough drinking water during summer due to rain-
water harvesting structures called *kunds* established by local communities. Globally, more than 50 percent of cultivated areas will continue to depend on rainfall and, hence, rainwater management is vital for sustainable food security. In the past, famines were always associated with the failure of rainfall. Irrigation systems have helped to reduce variability in production from year to year and have provided insulation against total crop failure in years of drought.

Currently, water is used in four major sectors – domestic needs (including drinking water), agriculture, industry, and ecosystem conservation. In most calculations, the need for water to maintain ecosystems, particularly those rich in biodiversity, is not taken into consideration. For example, many mangrove forest ecosystems that occur in the estuaries of major rivers are adversely affected when the flow of freshwater goes down. Salinity then increases, and not all mangrove species can withstand a high degree of salinity. Indiscriminate deforestation disturbs hydrologic cycles and increases the frequency of floods and drought. Hence, water allocation policies should include adequate provision for safeguarding the integrity of critical ecosystems. Disruption of hydrologic cycles hastens the process of desertification, as is evident from the ravines of the sub-Himalayan zone. There is need to standardise methods for calculating water requirements for the conservation and sustainable management of forests and natural ecosystems, and to merge them into sectoral assessments. River basins are highly integrated hydrological systems, with the same water flowing and recycling through the agricultural, domestic, industrial, and environmental sectors.

Structures for policy-making and implementing issues to deal with water allocation and use in a holistic manner are becoming urgent in many countries. This will be clear from the recent decision of the International Irrigation Management Institute (IIMI) in Sri Lanka to change its name to the International Water Management Institute in order to enable it to look at water problems in their totality.

Some aspects that will need integrated attention while developing a holistic approach to water management are discussed below.

• The need for water for household use and for agriculture, industry, and ecosystem conservation will have to be assessed both locally and nationally. The qualitative aspects of water should receive equal attention. While projections of global demand are useful, what matters to individuals is the local availability of water.

• Different methods of enhancing water availability will have to be promoted at the local and regional level through an appropriate mix of major, medium, and mini irrigation projects. Conjunctive use of different sources of water such as rain, river, ground, sea, and waste water will have to be promoted, as is being done effectively in countries like Israel. Computerised systems of water management and delivery need popularisation. Water Information Shops can be started in areas characterised by severe water scarcity.

• Efficient systems of water management, including equity in distribution and the control of pollution, will have to receive attention. Seasonal fluctuations in demand will have to be addressed through suitable management protocols.

• Conflicts on sharing water are likely to grow at the national and regional levels. At the local level, inter-sectoral demands will have to be resolved, and suitable institutional structures developed, for a proactive resolution of emerging conflicts. The Water Court operating in the city of Valencia in Spain for centuries now is a good example of a local initiative in resolving conflicts amicably. In the new millennium, arguments are likely to arise between the need of water for human use and that needed for irrigation. There are also possibilities of conflicts between countries, if changes in precipitation and temperature occur as a result of climate change induced by greenhouse gas emissions. The Framework Convention on Climate provides a mechanism for co-operation among countries in preventing adverse changes in rainfall, temperature, and sea level.
Technology development and dissemination have to receive high priority, since technologies are now available to harvest every drop of water and use it economically and efficiently. Local level water users’ associations can help to save and share water, based on the principles of equity and efficiency.

Public awareness, social mobilisation, and information empowerment are areas of great importance, particularly in countries where a majority of farmers operate small holdings. In India and China, for example, the average size of holding is less than one hectare. Group co-operation will be essential under conditions of small and fragmented holdings for both water harvesting and efficient use. It has to be emphasised that without equity in water sharing, collaboration in water saving will not be forthcoming.

The requisite managerial, institutional, and financial resources will have to be mobilised for achieving the above objectives. Institutional structures will be needed for demand forecasting and management, and for advice on efficient water use.

Coalitions of all concerned – scientists and engineers, political leaders, mass media, civil society, farm families, private sector industry, women’s organisations, and bilateral and multilateral donors – will have to be formed to tackle water problems on an end-to-end basis.

With every increase in population, there is a decline in per capita availability of water, a situation that can be altered only by new technologies such as solar desalination of sea water. For example, water availability per capita in India was over 5000 cubic metres (m³) per annum in 1950. It now stands at hardly more than 2000 m³ per capita. By the year 2025, per capita availability is projected at only 1500 m³. Such quantitative data alone are not adequate to get a real picture of the status of water availability. Pollution affects water quality both in rivers and groundwater. Also, there are gross inequalities between basins and geographic regions. Water markets, if they are organised in a non-exploitative manner, can help to meet the minimum household and agricultural needs.

Sandra Postel (1996) has described the problems faced in dividing waters for different uses. In a more recent paper, Mark W. Rosegrant (of the International Food Policy Research Institute) and Claudia Ringler (of the International Irrigation Management Institute) contend that re-allocation of water out of agriculture can have a dramatic impact on global food markets (Rosegrant and Ringler, 1997). Their calculations indicate that the projected reductions in agricultural water availability will be substantial by 2020 – as much as 24 percent in China and 21 percent in India. In developing countries, yield growth for all cereals will slow down from 1.20 percent to 1.07 percent per year during the period 1993 to 2020. The area decline during the same period will be from 0.29 to 0.23 percent. Rice will suffer most, since it needs larger quantities of irrigation water. Consequently, the average price of rice is projected to increase by 68 percent between 1993 and 2020.

In addition to direct impacts on agricultural production, water transfers can negatively affect business activities, fishing, and hydro-electric power generation. Under conditions of scarcity, water markets grow. They can be of benefit to those who do not own a well or any other source of water, if they function in a regulated environment where making profit out of water scarcity is unethical. Rosegrant and Ringler recommend policy reforms such as the establishment of secure water rights to users, the decentralisation and privatisation of water management functions to appropriate levels, pricing reforms, markets in tradable property rights, and the introduction of appropriate water-saving technologies. While developing public policies for specific agro-ecological and socio-economic conditions, the trade-offs among various policy options will have to be carefully considered.

Often, local solutions will have to be found to manage water scarcity. Contingency plans and alternate cropping strategies will have to be developed for different water availability situations. Irrigation methods to save crops will help to optimise yield under conditions of...
water scarcity. Most of these methods will require the active co-operation of all the families residing in a watershed. Management procedures relating to inter-sectoral availability of water should keep in view the needs of women, who are mostly in charge of fetching and managing water at the household level. Hence, the gender dimension should be internalised in all technological and policy issues relating to water. The major components of a National Water Security System are indicated in Figure 2.

**Global Water convention**

Trends in water consumption indicate that demand for water for household and industrial uses in developing countries could double as a proportion of total water demand in the next 25 years. Scope for expansion of water supply will, at the same time, be limited because development of irrigation and urban water supplies is becoming increasingly expensive, and often involves high costs in terms of environmental degradation and human resettlement. Without fundamental reform of water management, the rapid growth in urban water demand will require large transfers of water from irrigated agriculture, thereby threatening food security. Hence, water supply and demand should be managed in an integrated fashion, simultaneously considering all uses and sources.

How can we accomplish this objective? At the global level, several initiatives have been taken in recent years such as the organisation of a Global Water Partnership and a World Water Council. At a meeting held in Valencia in Spain in December 1997 under my chairmanship, the participants recommended the establishment of an International Water Centre for undertaking research, analysis, appraisal, information dissemination, training, and consultancy activities. Such a centre could also specialise in water laws and help in resolving water disputes through proactive analysis and information. It was felt that a new age instrument for promoting sustainable water security in the world is urgently needed.

While global mechanisms and institutions are important, it is essential that every country sets up institutional structures to deal with national and local level problems. International conflicts over water are often precipitated by a failure to meet local,
provincial, national, and regional water demands. An institutional structure for dealing with the multiple dimensions of water management at the country level should be established to look into issues like legislation and regulation, technology development and dissemination, networking institutions, social mobilisation, allocation problems and structures for conflict resolution, economic policies (water charges, pollution fees, etc.), and procedures for gender and social equity. This organisation could be called the National Water Trust instead of the commonly used term National Water Authority, to emphasise that water management should be carried out in a trusteeship mode. We must consider ourselves as trustees of water sources and not as owners. This will help to instil the sentiment that management of water should not only be in the interests of the present generation but also of the generations yet to be born. Provincial and local level units of the National Water Trust can be organised, according to needs. The National Water Trust will serve as the hub of a grid of institutions, including policy-making bodies, and will thus be the flagship of a national system for sustainable water security. One of its urgent tasks will be the conservation, sustainable use and equitable sharing of benefits. The programmes and priorities of the National Water Trust should be rooted in the principles of ecology, equity, economics and employment generation. This is the pathway to achieving the goals of “water for all and for ever”.

Once Community Food and Water Security Systems and National Water Trusts are established there could be a legally binding Global Water Convention on the model of the Global Conventions on Climate and Biodiversity. The details of such a Global Water Convention can be finalized at one of the future Stockholm Water Symposia. Since agriculture is a major consumer of water, every effort should be made to improve the efficiency of water use in all farming systems. Also, efforts should be made to widen and diversify the food basket, since at present global food security is determined by too few crops (Figure 3). Many of the millets and legumes require much less water for producing a kg of grain than crops like rice. Both the principles of ecology and economics will be satisfied if high value but low water requiring crops are grown in areas where water is a limiting factor.

There are uncommon opportunities today for a water-secure world. Achieving sustainable global water security will be possible only if the two principles of M K Gandhi mentioned at the beginning of this paper are adhered to by both people and nations.

Figure 3 Global production of food crops – 1996 (from Mann (1997), FAO).
References


