

Sustainable Water Management and International Trade Solution

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Abstract

All the factors of production are not uniformly distributed among all the countries of the world. Some countries have more of some factors relative to other countries. Natural resources are free gift of nature and these resources are also not equally distributed among all countries of the world. For some countries water is scarce than other and some commodity relatively less water is required for production. Due to this difference in production technique and relative abundance of water resources international trade can take place. Studies in virtual water trade are of recent origin. Water has dual role in international agricultural trade. It is responsible for huge export earnings but at the same time is a loss of scarce water through trade. This is relevant for adopting appropriate policies for sustainable agricultural growth.

Key words: Water, sustainable development, growth, pollution, management, demography

1. Introduction

The crisis of water has been a serious problem not only in India but in most of the countries of the world. We all know that “water is life” but we are not serious about planned use of water. As a result the whole society is facing a serious crisis for maintaining regular needs of life. It is a fact that water is not only the essential ingredient of all living beings but also highly essential component for our irrigation, technology, industry, urbanization and so on. An intensive discussion has been made in this article about water resources its uses and crisis and their effects on the society. The water is used for many purposes, such as drinking, domestic, irrigation for agriculture, industry, urbanization, plantation cleaning, cooling, gardening, livestock management thermal- power generation, hydro-electric generation, nuclear- reactor etc. However due to the unplanned use of water resources day by day a serious crisis has been originated not only in India but also in many other countries. It is a threat for survival of human society that life will not stay for a long due to the scarcity of water. Hence it is very crucial to develop a scientific plan of water use with a view to sustainable management of water resource. Management of shortage of water and management of water pollution are complex task. These issues have drawn the attention of the developed and developing countries as well as the various national and international organizations including the Johannesburg Summit 2002, Year 2003 has been declared as year of Fresh -Water.

2. Sustainable development

Sustainable development is a pattern of resource use that aims to meet human needs while preserving

the environment so that these needs can be met not only in the present, but also for future generations. The term was used by the Brundtland Commission which coined what has become the most often-quoted definition of sustainable development as development that “meets the needs of the present without compromising the ability of future generations to meet their own needs”. It is usually noted that this requires the reconciliation of environmental, social and economic demands - the “three pillars” of sustainability. This view has been expressed as an illustration using three overlapping ellipses indicating that the three pillars of sustainability are not mutually exclusive and can be mutually reinforcing. Sustainable development ties together concern for the carrying capacity of natural systems with the social challenges facing humanity. As early as the 1970s “sustainability” was employed to describe an economy in equilibrium with basic ecological support systems [Wikipedia]. Sustainability is a dynamic concept born out of the environmental debate of the last quarter century. The important issue of the 21st century is to create greater economic and social well being without harming our environmental resources. Sustainable development is a norm has been accepted in the literature ever since the publication of the Brundtland Commission report on 1987. A primary goal of sustainable development is to achieve a reasonable and equitable distributed level of economic well being that can be perpetuated continually for next generation.

Thus the field of sustainable development can be broken into three constituent parts i.e. environmental, economic and social sustainability. It is proved that socio- economic sustainability is depended on environmental sustainability because the socio- economic aspects, like agriculture, transport, settlement, and other demographic factors are born and raised up in the environmental system. All the environmental set up is depended on a piece of land where it exists. So, to get sustainable environmental management, sustainable land management is necessary.

3. Water as a Scarce Resource

Water is a renewable natural resource and is a free gift of nature. In the early days the supply of water was plenty in relation to its demand and the price of water was very low or even zero but in course of time the scenario has totally changed (Bairagya R. and Bairagya H., 2011). Water is a prime need for human survival and also an essential input for the development of the nation. For sustainable development management of water resources is very important today. Due to rapid growth of population, expansion of industries, rapid urbanization etc. the demand of water rises many-fold which is unbearable in relation to its resources in the earth. If this situation continues it would an alarming threat for the human society that life will not exist in the earth for more than two hundred years due to the scarcity of this resource. It would also be surprising for our future generation that they will have to pay price higher for water than for diamond. This paper intends to develop a scientific plan of water use with a view to sustainable management of water resources.

Over the last two decades total population in the industrialist countries have increased by 28%. These countries are facing many problems such as environmental degradation, over dependence on non-renewable sources, of energy, declining standard of living. Developing countries are facing the problems more acutely compared to the Developed countries. A great deal of harm has been done to the agriculture sector due to the scarcity of water. Due to the exploitation of natural resources a rapid ecological changes are taking place and traditional water born diseases such as cholera caused by unsafe drinking water and lack of environmental hygiene. Our common future can only be achieved with a better understanding of our common concerns and shared responsibilities. The United Nation predicts two thirds of the world population will experience water shortage by 2005 affecting 1.8 billion people and by 2050 affecting 7 billion people. Water scarcity forces people to rely on unsafe drinking water which causes many water born diseases like cholera, typhoid, dysentery etc. The per capita availability of fresh water in the country has dramatically fall. The minimum acceptable level were 5,180 cubic meters in 1951 and 1,820 cubic meters in 2011 and it will be predicted that it will drop to 1,340 cubic meters by 2025 and 1,140 cubic meters by 2050.

4. Water Resources in the World

Most of the nations have a fair estimate about their natural resources like oil and minerals but they neglect to estimate their water resource potentials. The modern day tragedy for water scarcity lies in the negligence of this life saving scarce potential and unplanned use of this resource. The United Nation estimates that 97% of the total volume of water on the earth is in the form of salt water and only 03% (Table-1) is fresh water. Fresh water is distributed globally in various forms on the earth (Table-2). The United Nations Organisation predicts two thirds of the world population will experience water shortage by 2005 affecting 1.8 billion people and by 2050 affecting 7 billion people. Water scarcity forces people to rely on unsafe drinking water which causes many water borne diseases like cholera, typhoid, dysentery etc. The per capita availability of fresh water in the country has dramatically fallen.

5. Various facets of water use

5.1 Water resource and consumption in India

Consumption of water in a country depends upon many factors like its geographical position, number of population, climate, type of agricultural production, industry etc. The important water consuming countries in the world are China, India, USA, Japan etc (Datt Ruddar and Sundharam K.P.M. 2009). The pattern of water consumption in India (Table: 2) is for Agriculture 76.00%, for Power generation 6.25%, for Industries 6.25%, for Domestic use 4.70% and for Transport and others 6.80% (Table-3).

It is a fact that about 17% of total world population lives in India which occupies only 2.4% of geographical land area. If the current growth rate of population (2.11% per annum) continues it will exceed China by the year 2030. On the other hand India occupies only 4% of the fresh water resources. Hence for India the scarcity of fresh water is a more acute and alarming problem compared to other countries.

5.2 Water use in Irrigation

About 70% of Indian population are primarily engaged in agriculture which is the primary source of income to maintain their livelihood. Indian agricultural production is the gambling of rainfall. To raise agricultural productivity various dams have been made in an unplanned way which have adversely affected to the commons and the environment. To control flood and supply irrigation water the construction of big dams have rarely helped. In villages for irrigation many tube-wells and submersibles have been installed in an unplanned way (it should not be bored less than 1000 feet) which use the ground- water in a massive scale and consume a huge amount of electricity. As population raises the scarcity of food grains rises. Food scarcity is highly positively-correlated with water scarcity. According to Lester Brown, "Water shortage may soon become food shortage". Rice, wheat and sugar-cane together constitute 90% of total water consuming crops. From the economic point of view, return of water in industrial sector is many times more attractive than in agriculture. Approximately 1000 tonnes of water is required to produce only one tone of wheat. This monetary return is much lower than if this water is invested in industrial sector. It is expected that total ground water requirement for this irrigation will increase by 50% from the year 2000 to 2050. In this case the non-food grains like fruits, vegetables and animal products for daily food intake should be raised as a substitutes to rice and wheat. The per capita availability of fresh water during the period 1951 to 2050 will fall from 5,180 cubic meter to 1, 140 cubic meters.

5.3 Water use in Industry

In proportion to the rise in population the demand for industrial products raises many- fold. Agriculture based industries like textile; sugar and fertiliser are among the top most users of waste water and they withdraw ground water beyond recharge capacity. During the period 2000 to 2025 it is expected that the use of fresh water by this sector will increase by 3 times. Due to rise in standard of living the demand for not only the essential products but also luxury commodities like motor- vehicles, air conditioners, cars, TV, fridge, medicines, mobile phones, transport, telecommunication, cosmetic products.etc. raises many-fold. To meet this present rising demand various plants, factories, (may be small, medium or large) have been established which not only use huge amount of water but also create pollution. In case of nuclear reactor huge amount of water is used. The industry which uses plenty of

fresh water resources should efficiently and effectively use this valuable resource.

5.4 Water use in Urbanization

Rapid growth of urbanization is also an important factor for water scarcity. It requires more ground water for construction of new buildings, municipal water supplies for drinking and domestic purposes. In some cases there is wastage of valuable resources by misuse of water through open taps which are not properly maintained that has also created serious crisis. High excessive distribution losses of treated water in municipal water supply system and also high rate of evaporation losses make the crisis more acute. Due to higher wage rate and better standard of living and to avail all other facilities in the town, migration from rural areas to urban areas makes the problem more acute.

6. Policy measures

6.1 Rain Water Harvesting

To reduce urban wastage of fresh water the following steps can be taken. Here the rain water harvesting during monsoons may be properly used (Jha B. M. and Jain R. C., 2010). It is the storing and collection of rain water that runs-off from top of roofs, parks, roads and also opens space. This stored water may be used for drinking (after modification), house-hold use, and live-stock, construction of new buildings or even in irrigation. The rain water harvesting system also reduces power consumption. It is the simplest alternative way of recharging ground water which is extracted in a massive way. But unfortunately, the rain water harvesting system is partly failure due to uncertainty of rainfall simply because of pollution. At the same time a social awareness should be created not to waste water by any way like municipal taps and the household use.

6.2 Controlling Pollution

Due to various pollution and global warming the amount of average temperature is increasing and the amount of average rainfall is falling day by day (Goswami, U. A. 2010). As a result the dependency upon ground water for irrigation, industry, urbanization and for domestic use has increased many- fold (Kundu, A. 2009). This shows that water crisis arises due to various pollutions in a cyclic manner. Thus pollution control may be an alternative way to reduce the withdrawal of ground water. Due to increase in temperature the amount of ice in the glaciers has drastically fallen raising the sea level and some countries will be immersed under water and on the other hand the rivers, lakes and springs which are filled up by melting ice supplying water throughout the year will be dried up during summer and finally create water scarcity for irrigation and drinking purposes. It is a fact that as temperature rises the evaporation of water also raises which, in turn, increases the rain-forming cloud. But in this case the distribution of rainfall is very uneven and this random amount of rainfall (like rainfall in Leh) is not effective for the purpose of utilisation.

6.3 Plantation

Plants have the capacity to reduce CO₂ in air which, in turn, is responsible for global warming (Balasubramanian, K.V. 2010). Conservation methods like forestation, reforestation and ban on deforestation will bring rain forming cloud. Apart from that roots of plants will hold water and conserve soil. Conserving land and water in an integrated manner will be more effective than conserving them separately. The use of vermicompose and other bio- fertilisers helps to increase the organic matter in the soil which, in turn, increases the water holding capacity of the soil. This will finally reduce the total water requirements for agriculture and create less dependency upon the withdrawal of ground water.

6.4 Sustainable use of water in agriculture

Various ponds, tanks and reservoirs should be made which will be filled in the rainy season and will supply irrigation water. Various fruits and vegetables should be cultivated on the pond side and pisciculture should be practised in the pond water which will also be used for irrigation purpose. Hatchery, Ducery and Piggery may also be cultured in the pond side and their waste product may be

used for fish seeds. In this eco-friendly way the water should be used for many purposes simultaneously (Fig.-1). In a deserted land like Rajasthan various *Tanka* (i.e. small circular or square underground tank constructed with lime mortar or cement plaster) may be filled up by run-off water and may also be used for rain water harvesting system as well as domestic purposes.

6.5 National Action Plans for Sustainable Water Management

A National Water Mission has been established for water resources management to conserve water, minimizing wastage, recycling of waste water, use of improved technology using minimum water resources, recharging of underground water source, adoption of water neutral technology in a large scale irrigation programme, encouraging rain water harvesting system and use of water resources for multiple purposes. To save the rivers from water pollution recycling of urban waste water into the river like the Ganga and the Yamuna Actions plan. Ruthless ground water withdrawal in greater amount is done before waste is discharged than the recharge of water is the main cause of water shortage in India. Dug wells and ponds should be the most important source of irrigation water in the drought areas. For efficient utilization and effective management of water resources the 11th plan estimated a total investment of Rs.80, 000 crore.

6.6 Implication in International Trade

All the factors of production are not uniformly distributed among all the countries of the world. Some countries have more of some factors relative to other countries. Natural resources are free gift of nature and these resources are also not equally distributed among all countries of the world. For some countries water is scarce than other and some commodity relatively less water is required for production. Due to this difference in production technique and relative abundance of water resources international trade takes place. Studies in virtual water trade are of recent origin. Water has dual role in international agricultural trade. It is responsible for huge export earnings but at the same time is a loss of scarce water through trade. This is relevant for adopting appropriate policies for sustainable agricultural growth.

For policy implication the scarcity of water can be applied in international trade-theory. For example we consider two countries, say A & B and two crops, say X & Y. Moreover it consider country A is relatively water-abundant and country B is water-scarce and crop-X is more water-intensive than crop Y i.e. for production of one unit of crop Y requires more water than crop X. In this situation country A will produce and export X and import Y and country B will produce and export y and import X to gain in comparative advantage in international trade and specialization in production. This is shown in the table- 3.

6.7 Integrated Water Resources Development and Land Management

Water resource management and development efforts in the country recognize the inter-relationships between water and land use. Various schemes are being implemented on an integrated watershed basis with agencies such as Damodar Valley Corporation, Krishna Godabari Commission, Brahmaputra Board, Narmada Control Authority, Upper Yamuna River Board etc (Uberoi N.K. 2010). The National Water Policy identified multi-stake-holder involved in an integral part of all water resource development programmes. Various research institutes and organizations have been undertaken by the Rural Development Programme and capacity building programmes on different subjects ranging from resource assessment and conservation to better operational technology. In spite of that a significant portion of population is still without access to safe water and sanitation. There is inequitable access to water services within the country and the high levels of water pollution.

The definition of sustainable land management calls for integrating technologies, policies and activities in the rural sector, particularly agriculture, in such a way as to enhance economic performance while maintaining the quality and environmental functions of the natural resource base. Five criteria, called the pillars of SLM, were identified: security, productivity, protection, viability and acceptability. The objective of sustainable land management is to harmonize the complementary goals of providing environmental, economic and social opportunities for the benefit of present and future generations,

while maintaining and enhancing the quality of the land (soil, water and air) resource. Land provides an environment for agricultural production, but it is also an essential condition for improved environmental management (source/sink functions for pollutants, transmitting and purifying water as part of the hydrologic cycle, etc. these criteria are particularly important in assessing the impacts of agricultural management in rural landscapes. Agriculture is often cited as being part of the environmental problem, and it is recognized that agricultural land use systems are often significant contributors to pollution and environmental degradation.

6.8 Pricing Policies of drinking water

The price for water use in different sectors is fixed by the state governments and varies from state to state. Typically, water rates for agriculture and domestic consumption do not cover even the working capital cost of providing the service. In the irrigation and urban sectors, the percentage recovery of working expenses through gross receipts in recent years is only 10% and 30% respectively (Ranganathan, M., Kamath, L. and Baidur V. 2010). The subsidy regime has on the one hand encouraged inefficient use of the resource and on the other, led to poor financial health of the sector, resulting in poor services and user dissatisfaction. If the water is supplied by the government in a free of cost or even low price like other public goods the wastage of this valuable resource may increased. High price for water (i.e. like private good) is needed for efficient utilization of it and to reduce the wastage of this resource.

7. Conclusion

The earth is full of two thirds of its own volume with water resources. But the existence of living being is a serious question due to the scarcity of water. The great scientist Stephen William Hawking suspects that human being will exist on the earth near about 200 years more. The tragedy is not only true for the present but also for the future generation. So we have to be aware that to save life we have to save water. We have to proceed for the sustainable development with cost effective and efficient management of these scarce resources. In case of nuclear reactors a huge amount of water is used in an unplanned way. This waste must be controlled on a worldwide scale. Every person should be advised to save water to save him and for next generation. Thus to save this valuable life saving water resources all the nations have equal responsibility. If we do not take the water crisis on a global basis it will be a global threat to us for our existence. Each Govt. has to take some initiatives by taking some policies and banning on withdrawal of ground water up to a limit and recharge of water as much as possible. Moreover all the nations of the world have to work in a united manner for research on eco-friendly development and sustainable management of water resources. Indian government is planning to access sanitation to improve health to all in a sustainable manner within the year 2015.

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Tables and Figure:

(Table-1) The Total Volume of water on the Earth:

Salt water	97%
Fresh-water	3%

Source: UNO, 2008

(Table-1) The Global Distribution of fresh-water (cubic km.)

Ice	2,40,00,000
Ponds, Lakes & Reservoirs	2,80,000
Streams & Rivers	1,200
Ground water	60,000,00
Total	62,42,81,200

Source: UNO, 2008

(Table-3) Water consumption pattern in India

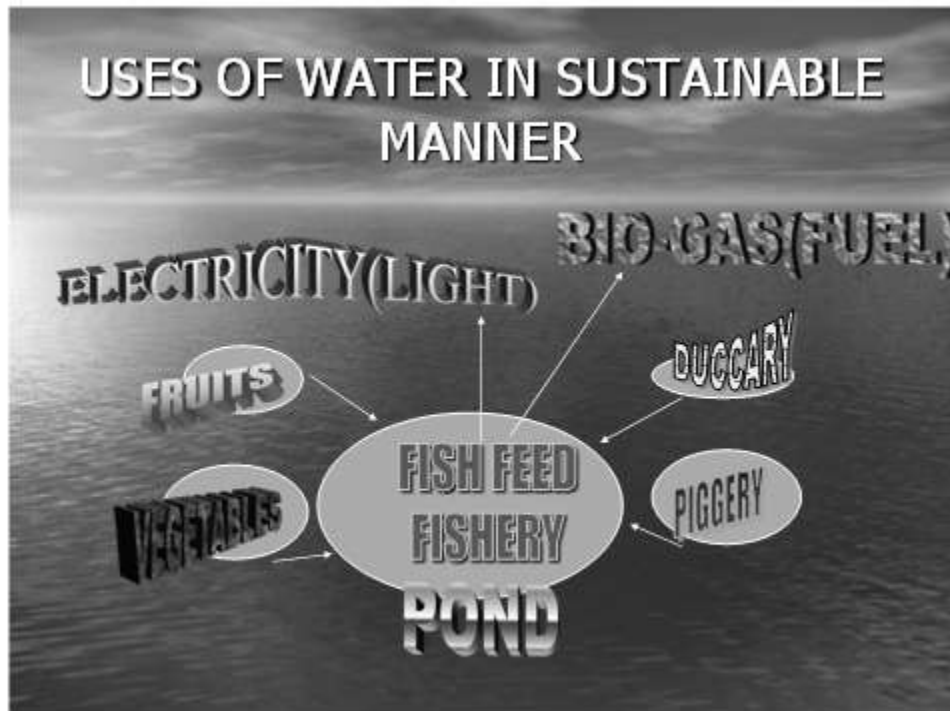
Agriculture	76%
Power Generation	6.25%
Industries	6.25
Domestic Use	4.7
Transport & others	6.8
Total	100%

Source: UNO, 2008

Table-4 (Two-commodity, two- country model)

Country	Export	Import
A	X	Y
B	Y	X

Figure-1



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