Virtual Water – A Tool For Addressing Competing Water Demands

Vivek Kumar Bhatt
Assocociate Professor, MP Water and Land Management Institute, Bhopal, India

Dr. J.S. Chouhan
Professor and Head, Department of Civil Engineering, Samrat Ashok Technological Institute, Vidisha, India

KEYWORDS
Virtual Water, Agriculture, Water Use efficiency, Agroclimatic regions, System efficiency

ABSTRACT:

Virtual Water has been defined as the water embedded in production of a commodity or service. Traditionally agriculture has been the largest consumer of water. With the growth in the economy a sharp increase in water demands from other sectors has been witnessed in the recent past. Agriculture accounts for about 80-85% of consumption of water resources in most of the developing states in India, including Madhya Pradesh. This includes water used in crop production by evaporation, transpiration, conveyance and field application. Water being a limited resource, is gradually becoming an economic good. Consequently, agricultural water demand is facing an acute competition from other sectors like drinking, industrial etc. Due to inefficient use of water on account of wastage, the water content embedded in production of commodity in account of related processes of production is large. By introducing suitable interventions for improvement in production processes, a large amount of embedded water may be unlocked which may be used for fulfilling competing demands from other sectors of economy.

This paper attempts to examine related aspects of virtual water content in agriculture sector and its role in addressing competing water demands arising from different sectors. The savings resulting from efforts for efficient use of water, both hardware and software, including technological, managerial and policy interventions in agriculture will help in reducing virtual water content of agriculture products. This in turn, shall increase water availability for other sectors of economy that are posing competing water demand to agriculture sector ensuring balanced regional development.

1. INTRODUCTION

The Indian economy was traditionally known as agrarian economy. The agriculture is of fundamental importance in India's economy contributing about 20 – 21% of gross domestic product (GDP) and generates two third of the employment.

With the economic liberalization initiative in the last decade of 21st century, India is a fast developing economy now. The economic growth in India shows contrasting patterns before and after the economic liberalization. India's per capita Gross Domestic Product (GDP) increased at 1.9% annually in the pre-liberalized economy (1961–1990) and at 3.8% annually thereafter.

As per a report by IWMI, "India's per capita income will increase at 5.5% annually over the next 50-year period. At this rate, the GDP will increase at 6.8% annually from 2000 to 2025, and at 6% annually from 2025 to 2050. The per capita GDP will increase from $463 ($1.00=Indian Rupees 33.45 in 1995 prices) in 2000 to about $1,765 by 2025 and to about $6,735 by 2050. We also assume that the contribution from the industrial and the service sectors to the overall economic growth will continue to increase. By 2050, the GDP of the industrial sector will contribute to about 40% of the total GDP."

It is estimated that the population of india will surpass that of China well before 2025. Though one of the biggest challenges before the India is to manage its resources for its large population along with sustaining its economic growth for ensuring better living standards. A comparison of past trends and projections of population and GDP growth is shown in Figure 1

.

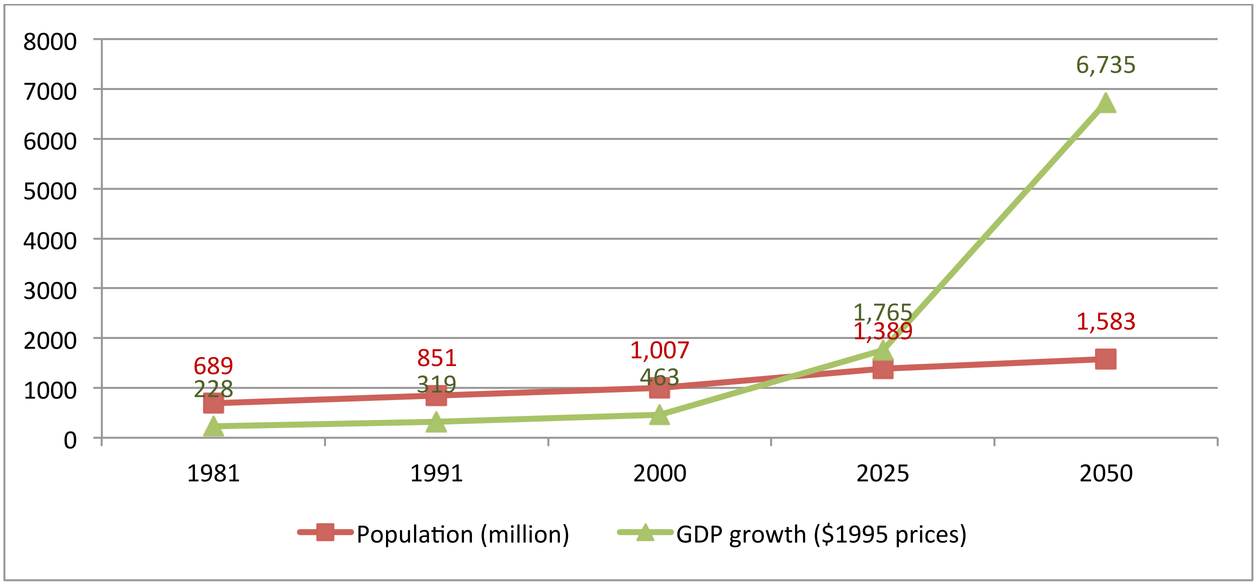

Figure 1. Comparison Of Past Trends And Projections Of Population And GDP Growth of India

It is evident that in the current century will be witnessing a higher GDP growth rate than the earlier one.

Every sector consumes water for its various activities. India is well endowed with natural resources. The water resource development is a must for economic prosperity and for enhancing the quality of life of the people. India is among the foremost countries in the world in exploiting its river water resources for conservation of water for irrigation, flood control, generation of hydro power and water supply, industrial and various other miscellaneous uses.

Industry and energy sectors are expected to give a large contribution largely in the economic growth of the country in years to come.   To feed the requirements of growing population ensuring better standards of living as well as economic growth of the country, there will be increased water requirements by different sectors.

The sector-wise projected water demand for India has been shown in the following Table 1:

Table 1. Sector-Wise Projected Water Demand For India

Projected Water Demand (BCM)	2000	2025	2050
i) Domestic	42	73	102
ii) Irrigation	541	910	1072
iii) Industry	8	23	63
iv) Energy	2	15	130
v) Others	41	72	80
Total	634	1093	1447

2. COMPETING DEMANDS OF WATER

It is clear from the table that in the years to come all the sectors will require more water. The water demand will increase by 459 BCM during 2000-2025 and further by 354 BCM during 2025-2050.The share of increased water demand by different sectors during 2000-2025 and 2025-2050 has been shown in the Figure 2 and Figure 3 respectively.

Figure 2. Share of Increase in Water Demand During 2000-2025

Figure 2. Share of Increase in Water Demand during 2025-2050

To ensure increased water availability for the desired level productions, there is an urgent need for managing this finite resource. Inefficiency in water use and irresponsibility in the management of water resources pose a serious threat to our water security and sustainability. Going forward, the availability of water could pose significant challenges for economic growth.

It is well known fact that water is a finite resource. The increased demands from one sectors poses a pressure on water available to all the other sectors competing with demand of water. In terms of usage of water, agriculture is the largest consumer, accounting for almost 85 per cent of the total water consumption however irrigation has a low water use efficiency of about 30%-35%. At the same time, agriculture is also a highly inefficient consumer of water. Thus there is an urgent need for efficient use of water for increased food production to keep pace with the increasing population and to bring more land under irrigation and multi crop farming. This will also make water available for other developmental needs.

3. VIRTUAL WATER AND AGRICULTURE PRODUCTION

Agriculture consumes water in different phases and places for crop production. Concept of virtual water can we used to understand the consumption pattern of water in the process of agriculture production. Virtual water (also known as embedded water, embodied water, or hidden water) is the amount of water that is embedded in food or other products needed for its production. Virtual water is the water used in production, rather than the water contained in the product. Water contained in the product is a fraction of the water used in production. For instance, it takes 1,300 cubic meters of water on average to produce one metric tonne of wheat. The precise volume can be more or less depending on agroclimatic regions and agricultural practices. Hoekstra and Chapagain have defined the virtual-water content of a product (a commodity, good or service) as "the volume of freshwater used to produce the product, measured at the place where the product was actually produced". It refers to the sum of the water use in the various steps of the production chain.

The agriculture production chain in irrigated projects with reference to water use is schematically shown in following Figure 4.

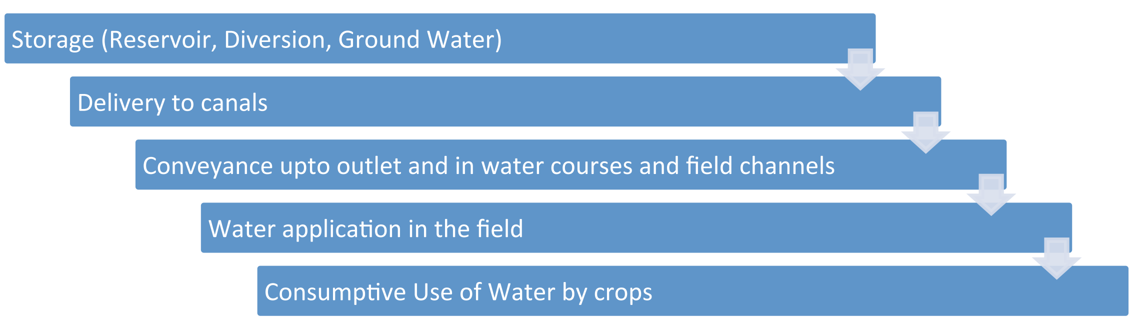

Figure 4. Agriculture Production Chain In Irrigated Projects With Reference To Water Use

Thus, at the stage of harvesting, in most of the crops, there is more than about 99 percent of virtual water. This virtual water consumption may be attributed to losses in main/branch canals/ distributaries, minors & subminors, losses in field channels and water courses and losses in field application i.e. during application of irrigation water to individual farm plots as well water lost by crop in its consumptive use which includes water used by in evapo-transpiration and metabolic activities.

The virtual water content in first four stages is may be saved by efforts for efficient use of water, both hardware and software, including technological, managerial and policy interventions related to various of agriculture production.

4. VIRTUAL WATER CONCEPT FOR WATER MANAGEMENT IN IRRIGATION

Traditionally, performance of irrigation system is judged by different efficiencies concept. These include reservoir efficiency, conveyance efficiency, field channel efficiency, field application efficiency. These efficiencies are dependent on numerous factors like evaporation, percolation in reservoir bed, leakage from structures, seepage from canal, irrigation scheduling, water application methods, attitudes of farmers, their inter-dependency in water sharing, cropping pattern, cost of energy, conjunctive use, cost of labour, etc.

The virtual water concept may be used as an effective tool for improving the efficiencies of water use. For example the virtual water content of crop resulting from conveyance phase in tradition conveyance system is about 25 to 40 percent depending on type and extent of lining, while it is 15 to 35 percent in field application stage.

Studies for assessment of water use efficiencies were carried out for 28 completed irrigation projects under the aegis of MoWR by different agencies. Main findings of studies are included (i)wide variation in the water use efficiency (varying from as low as 14% to high up to 62%. while average conveyance, on farm application and overall project efficiencies were 69%, 52% and 38% respectively. Also on-farm application efficiencies were much less than the conveyance efficiency.

Reasons for low water use efficiency or high virtual water included (i)poor or non maintenance of irrigation system resulting in growth of weed & vegetation, siltation, damages in lining etc. (ii) distortion of canal sections due to siltation and collapse of slopes (iii) Absence of lining provisions in canal reaches passing through permeable soil strata, (iv) Leakages in gates and shutters.

The virtual water content of agriculture produce may be reduced by hardware measures as well as software measures. Hardware measures include regular maintenance of canals by clearing off weed/ vegetation growth etc., restoration of channel sections to their designed sections, repair of damaged lining in canals and regular maintenance of lining, selective lining of canals in reaches passing through permeable soil strata, Lining of field channel/water courses having high losses, regular maintenance of gates and shutters to eliminate losses on account of leakages, repair / replacement of damaged gates and shutters, provide appropriate control structures in canals and distribution system, promoting volumetric supply of irrigation water to farmers, Rehabilitation & Restoration of Structures, encouraging innovations like piped distribution system network in command area, promoting micro irrigation, introducing canal automation etc.

The software measures may include Involvement of farmers in the management of irrigation water, promoting Participatory Irrigation Management practices, Training and capacity building of farmers on various issues related to correct irrigation and agricultural practices, Providing agricultural extension facilities, Appropriate pricing policy for irrigation water to avoid wastages and over irrigation, providing suitable legal framework for ensuring efficient use of water in irrigation sector etc.

Virtual water can be used as an effective tool for identifying and prioritizing regions, sectors and even items of intervention for optimum operation of irrigation projects. The water auditing concept may be useful in assessment of virtual water. Government of India, Ministry of water resources has published guidelines for carrying water audit. From the Table 1 it can easily be derived that merely about 7% reduction in additional water demand of irrigation may result in fulfilling demand of industry and energy sector in 2025 which is of the tune of about 28 of total additional projected demand. Even a marginal improvement in the efficiency of water use in irrigation sector will result in saving of substantial quantity of water which can be utilized either for extending the irrigated area or for diverting the saving to other sectors of water use.

Due to inefficient use of water on account of wastage, the water content embedded in production of commodity in account of related processes of agricultural production is large. By vigilant examination and introducing suitable interventions for improvement in agriculture production processes, a large amount of water embedded in agriculture produce may be unlocked which may be used for fulfilling competing demands from other sectors of economy. Thus virtual water can be used as an important tool in addressing competing water demands.