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VIRTUAL WATER IMPORTS IN DELHI CITY, INDIA WITH REFERENCE TO AGRICULTURE SECTOR

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ABSTRACT

The water consumed in the production process of a product is called the 'virtual water' (VW) contained in that product. Trade of real water between water-rich and water-poor regions is generally unrealistic due to the large distances and associated costs, but trade in water-intensive products is quite convincing. If a region imports a water-intensive product from another region, it imports water in virtual form. In this way, some regions support other regions in their water needs. For water-scarce regions it could be an opportunity to achieve water security by importing water-intensive products instead of producing all water-demanding products domestically. On the other hand, the water-rich regions could make profit from their abundance of water resources by producing water-intensive products for export. Virtual water trade between nations and even continents could thus ideally be used as an instrument to overcome the uneven spatial distribution of water resources across the globe and improve global water use efficiency. Virtual water trade is gaining popularity day-by-day.

With the growing population and economy, India is facing severe water crisis and its cities are not exceptions. The exponential urbanization and development in the Delhi, the capital city have put on tremendous pressure on the water resources and government is making lot of efforts to overcome it. VW import can be a useful tool which can be helpful in this direction because it will be helpful to divert its precious water resources to alternative, higher valued uses. This paper attempts to quantify the VW import volumes for agriculture products including animal-based products for Delhi. The data from January, 2010 to December, 2010 have been used in the study. Certain assumptions were made due to non-availability of some of the data. With the availability of more data, the assessment can be improved.

KEYWORDS: *Water Footprint, Virtual Water, Virtual Water Trade*

INTRODUCTION

In order to meet water demand, humankind has always modified the hydrological cycle by building wells, dams, reservoirs, aqueducts, water supply systems, drainage systems in large irrigation projects, and other structures. Governments and public institutions spend large amounts of money in implementing and maintaining such installations. Despite all efforts, approximately more than two billion people worldwide live in regions facing water scarcity. There is no shortage of water at world level, but the inappropriate spatial and temporal distribution of the resources and this imbalance can cause permanent water deficits in given regions. Trade of real water between water-rich and water-poor regions is unrealistic and next to impossible due to the large distances and associated costs, but trade in water-intensive products is quite realistic. In view of this, a new concept of 'virtual water trade' was developed as a way of understanding how water scarce region could provide food, clothing and other water intensive goods to their inhabitants.

Virtual water contained in a product can be defined as the water consumed in the production process of that product. It refers to the sum of the water use in the various steps of the production chain. Virtual water trade refers to the hidden flow of water if food or other commodities are traded from one region to another. The water is said to be virtual because once the crop is grown, the real water used to grow it is no longer actually contained in the crop. The concept of virtual water helps us realize how much water is needed to produce different goods and services. In semi-arid and arid areas, knowing the virtual water value of a good or service can be useful towards determining how best to use the scarce water available.

If a region imports a water-intensive product from another region, it imports water in virtual form. In this way some regions support other regions in their water needs. For water-scarce regions it could be attractive to achieve water security by importing water-intensive products instead of producing all water-demanding products domestically. On the other hand, water-rich regions could profit from their abundance of water resources by producing water-intensive products for export.

Virtual water trade refers to the idea that when goods and services are exchanged, so is virtual water. When a country imports one ton of wheat instead of producing it domestically, it is saving about 1,300 cubic meters of real indigenous water. If this country is water-scarce, the water that is 'saved' can be used towards other ends. If the exporting country is water-scarce, however, it has exported 1,300 cubic meters of virtual water since the real water used to grow the wheat will no longer be available for other purposes. In recent years, the concept of virtual water trade has gained weight because it helps to find out how the water resources in one region are used to support consumption in another region. Many regions import a large portion of their food supply, whether or not they are explicitly implementing a virtual water strategy. Food imports have enabled several arid regions to maintain national food security as their populations have increased, over time, while their water resource endowments have remained the same.

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The rapid urbanization, growing population and increasing water scarcity in Delhi are now well accepted facts. Serious efforts are continuously being made by various organizations to develop strategies to meet out the water demands. From public as well as private sectors different initiatives have been launched (e.g Reduce-Reuse-Recycle, Rainwater harvesting, Automated irrigation system, Anti-boring laws for ground water extraction, Rational water pricing etc.) to prevent and mitigate water scarcity for developing water sustainability. But still water scarcity is one of the major open ended challenges and issues of prime concern for the administrators and water managers of Delhi, as water is the essential obligation for living population.

STUDY AREA

Being the capital city of the country, Delhi has a distinct position in the Indian institutional system. Although, about 75% of the total geographical area (1483 km^2) is urbanized, the urban agglomeration of Delhi extends its limits out of the Delhi, with satellite towns like Gurgaon, Noida, Faridabad, and Ghaziabad, growing in the immediate vicinity of Delhi in the neighboring states of Haryana and Uttar Pradesh. The location of Delhi city is shown in Fig 1.

The climate of the Delhi is semiarid in nature. About 87% of the annual rainfall is received during the monsoon months viz. June to September. The average annual rainfall of the Delhi is about 800mm. Delhi's population grew at an annual growth rate greater than 4% during the last decade. Although the Delhi is said to be 75% urban but the 25% rural area contributes a variety of livestock presence at Delhi. The travel and transport demands of Delhi are increasing with the growth of population and economic activities.

AGRICULTURURAL ACTIVITIES

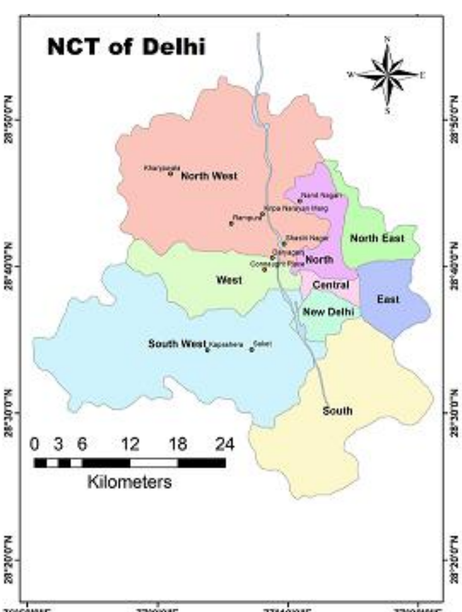

Fig 1: Location and administrative boundaries of Delhi

The agricultural activities in Delhi include (i) growing of field crops, fruits, seeds, and vegetables and (ii) management green area and forest plantations. It is altogether different from national perspective so far, as priority and contribution of agriculture and rural development in the economy of Delhi is concerned. Ever swelling population in Delhi is leading to diminishing rural areas. Further very fast growth of services sector is making agriculture and rural economic activities less attractive. As a result, the contribution of agriculture and allied activities in the Gross State Domestic Product at current prices in Delhi declined from 1.09% 2004-05 to 0.87% in 2011-12. As per Census of 2011, rural population in Delhi was 4.19 lakh (2.5% of the total population of 167.53 lakh). Around 25% of the total area of Delhi, as per 2011 census, was in rural and the remaining 75% in urban. The number of rural villages in Delhi reduced from 214 in 1981 to 112 in 2011.

Delhi is the biggest urban consumer in Northern India. The agricultural products produced in Delhi are not enough to support its population, hence, it heavily depends on the neighboring states and other parts of the country for fulfilling the food requirements of its population.

TRADING OF AGRICULTURE PRODUCTS IN DELHI

Trade and commerce have played a pivotal role in shaping the development of Delhi's economy. Trading of agricultural produce in Delhi is through a network of regulated markets. The Delhi Agricultural Marketing Board (DAMB) is the apex body established in 1977 under the Delhi Agricultural Produce Marketing (Regulation) Act 1976 which was replaced subsequently by a new Act in 1998. The Board exercises supervision and control over various agricultural produce markets and promotes better marketing of agricultural produce by developing infrastructure facilities and providing facilities for grading and standardization. At present, there are nine principal markets functioning in Delhi out of these seven are related to agriculture based products including food grains, fruits, vegetables, fodder and flowers. The map indicating location of these nine principal markets is given in Fig. 2. The details of arrival of commodities in these markets are given in Table 1.

Fig. 2: Map Indicating Location of Nine Principal Agriculture Markets in Delhi

Table 1: Annual Arrival in Agricultural Produce Marketing Committee in Lakh Tonnes

Market	Commodity	2005-06	2006-07	2007-08	2008-09	2009-10
Azadpur	Fruits	24.43	21.56	24.28	22.65	20.42
Azadpur	Vegetables	21.46	21.23	21.39	21.63	21.79
Sub - total		45.89	42.79	45.67	44.28	42.21
Narela	Food Grains	3.31	4.22	4.33	4.88	6.58
Najafgarh	Food Grains	0.84	1.54	1.49	1.35	0.97
Shahdara	Fruits & Vegetables	2.27	2.05	2.43	2.84	3.04
Keshopur	Fruits & Vegetables	2.35	2.38	2.75	3.02	2.77
Tikri Kalan	Fodder	1.13	1.01	1.09	0.52	0.37
Mahrauli	Flowers	39.81	45.78	61.16	80.18	84.84

Table 2: VW import in various Agriculture Produce Marketing Committees (APMC) of Delhi with reference to Agriculture Sector during 2005-06- to 2009-10

S.No.	APMC	Commodity	VW Imported
1.	Narela	Food Grain	6439.20 MCM
2.	Nazafgarh	Food Grain	1422.00 MCM
	Total		7861.20 MCM
3.	Azadpur	Vegetables and Fruits	12263.90 MCM
4.	Shadara	Vegetables and Fruits	358.90 MCM
5.	Keshopur	Vegetables and Fruits	935.68 MCM
	Total		13558.48 MCM
6.	Mehrauli	Flower	3117.90 MCM
7.	Tikri Kalan	Dry Fodder	692.50 MCM
		Total VW Import	25230.08 MCM
		Annual VW Import	5046.02 MCM
		Daily VW Import	13.82 MCM
		LPDC	845.19

Table 3: Annual Virtual Water Import in Delhi with reference to Agriculture Sector

Virtual Water Import due to Food Grains annually	1572.24 MCM
Virtual Water Import due to Fruits and Vegetables annually	2711.70 MCM
Virtual Water Import due to Flowers annually	623.58 MCM
Virtual Water Import due to Dry Fodder annually	138.50 MCM
Total Virtual Water Import due to Agriculture Sector	5046.02 MCM

METHODOLOGY

The virtual water transfer has been estimated by various researchers over the years. Its computation need huge amount of data related to import and export of the products to and from the region. In the present study, the virtual water import has been assessed for Delhi for agriculture products including food grains, fruits, vegetables, fodder and flowers.

The data related to import of these products to Delhi from 2005-06 to 2009-10 has been obtained use in the study which has been obtained from Delhi Agricultural Marketing Board. Other related data has been collected from various sources, published reports from various departments of government of Delhi and from other important literatures. The virtual water content related data for the agriculture sector has been use from the reports of 'Water Footprint Network' and other published literature (Delhi Statistical Hand Book, 2012; Economic Survey of Delhi 2012-2013). The VW related data is available at country level not at Delhi level, but it was used for Delhi as well. The data which was not available has been assumed (Chapagain, 2006; Doeke 2007). The virtual water import of a product in Delhi has been computed by multiplying its quantity received in Delhi by its virtual water content (Kumar and Jain, 2007; Verma and Zaag, 2007).

RESULTS AND DISCUSSION

A huge quantity of virtual water is being transferred to Delhi in the form of various goods, commodities and products etc. In the present study an attempt has been made to quantify the VW import of Delhi with reference to agriculture sector. The results of the study have been given in Tables 2 and 3 and discussed in further sections below:

TOTAL VW IMPORT

Based on the available secondary source data for the study period of five years the total VW import in Delhi due to agriculture sector has been assessed as 5046.02 MCM per annum, which is due to VW import of 32% by food grains, 52% by fruits and vegetables, 13% by flowers and 3% dry fodder. Few of the data which were not available Delhi specific have been assumed with justification, while making this assessment.

Based on the available data, it can be concluded that Delhi imports about 13.82 MCM of the VW per day in the form of agricultural products. This is actually an amount of 845.19 liters of virtual water import by each of the resident of Delhi city per day. It is much beyond that is recommended by BIS guidelines of 135 LPCD. VW studies are data intensive studies. In the present study because of limited data availability, several assumptions were made. Few of the data was not specifically available for Delhi. For those data available for India has been considered and if it was not available for India also then the global average has been used.

CONCLUSION

Many regions save their water resources by importing water-intensive products and exporting commodities that are less water intensive. Regional water saving through the import of a product can imply saving water at a global level if the flow is from sites with relatively high water productivity (i.e. commodities with a small water VW) to sites with low water productivity (commodities with a large VW footprint). The concept of virtual water has become a management tool for the efficient use of water resources and may serve to create awareness among consumers in general about their consumption of water where they use apparently a dry product, e.g. a computer chip. A rating system could be developed for labeling the products with reference to the virtual water content.

With the growing population and rapid urbanization, water consumption is increasing day by day. The study of 'Virtual Water Imports in Delhi City, India with Reference to Agriculture Sector' has been done in order to have the clear picture of import of water in Delhi from agricultural sector. The VW imports have been assessed for food grains, fruits and vegetables, flowers and dry fodder in the Delhi. The present assessment has been carried out based on the best possible available data sets related to virtual water transfer as the data of all the commodities was not available. With the availability of more data, the VW import of Delhi is expected to increase. The total VW import in Delhi due to agriculture sector has been assessed as 5046.02 MCM per annum which is due to VW import of 32% by food grains, 52% by fruits and vegetables, 13% by flowers and 3% dry fodder. The VW comes out to be 845.19 LPDC.

The results of the study will enable authorities to develop improved strategies for efficient water management. It will also help the authorities to identify the sectors/commodity with large water requirements. Virtual water trade between nations and even continents could thus ideally be used as an instrument to improve global water use efficiency, to achieve water security in water-poor regions of the world.

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