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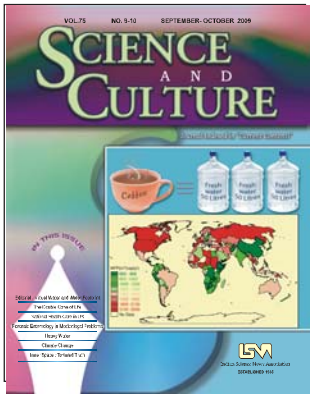
EDITORIAL

VIRTUAL WATER AND WATER FOOTPRINT



When you drink a cup of coffee in the morning, you consume 150 litres of precious fresh water of the earth without knowing. The cotton T-shirt that you are wearing is equivalent to about 2,000 litres of water wrapped around you. Sounds incredible, right? But according to Professor John Allan of the University of London, who has been recently awarded the 2008 Stockholm Water Prize, this is the amount of fresh water hidden (virtual water) in the amount of coffee you use in your morning cup of coffee. This amount of water is about double the amount an average Kolkatan uses daily for drinking and household purposes. But the amount of virtual water consumed through food and clothing is many times that amount.

Professor Allan has invented a method in estimating the amount of freshwater needed to produce different commodities, a metric he has christened 'virtual water'. This is how it works: it costs about 21,000 litres of water to produce one kilogram of roasted coffee. For a standard cup of coffee we require 7 grams of the roasted coffee, so it turns out that a cup of coffee costs about 150 litres of water. For a cup of tea of the same measure costs about 30 litres of water. Virtual water content of one kg of rice, one litre of milk and one kg of meat are 2,300 litres, 800 litres and 16,000 litres respectively. International trade reports indicate we export about 4 million kg of coffee annually, and are therefore responsible for exporting about 80 million cubic metres of virtual Indian water with it. Countries like Argentina, Brazil and US export billions of virtual water every year while countries like Egypt, Italy and Japan import billions of virtual water.

While calculation of water footprint for an individual item may be simple, doing the same for a nation is much more involved and complicated, as one needs to combine domestic water resources with the import-export of virtual water. The water footprint of a country is defined as the volume of water needed for the production of the goods and services consumed by the inhabitants of the country. Water footprint of a nation therefore is the sum of volume of water used from domestic water resources and the import of virtual water, less the export of virtual water from that nation. The average water footprint of India is about 980cubic metre/capita/year, while the global average is about 1,250 cubic metre/ capita/year. Countries with an average water footprint substantially higher than the global average are USA, Canada, France, Germany, Italy, Russia, and Thailand. USA possesses the highest water footprint (2,500 cubic metre/capita/year) while China has the lowest (700 cubic metre/capita/year). It is important to note that in absolute terms, India and China have the highest water footprint, and it is the sheer population of these two countries that reduces the relative water footprint when converted to per- capita.

The concept of 'water footprint' has been introduced recently to understand how much water people consume daily in their day-to-day lives, and is similar to the ideas of 'carbon footprint' or 'ecological footprint' that many are familiar with. To summarise, carbon footprint is a measure of the greenhouse gases we generate in our daily activities, ecological footprint quantifies the area needed to sustain people's living, and water footprint indicates the water required to sustain a population. It is an irony that while we are concerned about greenhouse gases and their impact on the environment, we are more or less oblivious to the freshwater consumption and its impact on the environment and population. In a world where one in five persons does not have any access to freshwater, and particularly when the demand on water resources in

the whole world is increasing, the concept of water footprint needs to be taken seriously.

"Water, water, everywhere—nor a drop to drink" said the poet S. T. Coleridge in the *Rime of the Ancient Mariner,* although in a different context, but it is true that only 1% of all water available on the earth is usable by humans. Of the total amount of 1,400 million cubic kilometres of water on earth, only 2.7% is fresh water of which about 69% is locked up in the form of icecaps and glaciers in polar region and about 30% is in the form of ground water, while the rest is available in lakes, rivers, in atmosphere etc. A large portion (99%) of the usable water is found underground and the rest is available in lakes and rivers. It is true that the earth is a closed system and the water cycle ensures that as a whole, it neither loses nor gains water, and so the water will never be depleted. It is jokingly said that it is quite possible that the water that you drank just now was once used by Mama Dinosaur to give her baby a bath! Critics have legitimately questioned the need to conserve water, given that all we use will be returned back. While that is certainly true for a closed system, with the dichotomy of increasing population and finite resources, resource management is important to maintain the minimum requirement of water per individual. An analogy is having inherited a fixed amount of money which can be used only for your children with the understanding that the children will eventually return the money back to your kitty. The amount of money spent per children (capita) will diminish if the number of children increases, and with more progeny a time may come when money available per capita falls below what if needed to fulfill the basic needs. To be a little conservative in using water may help to avoid, or at least delay, a future catastrophe.

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The concept of water foot print is a tool to understand how to manage water resources efficiently. For countries with poor water resources, the best bet is not only to conserve the water resources as far as possible not only by encouraging the preservation of water with efficient agricultural practices, but also by increasing the import of items with high virtual water index. For instance, Jordan has successfully reduced its water footprint by importing wheat and rice products from the USA, which has higher water productivity than Jordan. Changing eating habits to foods with lower virtual water index also helps conserve domestic water resources. Unfortunately, an appeal to renounce ingrained habits is deeply polarising, and is akin to trying to influence people to move away from fossil fuels to reduce greenhouse gases.

National, regional and global water and food security can be made better by importing water intensive commodities from places where they are more viable to produce from a resource perspective. Ironically, foods and clothing consumed by many of the developed countries come from regions where the situation of domestic water resources is unsatisfactory. Professor Allan, while studying water scarcity in West Asia, suggested importing virtual water through food and clothing to reduce pressure on the available water resources. It is interesting to note that with increased globalisation, we are not only sharing our human resources, language and culture, but also exporting or importing one of our precious natural resources.

Water footprint of a country is also an indicator of the efficiency of the nation's water management and agricultural practices. The United States and Europeans countries with better national income can afford to consume more goods and services which translate into higher water footprint. They also consume more meat than an average Indian, and hence the per-capita use of virtual water by Americans and Europeans will be understandably higher than Indians. However, it is to be remembered that the virtual water content of products strongly varies from place to place depending upon the climate, the technology adopted for farming and corresponding yields. For example, the unusually high water footprint of Thailand (2,223 cubic metre/capita/year) has been identified as the result of inefficient agricultural practices coupled with low crop yield. Internal water footprint for agricultural goods for Thailand is 1,987cubic metre/capita/year, compared to 907 for India and 565 for China.

Of the total volume of water used globally for crop production (6,390 billion cubic metre/year at field level), rice takes the largest share (about 21% of the total), followed by wheat and maize consuming about 12% and 9% respectively. The world average of virtual water content in rice production is 2,291 cubic metre/ton, which is 2,850 for India, 1,321 for China and 1,221 for Japan. Wheat

consumes much less water per ton than rice— the world average of virtual water content for wheat is 1334 cubic meter/ton. The higher virtual water content of rice is due to the high evaporative demand for the production of rice. India, China, USA, Russia, Indonesia, Nigeria, Brazil and Pakistan together contribute fifty percent to the total global water footprint. India (13%), China (12%) and the USA (9%) are the largest consumers of the global water resources.

Water is getting dearer. Population growth and rising per-capita consumption are placing increasing pressure on the availability of water resources. If the current rate of consumption continues, it is feared that two out of three people will suffer from water shortage by 2025. The essential task before us this century is better water management, since the world's total freshwater reserves remain sufficient to meet all our needs if managed well. The United Nations has declared access to water for basic human needs as a fundamental human right. However, water management requires a holistic view on water resources, water recycling, consumption pattern, efficient use and sustainable management of the water resource. Water footprint is one of the many processes for better management and can be used to make people understand simple water saving measures.

The time has now come to stop wastage of water which arises due to poor maintenance, a weak distribution system and lack of awareness among people about the value of this a precious natural resource.

The world needs to be alert about water consumption patterns, and disallow nations wasting water while others reel from water scarcity. The time has now come to stop wastage of water which arises due to poor maintenance, a weak distribution system and lack of awareness among people about the value of this a precious natural resource.

That a simple change in lifestyle can do wonders in reducing CO_2 emission and power usage has been demonstrated by Gopal Gandhi, the Governor of West Bengal as has been published in a recent newspaper report. According to the experts such voluntary actions led to six times as much saving as achieved by technological interventions.

We can no longer afford to use drinking water for washing cars, watering plants and flushing toilets— rain water or grey water harvesting from a simple roof-collector system can be used for feeding into various services other than drinking. If we are not careful today, unequal access to water may produce societal instability and lead to conflicts between nations as we observe in relation to greenhouse gases. And yes, water war has started ! As was reported last month, that a gang of farmers took up arms to guard their water fields from the other group trying to divert water towards their fields. They were ready to kill or to be killed to protect their water.❐

S. C. Roy

Letters to the Editor

Prof. M. Vijayan
President

भारतीय राष्ट्रीय विज्ञान अकादमी
बहादुर शाह जफर मार्ग, नई दिल्ली–110 002
INDIAN NATIONAL SCIENCE ACADEMY
Bahadur Shah Zafar Marg, New Delhi 110 002

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Dear Professor Roy,

I have received your letter of 20th July 2009 along with a very informative brochure giving historical introduction of the journal *Science and Culture*. I have been reading this since my young days and believe that the journal has not only disseminated information about science and culture but also contributed various aspects of developments. INSA had a very strong relationship with *Science and Culture* for a long time which was discontinued due to financial constraints. Presidents of the Academy have been expressing their thoughts through this widely circulated journal.

Incidentally I may mention that Indian National Science Academy is also celebrating its 75th year and the concluding function will be held at Kolkata where the Academy started functioning from the premises of the Asiatic Society. The concluding function will be held on 7th December 2009 which will be inaugurated by the Honorable President of India. A large number of Presidents of overseas Academies with whom INSA has collaborative relationship will attend the meeting, in addition to the Heads of the international bodies and Fellowship. Three mini symposia are organized in addition to the Blackett Memorial Lecture and various medal lectures instituted by the Academy.

I take this opportunity to invite you and the team of Indian Science News Association to attend the opening ceremony of the concluding function of the Platinum Jubilee of the Academy at Kolkata. .....

With my best regards,

Yours sincerely,

(M. Vijayan)

Professor S C Roy
Editor-in-Chief, Science & Culture
Indian Science News Associatin
92, Acharya Prafulla Chandra Road
Kolkata 700 009

❑ Tel. : 91-11-23235865 (Dir), 23235153, 23221931 - 23221950 (EPABX). ❑ Fax 91-11-23231095, 23235648
❑ E-mail : president@insa.nic.in, esoffice@insa.nic.in