Water Footprint and Public Health in Nepal

Bandana Pradhan, PhD
Associate Professor
Department of Community Medicine and Family Health
Maharajganj Medical College
Institute of Medicine, Tribhuvan University
bandana@reachpuba.org

The literal meaning of footprint is an outline or pockmark left by a foot on a surface also called *footmark*. In this paper footprint is considered in terms of requirements of an individual to live and to keep the ecosystem sustainable in the Earth. The well known ecological footprint concept was developed by Wackernagel and Rees (1996). They define it, how much biologically productive area is required to produce the resources required by the human population and to absorb humanity's carbon dioxide emission in terms of Global Hectare (GHa) per person. The average ecological footprint per person has been calculated at 2.1 GHa, which however varies from country to country. For instance, the average GHa ranges from 0.1, the lowest in Afghanistan to 11.9, the highest in the United Arab Emirates. Nepal's ecological foot print is estimated to be 1.01 GHa (Ewing et at. 2010, Chapagain et.al 2008).

The ecological footprint has two subsets, viz. carbon footprint and water footprint. The carbon footprint refers to the amount of carbon (CO_2) emitted individually per annum. A carbon footprint is usually expressed as a CO_2 equivalent (in kilograms or tonnes) in order to make the global warming effects of different greenhouse gases comparative and addable. The emission per capita varies from country to country and it has gone up to 20.4 tonnes per capita. The sustainable CO_2 emission quota per capita global inhabitants is 2 tonnes per annum and Nepal has very low emission of 0.11tonnes per annum.

The water footprint, another subset of ecological footprint, is an indicator that accounts both direct and indirect water use of a consumer or producer. Hence, water footprint of an individual, community or business is defined as the total volume of freshwater that is used to produce the goods and services consumed by the individual or community or produced by the business. People use lots of water directly for drinking, cooking, bathing, and washing and indirectly even more for producing things such as foods, paper, cotton clothes, etc. Indirect use can include virtual water embedded in tradable goods and commodities, such as cereals, sugar or cotton. A cup of coffee may use 140 litres of water while a lunch of a person may take about 2,400 litres and a pair of blue jean may consume 11,000 litres. It is quite clear that all the substances we buy or consume have water cost in the form of virtual water. The water footprint concept was introduced in 2002 by Hoekstra.

This paper intends to describe water footprint with respect to Nepal and its public health implication.

Database and Methods

Here, the concept has been discussed based on the secondary information. The water footprint for Nepal has been calculated based on the Hoekstra's (2011) water footprint assessment manual: setting the global standard. Information on evidence being gathered from the existing studies has been used to analyse the importance of water footprint in public health.

Findings

Water is the most important natural resource of Nepal. The country has about 224 billion cubic metres (km^3) of annual renewable water and the per capita water supply is 9.6 thousand cubic metres (DHM 2009). Agriculture has used major share of total withdrawal, followed by domestic and industry (Table 1).

Table 1: Water Availability and Use by Sectors, Nepal

Description		2001
1. Total annual renewable water resource (km^3/year)		224
2. Per capita renewable water resource ('000m^3/year)		9.6
3. Total annual withdrawal (Km^3/year)		18.5
4. Per capita annual withdrawal ('000 m^3/y)		0.8
5. Withdrawal (percent) from:	5.1 Domestic	3.6
	5.2 Industry	0.3
	5.3 Agriculture	96.1

Source: ICIMOD (2006)

Current annual withdrawal of groundwater is about 0.756 billion m^3 for irrigation and 0.297 billion m^3 for domestic uses (WECS 2005). Groundwater is the best alternative source of water supply, particularly in the Tarai region and Kathmandu Valley, with a potential of 12 billion m^3, of which 5.8 billion m^3 being extracted annually (ICIMOD 2006).

General uses of water footprint

The water footprint uses different types of water sources, such as:

(a) Blue water footprint – Volume of surface and groundwater consumed as a result of the production of goods or services. Consumption refers to the volume of freshwater used and then evaporated or incorporated into a product.

(b) *Green water footprint* – Volume of rainwater consumed during the production process which is being used for agricultural and forestry products (products based on crops or wood), where it refers to the total rainwater evapotranspiration (from fields and plantations) plus the water incur.

(c) *Grey water footprint* – It is the wastewater generated from the freshwater that is associated with the production of a product over its full supply chain.

Water footprints of national consumption

The water footprint of national consumption (m^3/year) is calculated by adding the direct water footprint of consumers and two indirect water footprint components such as agricultural and industrial developed for individual countries by Hoekstra et al. (2011) using the equation given below:

WFcon = WFcons, dir+WFcons, indir (agricultural commodities) + WFcons,indir (industrial commodities)

Where: *WFcom = Water footprint consumption*
WFcons,dir = Direct water footprint of consumers within the nation
WFcons,indir =Indirect water footprint of consumers in a nation

The total water footprint of the process of growing crops (*WFproc*) is the sum of the green, blue and grey components in volume per mass:

$$WF_{proc} = WF_{proc\,green} + WF_{proc,blue} + WF_{proc,grey}$$

Where

WF_{proc} = water footprint of a process
$WF_{proc,green}$ = green water footprint of a process
$WF_{proc,blue}$ = blue water footprint of a process
$WF_{proc,grey}$ = grey water footprint of a process

The process water footprint per unit of product is measured in water volume per mass. Usually process water footprint is measured in agriculture or forestry as m^3/tonne, which is equivalent to litre/kg. The global average water footprint related to consumption is 1400 m^3/yr per capita. Industrialised countries have water footprints in the range of 1250-2850 m^3/yr/capita, while the developing countries show a much larger range of 550-3800 m^3/yr/capita.

Table 2: Water footprint estimated (m^3/year/capita)

Water footprint	Average global	Minimum global	Maximum Global	Nepal
Total water footprint	1400	550-750	>3000	1300
Blue water footprint	160	5-50	>600	200-250
Green	1400	290-500	>1000	100-200
Grey	160	5-100	>1000	200-270
Consumption	1200-1400	600	3500	1000-1100

Source: Mekonnen and Hockstra 2011

Nepal has 9600 m^3 per capita water availability and 0.07 a ratio of withdrawal to long-term average annual runoff, indicating good status of water availability (Table 1). But the country's actual water withdrawal ratio is very low and its share by domestic activity is about 3%. This means that Nepal's water footprint is below the average global amount indicating low capacity of water withdrawing despite its richness in water resource.

While analysed the per capita water footprint of Nepal, the water sufficiency in terms of total withdrawal according to Hoekstra et al (2011) is not adequate. The current deficiency is about 25%, which will be increased further in the future, as the growth rate of population has an increasing trend.

In addition to determining a basic water use, water footprint has two fold benefits: it can provide a standard for comparing and benchmarking water use with other countries. Water foot print is geographically explicit, indicating the location of water withdrawal or discharge and includes both direct (e.g. water withdrawals) and indirect water use (e.g. water used to produce inputs). A water footprint measures three primary components: blue, green and gray water footprints.

The recent data shows that about 14% under five children are suffering from diarrhoea (NDHS 2011). The grey water footprint is responsible to pollute surface water as well as groundwater. It is mainly because of the lack of adequate treatment plants in the county. So, this factor can be considered as one of the underlying causes of water borne diseases including diarrhea across the country. This issue though critical has not been yet in the national priority.

Conclusion

The magnitude of the water footprint of national consumption is depended on: (a) volume and pattern of consumption, and (b) water footprint per tonne of consumed products. The water footprint for production is affected by the weather and climate of the area. The current national water withdrawal is not self sufficiency in terms of water footprint of Nepal, nor is the quality of water supply to the par of general health. Effective management of the grey water alone can reduce to a large extent the alarming rising of water borne diseases in Nepal.

References

- Chapagain, A.K. and Hoekstra, A.Y. 2008. The global component of freshwater demand and supply: An assessment of virtual water flows between nations as a result of trade in agricultural and industrial products, Water International 33(1): 19-32.
- DHM, 2009, Temperature records of Nepal. Kathmandu: Department of Hydrology and Meteorology Department
- Ewing, B., Moore, D., Goldfinger, S., Oursler, A., Reed, A. and Wackernagel, M. 2010. *The Ecological Footprint Atlas 2010*. Oakland: Global Footprint Network.
- Hoekstra, A.Y., Chapagain, A.K., Aldaya, M.M. and Mekonnen, M.M. 2011. *The Water Footprint Assessment Manual: Setting the Global Standard*. London: Earthscan
- Hoekstra, A.Y. 2002.Water footprints of nations, Value of Water Research Report Series No. 16, UNESCO-IHE, Delft, the Netherlands, www.waterfootprint.org/Reports/Report16Vol1.pdf
- ICIMOD, 2006. *Environmental Assessment of Nepal: Emerging Issue and Challenges*. Kathmandu: ADB/ ICIMOD
- Mekonnen, M.M. and Hoekstra, A.Y. 2010. The green, blue and grey water footprint of crops and derived crop products, *Value of Water Research Report*, Series No. 47, UNESCO-IHE, Delft, the Netherlands.
- NDHS, 2011. *Nepal Demographic and health Survey 2011: Preliminary Report*. Kathmandu: New ERA/ MOHP
- Wackernagel, M. and Rees, W.E. 1996. *Our Ecological Footprint: Reducing Human Impact on the Earth*. Canada
- WECS. 2005, National Water Plan Nepal. Kathmandu: Water and Energy Commission Secretariat, the Government of Nepal.