International Journal of Commerce and Management Research
ISSN: 2455-1627; Impact Factor: RJIF 5.22
Received: 22-12-2019; Accepted: 20-01-2020
www.managejournal.com
Volume 6; Issue 1; January 2020; Page No. 94-99

Water footprint: Dietary and income analysis

Namya Jindal[1], Anuradha Pant[2], Dr. Priyanka Raheja[3]
[1-3] Student Researcher, Economics Department, GD Goenka Public School, New Delhi, India

Abstract
Water, like energy, is a key input into any economy. With disparity in water availability as well as quality from nation to another, water is a local issue. Since we use international trade in goods to meet the needs of the world's populations, water is a global, collective resource. It has been warned by the United Nations that water use is growing at twice the rate of population growth. Unless this trend is reversed, two-thirds of the global population will face water "stress" by 2025. In light of this, sharing water in a sustainable manner amongst so many of us is one of the greatest challenges we confront in the 21st century. This paper tried to analyze the pattern of water footprint on the basis of income level of people and their dietary habits. To reveal the relation between income level and water footprint, correlation has been applied to the data from 2019.

Keywords: water footprints, consumption patterns, income distributions, dietary habits

Introduction
The water footprint measures the amount of water used to produce each of the goods and services we use. It can be measured for a single process, such as growing crop say rice, for a product, such as a shirt, for the fuel we put in our car, for an entire multi-national company or even for an entire nation. Water footprint and carbon footprint are complementary tools. 'Water use' is measured in terms of water volumes consumed (evaporated) and/or polluted. The water footprint of a nation has two components- internal water footprint and external water footprint. The internal water footprint measures the water used to produce goods and services consumed by the national population. Whereas the annual volume of water resources used in other countries to produce goods and services imported into and consumed in the country considered is known as the external footprint of the country. The total water footprint of a product breaks down into three components: the blue, green and gray water footprint. The blue water footprint is the volume of freshwater that was consumed or evaporated from the globe's surface and ground water resources known as the global blue water resources in order to produce the goods and services consumed by an individual or a community. The green water footprint is the volume of water evaporated from the rainwater stored in the soil as soil moisture known as the global green water resources. The gray water footprint is the volume of water polluted for the production of all goods and services for an individual or a community.

Objectives
- To calculate the water footprint of the study group.
- To find the correlation between income levels and water footprints.
- To analyze the problems pertaining to water conservation and thereby suggest measures to use water effectively.

Hypothesis
Null Hypothesis: H_0: "*There is no significant correlation between income level and water footprints"*

Alternative Hypothesis: H_1: *"There is a significant correlation between income level and water footprints"*

Research Methodology
- **Data:** The data collected is primary data as it was collected through a questionnaire circulated through social media.
- **Source of collection:** The data was collected through a well extensive questionnaire circulated through social media
- **Total number of responses:** 141 responses were collected through the questionnaire
- **Area concerned:** Since the questionnaire was routed through social media, responses were collected both from India and abroad.
- **Tools used:** Column chart and pie chart were used to represent the data. Correlation has been used to test the relation between income level and water footprints.
- **Limitation:** Though the research is unique and pioneering, but it suffers from certain limitations as data pertains to only 141 respondents and no spatial comparison has been made.

Data Analysis

Table 1: Demographic chart of respondents

S. No.	Characteristic	Category	No. of respondents	
			Total	Percentage
1.	Gender	Male	25	17.7
		Female	116	82.3
2.	Dietary Habits	Average meat consumer	38	27
		Vegetarian	99	70.2
		High meat consumer	4	2.8
3.	Gross yearly income in rupees	Upto Rs. 1 lakh	34	24.1
		Rs. 1lakh- 4 lakh	71	50.4
		Rs. 4 lakh-8 lakh	31	22
		Rs. 8 lakh and above	5	3.5

Gender

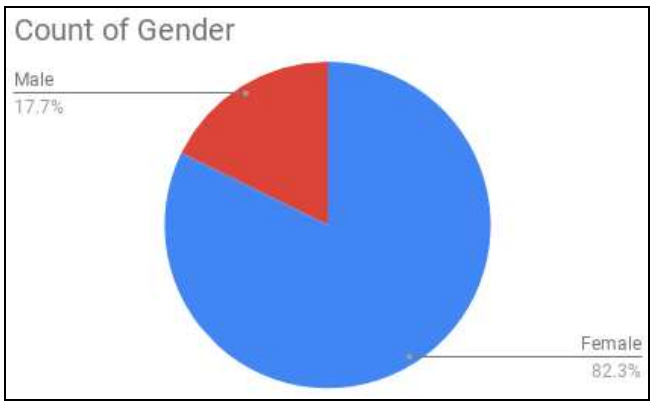

Fig 1: Gender distribution of respondents

The maximum number of respondents were females. The share of female respondents was 82.3% whereas that of male respondents was 17.7%.

Dietary Habits

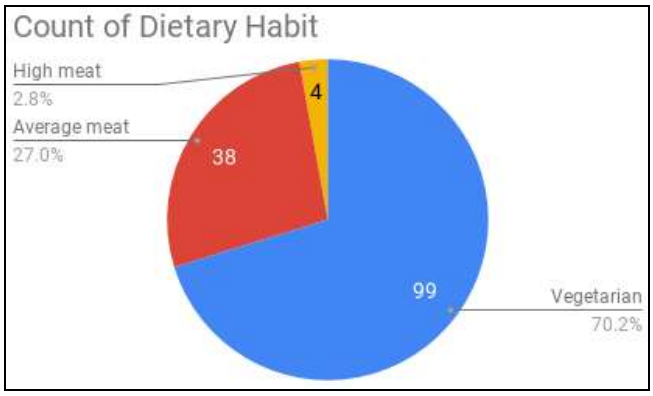

Fig 2: Dietary habits of respondents

Since food consumption gives the most important contribution to the water footprints of people, dietary habits greatly influence the associated water footprint. The maximum number of respondents were vegetarian whereas least are high meat consumers. The share of vegetarian respondents was 70.2%, of average meat consumers was 27% and of high meat consumers was 2.8%. Higher water footprint is associated with non-vegetarians as meat requires a lot more water than vegetables or fruit. About 85% of humanity's water footprint is related to the consumption of agricultural products; 10% relates to industrial products and only 5% to domestic water consumption. Within the category of agricultural products, one sub-category stands out: animal products. Products derived from animals generally have a much larger water footprint per kilogram or caloric value than crop products. In industrialised countries, the average calorie consumption is 3400 kcal per day; roughly 30% of that comes from animal products. An estimation shows that 1 kcal of animal product requires roughly 2.5 litres of water on average. Products from vegetable origin, on the other hand, require roughly 0.5 litre of water per kcal, this time assuming a reasonable mix of cereals, pulses, roots, fruit and vegetables. Since 70.2 % respondents in our case our case are vegetarians, thus it is reasonable to assume that water footprint calculated in our study are going to be less than the global standards.

Gross yearly income in Rs.

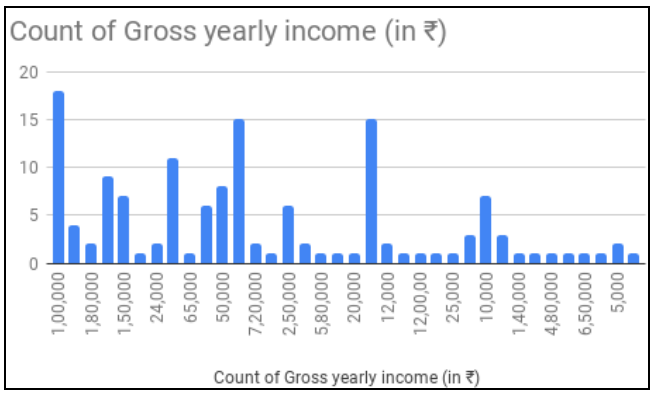

Fig 3: Gross yearly income distribution

Income is one of the four important factors affecting water footprint. The four major direct factors determining the water footprint of a country are: volume of consumption (related to the gross national income); consumption pattern (e.g. high versus low meat consumption); climate (growth conditions); and agricultural practice (water use efficiency).Rs. 15,00,000 is the maximum income earned by the respondents whereas Rs. 2000 is the minimum income earned. The mean income is Rs.34228.5 per annum whereas median income is Rs. 25,000 per annum.

Water footprint

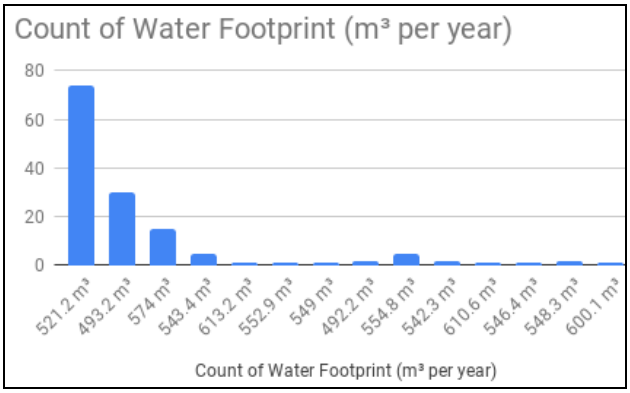

Fig 4: Distribution of water footprint

The global average water footprint is 1240 cubic meters per year per person and the same for India is between 1000-1200 cubic meters per year per person. As per our analysis the water footprint of maximum number of people is 521.1 cubic meters. The highest value corresponding to water footprint is 613.2 cubic meters whereas the lowest value is 492.2 cubic meters. The average water footprint as per the results of our study is 525.55. The result as per our study is below the global level and also below the average water footprint level of India. Reason for this could be composition of respondents as respondents are from urban areas and vegetarians. As per studies domestic usage accounts for less than 5% of India's annual water consumption, while agriculture's share is 90%.

Thus we can believe that water footprint varies from urban to rural areas and water footprint decreases with an increase in urbanization and income.

Table 2: Correlation between income and water footprints

Value of correlation	p value	Comment
-0.4357	0.00001	The result is significant at p<0.5

The correlation between income level and water footprint is found to be -0.4357. This shows that income level and water footprints bear a negative correlation. The result is significant at p<0.5 as p value is 0.00001. Hence with 95 percent confidence limit null hypothesis of no correlation between income level and water footprints cannot be accepted. Thus it can be concluded that there exists a significant negative correlation between income level and water footprints.

Though many studies confirm the positive correlation between income level and water footprints, but our analysis reveals a negative correlation. Results are statistically tested and significant. There is a reason to believe that in a developing country like India with comparatively low national income has higher water footprint as compared to any other developed nation. It is also believed that agriculture has a very high water footprint in developing nations like India. Developing countries in Asia use 80-90 per cent of the water for agriculture (leaving high water foot print) and only 5-12 per cent of the water for industrial use which highlights the inefficient use of water in agriculture and thus indicates a high water footprint for people with low income working in this sector. In spite of good rainfall distribution in last few years (besides poor rainfall in two consecutive years in 2013-14 and 2014-15), the country is struggling to make good use of rainwater and lack of awareness has been considered as a potent reason for high water footprints in lower income groups. Rising population, rising per capita income and lack of social interest for sensitive issues like water wastage and management will continue to pose challenges in front of developing nations like India until the necessary steps are taken in order to reduce this problem by some extent.

Suggestions

The task of reducing water footprint can be undertaken in various ways.

- A first way is to snap the seemingly palpable link between economic growth and increased water use, for instance by choosing those production techniques that require less water per unit of product. Water productivity in the field of agriculture can be enhanced by applying advanced techniques of rainwater harvesting and supplementary irrigation.
- A second way of reducing water footprints is to shift to those consumption patterns that require less water, for instance by reducing meat consumption. Consumption patterns influenced by pricing, awareness raising, labeling of products or introduction of other incentives that make people change their consumption behavior would contribute towards a more subtler and broader approach.
- A shift in area from low water productivity to higher water productivity, increases the global water use efficiency like it has been highlighted through the case of Jordan. Jordan has successfully externalized its water footprint by importing wheat and rice products from the USA, which has higher water productivity than Jordan.
- Reducing and offsetting of water footprint will help us move from concept to practice. All what is reasonably possible should be undertaken to reduce the existing water footprint like not going for water-using activities if better and more sustainable alternatives are available. Whereas by making investments in establishing or supporting projects that aim at a sustainable, equitable and efficient use of water in the area where the residual water footprint is located, the residual water footprint will offset.
- From the business perspective, influencing suppliers, labeling of products, benchmarking and coming up with quantitative footprint reduction targets can help in the reduction of the supply-chain and operational water footprint.
- Reducing the water footprint of public services, embedding water footprint analysis in legislation, supporting businesses to make annual business water footprint accounts and to implement measures that reduce the impacts of business water footprints along with promoting product transparency water label for water-intensive products can be done by the government.
- Forms of water governance that reduce the negative ecological and social impacts of the water footprints of communities, countries and businesses should be encouraged.
- Increasing the water footprint awareness of communities, government bodies and businesses and their understanding of how consumption of goods and services and production chains relate to water use and impacts on freshwater systems.

Annexure: List of respondents

Water Footprint (m^3 per year)	Gender	Dietary Habit	Gross yearly income (in Rs.)	gross yearly income (in $)
521.2 m^3	Female	Vegetarian	1,00,000	1406.9
493.2 m^3	Female	Average meat consumer	1,00,000	1406.9
493.2 m^3	Female	Average meat consumer	1,00,000	1406.9
521.2 m^3	Female	Vegetarian	60,000	844.14
521.2 m^3	Female	Vegetarian	1,00,000	1406.9
493.2 m^3	Female	Average meat consumer	1,80,000	2532.42
521.2 m^3	Female	Vegetarian	60,000	844.14
574 m^3	Male	Vegetarian	1,00,000	1406.9
521.2 m^3	Female	Vegetarian	5,00,000	7034.5
521.2 m^3	Female	Vegetarian	5,00,000	7034.5
521.2 m^3	Female	Vegetarian	1,50,000	2110.35
493.2 m^3	Female	Average meat consumer	1,00,000	1406.9
543.4 m^3	Male	Average meat consumer	70,000	984.83
493.2 m^3	Female	Average meat consumer	24,000	337.66

521.2 m³	Female	Vegetarian	60,000	844.14
521.2 m³	Female	Vegetarian	4,00,000	5627.6
574 m³	Male	Vegetarian	1,00,000	1406.9
521.2 m³	Female	Vegetarian	4,00,000	5627.6
521.2 m³	Female	Vegetarian	5,00,000	7034.5
493.2 m³	Female	Average meat consumer	4,00,000	5627.6
521.2 m³	Female	Vegetarian	65,000	914.49
493.2 m³	Female	Average meat consumer	6,00,000	8441.4
521.2 m³	Female	Vegetarian	4,00,000	5627.6
521.2 m³	Female	Vegetarian	60,000	844.14
521.2 m³	Female	Vegetarian	1,50,000	2110.35
493.2 m³	Female	Average meat consumer	1,80,000	2532.42
521.2 m³	Female	Vegetarian	50,000	703.45
521.2 m³	Female	Vegetarian	5,00,000	7034.5
521.2 m³	Female	Vegetarian	3,00,000	4220.7
521.2 m³	Female	Vegetarian	1,00,000	1406.9
521.2 m³	Female	Vegetarian	1,50,000	2110.35
493.2 m³	Female	Average meat consumer	6,00,000	8441.4
521.2 m³	Female	Vegetarian	7,20,000	10129.68
521.2 m³	Female	Vegetarian	8,00,000	11255.2
521.2 m³	Female	Vegetarian	2,50,000	3517.25
574 m³	Male	Vegetarian	10,00,000	14069
521.2 m³	Female	Vegetarian	5,80,000	8160.02
521.2 m³	Female	Vegetarian	4,00,000	5627.6
493.2 m³	Female	Average meat consumer	1,50,000	2110.35
543.4 m³	Male	Average meat consumer	35,000	492.42
521.2 m³	Female	Vegetarian	4,00,000	5627.6
521.2 m³	Female	Vegetarian	20,000	281.38
521.2 m³	Female	Vegetarian	6,00,000	8441.4
574 m³	Male	Vegetarian	2,00,000	2813.8
613.2 m³	Male	Vegetarian	12,000	168.83
521.2 m³	Female	Vegetarian	15,00,000	21103.5
521.2 m³	Female	Vegetarian	2,00,000	2813.8
493.2 m³	Female	Average meat consumer	2,00,000	2813.8
521.2 m³	Female	Vegetarian	4,00,000	5627.6
521.2 m³	Female	Vegetarian	6,00,000	8441.4
521.2 m³	Female	Vegetarian	2,00,000	2813.8
521.2 m³	Female	Vegetarian	3,00,000	4220.7
521.2 m³	Female	Vegetarian	2,00,000	2813.8
493.2 m³	Female	Average meat consumer	3,00,000	4220.7
521.2 m³	Female	Vegetarian	3,00,000	4220.7
574 m³	Male	Vegetarian	12,00,000	16882.8
521.2 m³	Female	Vegetarian	3,00,000	4220.7
521.2 m³	Female	Vegetarian	2,00,000	2813.8
552.9 m³	Female	Average meat consumer	15,000	211.03
493.2 m³	Female	Average meat consumer	3,00,000	4220.7
493.2 m³	Female	Average meat consumer	3,00,000	4220.7
549 m³	Female	Average meat consumer	12,000	168.83
521.2 m³	Female	Vegetarian	25,000	351.73
521.2 m³	Female	Vegetarian	2,00,000	2813.8
493.2 m³	Female	Average meat consumer	2,50,000	3517.25
521.2 m³	Female	Vegetarian	3,60,000	5064.84
493.2 m³	Female	Average meat consumer	50,000	703.45
521.2 m³	Female	Vegetarian	10,00,000	14069
521.2 m³	Female	Vegetarian	1,00,000	1406.9
492.2 m³	Female	High meat consumer	1,00,000	1406.9
521.2 m³	Female	Vegetarian	3,00,000	4220.7
543.4 m³	Male	Average meat consumer	2,50,000	3517.25
521.2 m³	Female	Vegetarian	5,00,000	7034.5
521.2 m³	Female	Vegetarian	5,00,000	7034.5
493.2 m³	Female	Average meat consumer	4,00,000	5627.6
493.2 m³	Female	Average meat consumer	4,00,000	5627.6
493.2 m³	Female	Average meat consumer	2,00,000	2813.8
543.4 m³	Male	Average meat consumer	3,00,000	4220.7
521.2 m³	Female	Vegetarian	3,00,000	4220.7
521.2 m³	Female	Vegetarian	5,00,000	7034.5
521.2 m³	Female	Vegetarian	3,00,000	4220.7
554.8 m³	Female	Vegetarian	10,000	140.69

521.2 m³	Female	Vegetarian	1,50,000	2110.35
521.2 m³	Female	Vegetarian	2,50,000	3517.25
521.2 m³	Female	Vegetarian	3,60,000	5064.84
521.2 m³	Female	Vegetarian	1,00,000	1406.9
521.2 m³	Female	Vegetarian	1,00,000	1406.9
521.2 m³	Female	Vegetarian	3,00,000	4220.7
521.2 m³	Female	Vegetarian	3,00,000	4220.7
521.2 m³	Female	Vegetarian	1,20,000	1688.28
521.2 m³	Female	Vegetarian	7,20,000	10129.68
521.2 m³	Female	Vegetarian	1,20,000	1688.28
574 m³	Male	Vegetarian	1,00,000	1406.9
493.2 m³	Female	Average meat consumer	5,00,000	7034.5
493.2 m³	Female	Average meat consumer	1,50,000	2110.35
493.2 m³	Female	Average meat consumer	1,50,000	2110.35
521.2 m³	Female	Vegetarian	50,000	703.45
574 m³	Male	Vegetarian	50,000	703.45
493.2 m³	Female	Average meat consumer	1,00,000	1406.9
542.3 m³	Male	High meat consumer	2,00,000	2813.8
521.2 m³	Female	Vegetarian	2,50,000	3517.25
521.2 m³	Female	Vegetarian	1,40,000	1969.66
521.2 m³	Female	Vegetarian	2,00,000	2813.8
610.6 m³	Male	Vegetarian	10,000	140.69
493.2 m³	Female	Average meat consumer	4,00,000	5627.6
493.2 m³	Female	Average meat consumer	50,000	703.45
521.2 m³	Female	Vegetarian	1,00,000	1406.9
493.2 m³	Female	Average meat consumer	2,00,000	2813.8
493.2 m³	Female	Average meat consumer	24,000	337.66
574 m³	Male	Vegetarian	2,00,000	2813.8
574 m³	Male	Vegetarian	2,00,000	2813.8
546.4 m³	Female	Average meat consumer	10,000	140.69
521.2 m³	Female	Vegetarian	3,50,000	4924.15
574 m³	Male	Vegetarian	2,00,000	2813.8
493.2 m³	Female	Average meat consumer	4,80,000	6753.12
521.2 m³	Female	Vegetarian	1,00,000	1406.9
493.2 m³	Female	Average meat consumer	90,000	1266.21
493.2 m³	Female	Average meat consumer	6,50,000	9144.85
521.2 m³	Female	Vegetarian	3,00,000	4220.7
521.2 m³	Female	Vegetarian	2,00,000	2813.8
492.2 m³	Female	High meat consumer	1,20,000	1688.28
543.4 m³	Male	Average meat consumer	1,00,000	1406.9
521.2 m³	Female	Vegetarian	6,00,000	8441.4
521.2 m³	Female	Vegetarian	50,000	703.45
542.3 m³	Male	High meat consumer	1,00,000	1406.9
554.8 m³	Female	Vegetarian	10,000	140.69
574 m³	Male	Vegetarian	84,000	1181.8
521.2 m³	Female	Vegetarian	4,00,000	5627.6
548.3 m³	Female	Vegetarian	5,000	70.34
574 m³	Male	Vegetarian	50,000	703.45
548.3 m³	Female	Vegetarian	5,000	70.34
554.8 m³	Female	Vegetarian	10,000	140.69
554.8 m³	Female	Vegetarian	10,000	140.69
554.8 m³	Female	Vegetarian	10,000	140.69
600.1 m³	Male	Vegetarian	2,000	28.14
521.2 m³	Female	Vegetarian	50,000	703.45
521.2 m³	Female	Vegetarian	5,00,000	7034.5
521.2 m³	Female	Vegetarian	6,00,000	8441.4
574 m³	Male	Vegetarian	3,60,000	5064.84
574 m³	Male	Vegetarian	3,00,000	4220.7
574 m³	Male	Vegetarian	2,50,000	3517.25

Annexure 2: Google form link
https://docs.google.com/forms/d/1cgFJxfkVO1tvQrTratGFB_wwFaI4iFd_iOWhp4jFWXA/viewform?edit_requested=true#start=invite

Conclusion

Controlling the global water footprint is an issue of concern and the Indian subcontinent, home to some of the most densely packed river basins in the world, is especially vulnerable in this aspect. Reducing the water footprint and its impact is a shared responsibility for all of us. As the father of green revolution MS Swaminathan appeals, Given the importance of water to human security, every nation should have a 'national water security policy' with

community participation. India should have water security policy that consists, Ground water, Surface water, Sea water, Rain Water and Recycled water.

References

1. Allan JA. Fortunately there are substitutes for water otherwise our hydro-political futures would be impossible. In: Priorities for water resources allocation and management, ODA, London, 1993, p13–26.
2. Gleick PH, (ed). Water in crisis: A guide to the world's fresh water resources. Oxford University Press, Oxford, UK, 1993.
3. Rees WE. Ecological footprints and appropriated carrying capacity: what urban economics leaves out. Environ Urban, 1992; 4(2):121–130.
4. Shiklomanov IA. Appraisal and assessment of world water resources. Water International. 2000; 25(1):11–32.
5. Wackernagel M, Onisto L, Linares AC, Falfan ISL, Garcia JM, Guerrero IS, *et al*. Ecological footprints of nations: How much nature do they use? How much nature do they have? Centre for Sustainability Studies, Universidad Anahuac de Xalapa, Mexico, 1997.