

Climate Change and Water Poverty: The Indian Scenario

Jagriti Kher¹, Savita Aggarwal² and Geeta Punhani³

1. Ph. D. Scholar, 2 & 3. Associate Professors, Department of Communication and Extension, Institute of Home Economics, University of Delhi, New Delhi (India)

Corresponding author e-mail: jagriti28@gmail.com

ABSTRACT

Climate change has become a reality, observational records and climate projections provide evidence that fresh water resources are most vulnerable. While on one hand, demand for water is increasing rapidly, on the other hand the availability of water faces serious threat from human induced climate change making it important to monitor the management of water across different regions. A water management tool, known as the Water Poverty Index (WPI), later modified to Climate Vulnerability Index (CVI) has been developed by Sullivan et.al. in 2002 and 2009 respectively encompassing various components such as water resources, access to water and its use, human capacity to lobby for water, the state of environment and the geospatial characteristics which includes climate. The present study was undertaken to quantify the climate vulnerability index for water at the household level (CVI-WH) for states and UTs in India. The study has shown that the states of Jharkhand, Bihar and Madhya Pradesh were the most vulnerable to climate and water related stresses with CVI-WH values greater than 0.61. Conversely, Goa and Chandigarh were the least vulnerable with low CVI-WH values of 0.36 and 0.37. Thus CVI-WH can be used as a tool to monitor the water stress at the regional level to determine priority needs for intervention in water sector.

Key words: Water; Climate change; Water Poverty Index; Climate Vulnerability Index;

During the past century, mean world temperature has increased by 0.74 oC and this rate is likely to increase in the near future. Such climatic changes are likely to affect all aspects of human development. Studies have shown impacts of climate change on forests, water resources, health, agriculture (food production), housing and industry (IPCC, 2007).

Observational records and climate projections provide evidence that fresh water resources are most vulnerable to such climatic changes. It is projected that rainfall in future will become more variable and uncertain leading to increased frequency of droughts and floods. At the same time, glaciers would recede at a rapid pace and sea levels would rise considerably. It is projected that glaciers in various regions of the world may suffer a volume loss of 60% by 2050 (IPCC Technical paper VI, 2008). All these would have an impact on the spatial and temporal availability of water in many parts of the world. It is also projected that water may be 20% more scarce by 2020 as compared to current availability (World Water Development Report, 2003).

Relationship between Water and poverty : Water being an important natural resource pervades all aspects

of human development. Water problems profoundly affect everyone directly or indirectly in the form of food production, domestic activities, health, and vulnerability to climatic hazards such as droughts and floods.

There is a two way relationship between income poverty and deprivation in access to water. People might lack water because they are poor or they might be poor because they lack water. Amartya Sen, the Nobel Prize Winner Indian Economist, has proposed that poverty itself is due to lack of access to different livelihood resources such as water (Sen, 1999). This is supported by the fact that almost two third of the global population without access to safe water lives on less than two dollars a day (Human Development Report, 2006).

According to the latest WHO/UNICEF Joint Monitoring Programme for Water Supply and Sanitation (JMP 2010), 884 million people in the world still do not get their drinking water from improved sources and almost all of them are in developing regions. The United Nations Conference on Sustainable development in Johannesburg in September 2002 and the World Water Forum held in 2003 have successfully drawn attention to the importance of access to safe drinking water as a

measure of poverty alleviation. The Millennium Development Goals were put forward by the United Nations in 2000 to improve the quality of life of people around the world. It is significant to note that all the eight goals are directly or indirectly water dependent (*WHO-UNICEF JMP, 2004*). Water scarcity and lack of sanitation facilities have become the key areas that need attention. Access to adequate water in equitable manner and its improved management are therefore imperative to the quality of life of a society, and for sustainable development and poverty alleviation.

Climate change and water

While on the one hand demand of water is increasing due to demographic, socio-economic and technological changes, on the other hand, the availability of water faces serious threat from human induced climate change. The rapid change that is currently taking place will leave the ecosystems vulnerable. It is estimated that water stress will increase in 62-76% of the global land area. By 2020 between 75 million and 250 million people around the globe are projected to be exposed to increased water stress (the per capita availability of water below 1700m³/capita/year) due to climate change (*IPCC, 2007*).

In India also the availability of water in the future will be different as compared to the present due to changes in the rainfall patterns. Climatic changes, associated with increasing population, urbanization and industrialization have drastically reduced the availability of water in India. It is estimated that the demand for water will rise by 20-40% in the next 20 years due to rapid urbanization, modernization and associated changes in lifestyle (*India vision, 2020*). It is projected that India will have per capita availability of water as low as 1140 m³/year by 2050 (*MOWR, 2008*). Thus on one hand, the demand for water in the country is likely to rise significantly but on the other hand the water availability is rapidly declining, thus compounding the problem.

Water Management tools to characterize water accession and management at household level

Several assessments of water resources through physical sciences and hydrological modeling are available. However, these do not link the availability of water with human resources as well as the socio-economic drivers determining capacity of people to access water and manage resources. The Human Poverty/Development Index although are very useful for assessing overall development of society, but are not able to capture entirely water related poverty

problems. A more holistic approach is needed to address the questions of water availability, and its relationship to human and ecological needs with special focus on the gender issues related to water. A water management tool known as the Water Poverty Index (WPI) was developed by Sullivan et.al in 2002. The index has been developed with a methodology similar to the Human Development Index (HDI).

In order to capture the impacts of climatic stresses and vulnerability to water availability, *Sullivan et.al., in 2009* later extended the WPI to Climate Vulnerability Index (CVI). Both WPI and CVI are holistic water management tools developed by physical and social scientists, water practitioners, researchers and stakeholders. The water management tools requires an interdisciplinary approach and is able to link physical estimates of water availability with the socio-economic drivers of household welfare at different scales ranging from a community or a village to district, region, or even national and international levels. They also indicate the degree to which climate vulnerability and water scarcity impacts human population.

Components of Climate vulnerability Index : The Climate Vulnerability Index has six components namely: Resources, Access, Capacity, Environment, Use and Geospatial characteristics. The 'Resource' component aims to capture the overall availability of water. 'Access to water' includes the access of population to safe drinking water and sanitation as well as access to water for other purposes. The 'Use' component focuses on the consumption of water at the domestic level, in industry and agriculture. 'Capacity' is the ability of people to manage water and is interpreted in terms of education, investment in the health sector and income which indicate the capacity of people to lobby for water. The 'Environment' component, combines variables such as quality of water, water stress and environmental degradation. The 'Geospatial' component describes the particular geographical characteristics of the location that make it vulnerable. Each of these components has several sub-components which are put together to generate the index value.

The Present study : Since India is a large country with wide differences across regions and states in terms of availability of water resources, the level of human development, the access of people to resources such as water, the vulnerability of people and the state of environment, assigning one CVI value does not reflect the regional variations in climatic and water related vulnerability. The present study was undertaken to

quantify the climate vulnerability index for water at the household level (CVI-WH) for states and UTs in India.

METHODOLOGY

In order to compute the CVI-WH values across states in India, a total of 21 sub-components were selected keeping the mind their suitability for the region and feasibility of obtaining data. The sub components were classified in two categories- negative indicators, and positive indicators. Variables such as percentage of households, having access to safe drinking water facilities, percentage of households having bathrooms in the house lead to better development and hence were classified as positive indicators. On the other hand, the indicators such as percent population living in slums were negative indicators. These figures were converted into index numbers by normalization method, as used for calculating Human Development Index (For detailed methodology, refer to *Sullivan, et. al., 2002*). In order to reflect the vulnerability, each index value was subtracted from one to arrive at the lack of resources, limited capacity and access to water, inadequate use of water, poor environment and climatic stresses.

An average of all these six values provided Climate vulnerability index at the household level (CVI-WH) which (as well as its components) ranged from zero (least vulnerability) to one (highest vulnerability).

The Index values of Climate Vulnerability : There was huge variation in CVI-WH values across states in India. The CVI-WH values ranged from as low as 0.36 in Goa (least vulnerable) to as high as 0.69 in case of Jharkhand (most vulnerable).

Three states namely Jharkhand, Madhya Pradesh and Bihar were extremely vulnerable, having CVI-WH values greater than 0.60. Fourteen states were highly vulnerable having CVI-WH values between 0.51-0.60. These included the populous states of Maharashtra, Uttar Pradesh, West Bengal as well as Rajasthan and Orissa. All the BIMAROU (Bihar, Madhya Pradesh, Rajasthan, Orissa and Uttar Pradesh) were either highly or extremely vulnerable to climatic and water related stresses. These states had considerable exposure to climatic and other environmental stresses, had limited ‘resources’ and human capacity leading to highly inadequate ‘access’ to and ‘use’ of water resources. Thirteen states including Haryana, Kerala and Himachal Pradesh were moderately vulnerable having CVI-WH values ranging from 0.41-0.50. These states generally

had comparatively higher level of human development and hence better ‘Capacity’ and ‘Access’ to water resources. By comparison, three states including agriculturally advanced state of Punjab, capital city Delhi and Goa as well as two Union Territories namely Chandigarh, and Pondicherry were least vulnerable to climatic and water related stresses (CVI= <0.4). Fig 1 and 2 depict their levels of vulnerability.

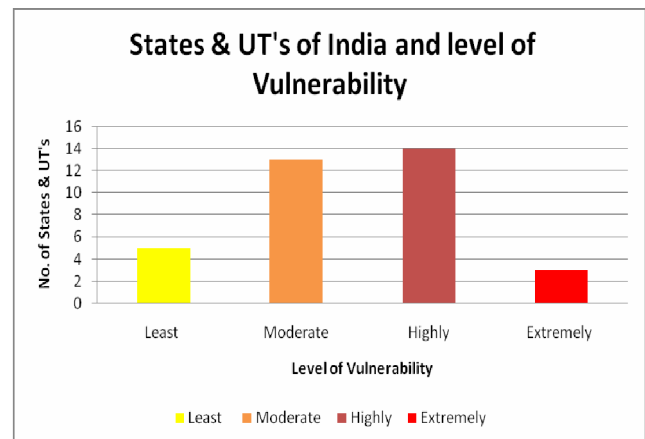


Fig 1. Vulnerability of states to climatic and water related stresses

The Household Climate Vulnerability Index (CVI-WH) for India on the whole was 0.54 indicating high vulnerability to climatic and water related stresses.

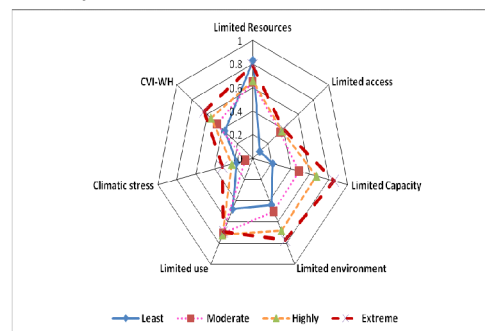


Fig 2. Differential levels of vulnerability of states to water and climatic stresses

CONCLUSION

The results show that if the climatic and water related vulnerability of different states has to be reduced, there is a need to improve the human capacity, access to and use of water resources. These are in turn are governed by the level of education, income, health and sanitation, as well as other conventional development indicators. In other words one can argue that as the overall development of the states would increase, their vulnerability to environmental stresses would decrease despite the pressure of climatic stresses. The study has

shown that in view of decreasing per capita availability of water in several parts of the world including India, due to urbanization, industrialization and climate change, CVI-WH can be used as a tool to monitor the water stress at the regional level to determine priority needs for intervention in water sector.

REFERENCES

- IPCC (2007). *Climate Change 2007. Impacts, Adaptation and Vulnerability*. Summary of the Policymakers. Contribution of the Working Group II to the Fourth Assessment Report of the IPCC (Intergovernmental Panel on Climate Change). Cambridge University Press, Cambridge, U.K.
- Lawrence, P., Meigh, J.R., Sullivan, C.A., (2002). *The Water Poverty Index: An International Comparison*. Keele Economics Department Working Paper, Staffordshire, UK. Retrieved from http://gisweb.ciat.org/wcp/download/water_poverty_index_Sullivan.pdf (September, 2010)
- Ministry of Water Resources, (2008). *Preliminary Consolidated Report on Effect of Climate Change on Water Resources*. National Institute of Hydrology and National Institute of Hydrology, MOWR
- Planning Commission (2002). *Report of the committee on India vision 2020*. Planning Commission, Government of India.
- Rupa Kumar K., Krishna Kumar, R.G Ashrit. S.K. Patwardhan and G.B. Pant. (2002). "Climate change in India: Observations and Projections." In *Climate Change in India: Issues, Concerns and Opportunities*, eds. P.R. Shukla, K. Subodh, S. Sharma and P.V. Ramana. New Delhi: Tata McGraw Publishing Company Ltd.
- Sen, A.K., (1999). *Development as Freedom*. Clarendon Press, Oxford.
- Sullivan, C.A., (2002). *Calculating a Water Poverty Index*. *World Dev.* 30, 1195-1210
- Sullivan, C.A., Meigh, J.R., Giacomello, A.M., Fediw, T., Lawrence, (2003)
- The Water Poverty Index: Development and application at the community scale. *Natural Resource Forum*. Retrieved from http://gisweb.ciat.org/wcp/download/water_poverty_index_Sullivan.pdf (Oct' 2009)
- Sullivan, C.A. and C. Huntingford, (2009). Water resources, climate change and human vulnerability, 18th World IMACS/ MODSIM Congress, Cairns, Australia 13-17 July 2009 Retrieved from <http://mssanz.org.au/modsim09> (November, 2010)
- Sullivan C. and Meigh J., (2005). Targetting attention on local vulnerabilities using an integrated index approach: the example of climate vulnerability index, *Water Science and Technology*, Volume 51, No. 5, pp 69-78, IWA Publishing 2005
- United Nations, (2005). *World Urbanization Prospects: The 2005 Revision*. Department of Economic and Social Affairs Population Division. New York, Retrieved from <http://www.un.org/esa/population/publications/WUP2005/2005wup.htm> (January, 2011)
- UNDP, 2006. Human Development Report, 2006. *Beyond Scarcity: Power, poverty and the global water crisis*, New York: Oxford University Press.
- UNDP, 2007/2008. Human Development Report 2007/2008 *Fighting Climate Change: Human Solidarity in a divided world*. New York: Macmillan
- UN/WWAP (United Nations/World Water Assessment Programme), 2003. Executive Summary of the 1st UN World Water Development Report: *Water for People, Water for Life*. New York, Oxford. UNESCO (United Nations Educational, Scientific and Cultural Organization).
- WHO/UNICEF, 2004 *Joint Monitoring Programme for Water Supply and Sanitation; Meeting drinking water and sanitation target: a mid-term assessment of progress, Water*. World Health Organization and UNICEF, 2004
- WHO/UNICEF, 2010. *Joint Monitoring Programme for Water supply and Sanitation. Progress on Sanitation and Drinking Water*. World Health Organization and UNICEF, 2010.
- World Bank. 2009. *Climate Change Impacts in Drought and Flood Affected Areas: Case Studies in India*, World Bank, Washington, DC.

