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THE WATER POVERTY INDEX: A DISTRICT LEVEL ANALYSIS OF WEST BENGAL

Dr. Parnasudha Karmodak*

ABSTRACT

Development is basically an emancipated procedure and this ability can be used to conserve, protect and improve the environment and not only to destroy it. Water, the supernatural element from which all living matters on the earth originates its existence. In the recent era water has become a matter of serious attention for both policy makers and government. Poverty implies non-acquisition of key resources. Water poverty denotes the non-acquittal of water resources. The world water Assessment program (WWAP, 2001) has defined water poverty as "the condition of insufficient water of satisfactory quality and quantity to meet human and environmental needs". Water poverty is a serious issue in India since it means a person fails to achieve the basic needs of water that is crucial for life. Recently, Water poverty has been presented as an indicator by a number of authors. In the paper, we have tried to access the Water Poverty Index (WPI) for twenty-three districts of West Bengal using National Sample survey organization (NSSO) 76th round data and District wise groundwater level report (2018-19) as published by Central Ground Water Board (CGWB) data. The index considered data on five components – Resource, Use, Access, capacity and Environment. The five components of WPI comprises of a total of twenty variables. The result displays an overall illustration of water poverty situation of the districts of West Bengal, that can probably assist the policy makers to assess the threats and to take the possible measures to overcome the situation. Water poverty Index (WPI) assembles the inappropriate issues related to water by combining the aspects of physical, social, economic and environmental and coupling water issues to poverty.

Keywords: *Water Issues to Poverty, Human and Environmental Needs, WPI.*

Introduction

Development is basically an emancipated procedure and this ability can be used to conserve, protect and improve the environment and not only to destroy it. Thus, thinking of environment simply in terms of preserving the already existed natural resources and not including the results of human creation in the environment makes no sense. For example- water purification is a process of enhancing the surroundings in which we exist. The removal of epidemic furnishes both to the development as well to environmental amplification (Amartya Sen, 2009).

According to Brundtland Report sustainable development has been defined as meeting 'the needs of the present without compromising the ability of future generations to meet their own needs'. But according to Sen (2009), visualizing individuals in term of their necessities will preferably give us an inadequate perspective of mankind. This is so because individuals have requirement but they have ethics too, specifically they nurture their potentiality to logically evaluate, select, engage and behave accordingly.

* ICSSR Post-Doctoral Fellow, The University of Burdwan, West Bengal, India.

Robert Solow in a monograph called *An Almost Practical Step toward Sustainability* (1992) has further extended the Brundtland concept of sustainability. Solow has considered sustainability as the condition that the upcoming generation must be left with 'whatever it takes to achieve a standard of living at least as good as our own and to look after their next generation similarly'. Solow's idea regarding sustainability has some interesting characteristics. Firstly, it provides incentive for conservation of the environment by emphasizing on maintaining the standard of living. Secondly, Solow has put emphasize on recursive formulation, the concerns of all the upcoming generations acquire attentiveness by the arrangements made by each generation for its descendant.

But according to Sen (2000), the very significance of human life exists not entirely in our standard of living and demand satisfaction but also in the liberation that we adore. Hence, the concept of sustainable development has to be reformed further. Therefore reformulated, Sustainable freedom can be further widened from the idea as proposed by Brundtland and Solow in order to enclose the safeguarding and when it is viable extend the scope and potentiality of today's people 'without compromising the capability of future generations'- sequentially to possess alike or better freedom.

Water, the supernatural element from which all living matters on the earth originates its existence. Its role has not changed since the formation of very existence of life on earth billions of years ago. In the recent era water has become a matter of serious attention for both policy makers and government.

Water cannot be considered as a scare resource globally. Most of the planet is covered with water and obviously cannot be scare in the aggregate. Even 2.532 percent of the fresh water on earth would be abundant if it were equally allocated. Yet, the percentage of all fresh water that is accumulated in ice-caps glaciers and permanent snow cover is 69.6. Water stored as groundwater is another 30.1 percent of which less than half is within a depth of less than 800m. only 0.266 percentage of fresh water which counts for 0.0072 percent of all water is readily available in rivers and lakes (Shiklomanov, I.A.,1933). Most of the human usable water comes from rivers. The perceptible portion of water are mentioned to as surface water. The major part of the fresh water is literally accessible from underground as soil moisture and in aquifers. Groundwater nourishes the streams; it is because of this reason that a river continues to flow unless there is no precipitation.

Thus, when talking about water scarcity we generally mean non-availability of fresh water resources. Availability problem arises when increased demand of fresh water is unable to cope up with the supply of fresh water. Now the supply of fresh water is not equally distributed over time and area and does not follow the standard human demand. In some areas and time bounds fresh water supply is abundant relative to its demand, while in other time periods and area especially in dry seasons or drought years there may be emergence of shortage of fresh water supply. Though water resources may be abundantly available, but scarcity of water is a problem when considered in terms of regional and local perspectives, especially when evaluations of the resources are considered in terms of quality and sustainability (Feitelson, Eran., Chenoweth Jonathan, 2002).

Poverty implies non-acquisition of key resources. Water poverty denotes the non-acquittal of water resources. The world water Assessment program (WWAP, 2001) has defined water poverty as "the condition of insufficient water of satisfactory quality and quantity to meet human and environmental needs". Water poverty is a serious issue in India since it means a person fails to achieve the basic needs of water that is crucial for life. Sometimes non-access to water is linked with economic and non-economic social barriers. Thus, availability and accessibility are separate terms for water poverty. There are some water bodies that are exclusive rights of upper caste people. Lower caste Dalits has no access to these water bodies. Thus, there might be extreme pockets of water poverty among social groups while plentiful for others.

Recently, Water poverty has been presented as an indicator by a number of authors. Salameh (2000) has described a ''water poverty index'' which he has defined as ''the ratio of the amount of available renewable water to the amount required to cover food production and the household uses of one person in one year under the prevailing climate conditions'' (p. 146).

Sullivan (2000) had put forward an alternative concept of water poverty proposing that it should be an aggregate index composed of percentage of water utilized in a region integrated with percentage of the population having access to safe water and sanitation, and the percentage of the population having easy access for domestic use of water. According to Dahl (1997) the aggregation of any multi-dimensional index is always accompanied with conceptual and empirical problems.

Feitelson, Eran., Chenoweth Jonathan (2002) has defined Water poverty as “a situation where a nation or region cannot afford the cost of sustainable clean water to all people at all times”.

Briscoe et al. (1993) analysis regarding willingness to pay for improved water services of rural villagers in developing countries revealed that the amount varies widely that the people are willing to pay for basic water services, and is affected by their level of income besides the features of existing supplies.

The chapter has provided the framework for calculating the ‘Water Poverty Index (WPI) in the context of West Bengal. In section II, a step-by-step procedure for constructing the index has been discussed. In section III, the application of the suggested methodology has been examined and section IV concludes the study.

Methodology for the construction of Water Poverty Index (WPI)

Sullivan (2002, p.1195) was the first to propose WPI as a combined approach of water poverty where he has defined water poverty as absence of sufficient and systematic supply of water linked with tangible evaluation of accessible to water with socioeconomic variables. She states (*ibid.* p.1197), "the development of a Water Poverty Index is intended to help [the] process of identifying those areas and communities where water is most needed, enabling a more equitable distribution of water to be achieved".

The index combines number of factors into a single index, an unique portrayal of the entire concept.

Any meaningful analysis is based on data. The present study tries to develop a new index of water poverty, the scope of the study dictates that the analysis should be broadly based on data i.e., representation of all the districts of west Bengal. It is difficult and probably impossible to generate such vast data from a primary source by anindividual researcher. It is thus almost tautological that the analysis will depend on the secondary data source, in this chapter we have considered 76th round dataset (Drinking water, Sanitation, hygiene and housing condition) as developed by National Sample survey organization (NSSO) and District wise groundwater level report (2018-19) as published by Central Ground Water Board (CGWB). A battery of indicators was sorted into five components of the index.

The methodology used by us for the construction of a water Poverty Index has been described below:

WPI requires details on five components. The five components of WPI comprises of a total of twenty variables (R1, R2, R3, A1, A2, A3, A4, A5, A6, C1, C2, C3, U1, U2, U3, E1, E2, E3, E4, E5).

The Resource (R) component considers Net availability of ground water its variability and sufficiency per household, while in the Access (A) component, access to water together with the distance tothe primary source of water and the time taken for the collection per household and other determinants are assimilated. In the Capacity component the capacity of the people in the management of water has been measured in terms of average monthly consumption expenditure, education and health. In the fourth component Use (U), measures various uses of water including irrigational, domestic and industrial purpose along with consuming treated Drinking water per household. Lastly, the component Environment (E) estimates the environmental unification associated with water and proper disposal of waste product in order to maintain a healthy ecosystem in the area. The details of the component of the Water Poverty Index (WPI) have been discussed in Table 1 below.

Table 1: Details Components of WPI.

WPI Components	Sub components or variables used
Resource (R)	• Percentage of households having sufficient water. • Percentage of households having sufficient water during dry period (March-May). • Ground water Net availability (bcm).
Access (A)	• Percentage of households with access to piped water. • Percentage of households with access to sanitation. • Percentage of households with access to latrine. • Average time taken in a day in a single trip to reach the source of drinking water (in minutes). • Average waiting time taken in a day at the source of drinking water (in minutes). • Average Amount paid per month for purchasing water.

Capacity (C)	• Average monthly consumption Expenditure. • Percentage of population aged 15 or more that are literate. • Percentage of household reporting water related illness.
Use (U)	• Percentage of total groundwater withdrawal for irrigation purpose. • Percentage of total groundwater withdrawal for domestic and industrial purpose. • Percentage of household using some methods of treatment for drinking water.
Environment (E)	• Percentage of households reusing water safely after treatment. • Percentage of households having arrangement for collection of garbage in the household. • Percentage of households not facing any problem of stagnant water in or around premises. • Percentage of households where human faeces are not visible around the household premises. • Percentage of households having arrangement of proper disposal of poultry waste.

Source: Author's Calculation.

The first step involves normalization of the raw data in order to make the data unit free. Thenormalized values are obtained considering the standard goal post method as used by UNDP.

$$X_{normalized} = \frac{X_i - X_{minimum}}{X_{maximum} - X_{minimum}}$$

where $X_{maximum}$ = Maximum value of respective component in the sample and $X_{minimum}$ = Minimum value of respective component in the sample. Each indicator (X_i) has been assigned a score between zero and one where zero represents worst value and one represents best possible value.

After normalization of all the indices chosen by us across the districts of West Bengal, we now move to assign weights to each of the sub-indices of each component in order to combine the components into a single Water poverty Index (WPI). For this we have used PCA technique.

The WPI for a particular location has been calculated as described by Sullivan et al. (2003) as presented below –

$$WPI = \frac{W1 \times R + W2 \times A + W3 \times U + W4 \times C + W5 \times E}{W1 + W2 + W3 + W4 + W5}$$

where, Wi is the Weight applied to each of five components R – Resource, A – Access, U – Use, C – Capacity, E – Environment. These weights (Wi) are constrained to be non-negative and sum to unity. For calculation of WPI, we have used balanced methodology for calculating the weights in which equal valued weight has been considered.

Empirical Analysis

The values of the WPI have been presented in ***table 2*** below across different districts of West Bengal. The average WPI for West Bengal has been presented in ***Figure 1***in which Use component is the lowest and resource is the highest. In west Bengal we have resources but we are unable to utilize it fully and effectively.

Table 2: Water Poverty Index (WPI) for West Bengal

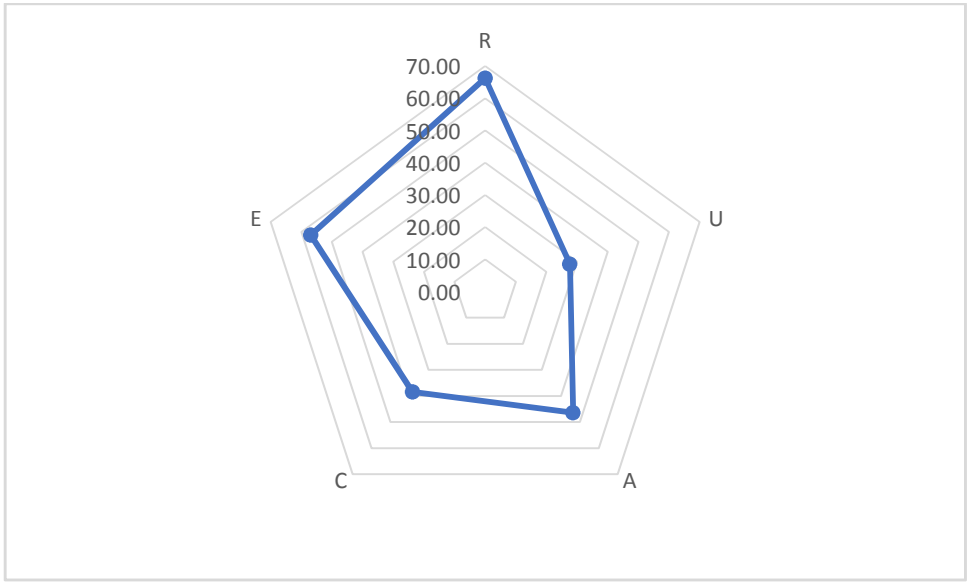
Districts	R	U	A	C	E	WPI
Alipurduar	73.09	1.67	35.60	40.13	61.81	42.46
Bankura	72.92	29.37	38.85	26.31	50.39	43.57
Barddhaman	80.52	31.92	51.27	25.46	55.43	48.92
Birbhum	82.63	26.71	19.78	33.68	52.34	43.03
Dakshin Dinajpur	30.66	27.24	33.83	24.76	54.06	34.11
Darjiling	55.29	23.14	89.27	65.33	68.62	60.33
Haora	68.12	32.97	59.52	45.61	64.47	54.14
Hugli	52.72	30.61	53.15	42.34	71.57	50.08
Jalpaiguri	90.05	30.89	59.17	22.23	59.29	52.32
Jhargram	71.35	0.96	10.93	27.49	50.82	32.31

Kalimpong	17.95	31.82	93.80	26.58	68.32	47.69
Koch Bihar	92.46	14.36	32.22	32.33	52.45	44.76
Kolkata	59.40	15.27	77.57	73.21	55.16	56.12
Maldah	65.38	35.87	22.07	40.21	45.40	41.79
Murshidabad	85.36	50.10	32.52	30.91	53.49	50.47
Nadia	89.84	52.37	59.12	37.61	49.56	57.70
North Twenty Four Parganas	72.94	65.40	66.91	58.27	75.35	67.77
Paschim Barddhaman	59.95	10.63	73.57	43.74	56.68	48.91
Paschim Medinipur	63.42	27.92	31.31	48.95	56.47	45.61
Purba Medinipur	52.42	28.39	25.20	47.91	60.05	42.80
Puruliya	41.11	25.01	34.93	21.54	25.11	29.54
South Twenty Four Parganas	64.63	5.63	53.99	35.01	72.17	46.29
Uttar Dinajpur	81.59	36.23	12.26	33.26	50.45	42.76

Source: Author's Calculation.

Figure 1: Components of Water Poverty Index (WPI)
Showing the Average Score of Each Component

R	U	A	C	E
66.25	**27.59**	**46.38**	**38.39**	**56.93**



Source: Author's Calculation

Among Twenty-three districts of West Bengal, the Resource (R) component is smallest for kalimpong and highest for Koch Bihar. Jhargram has the lowest value for use component and North 24 Pargana has the highest. Again, Jhargram has lowest access value but interestingly Kalimpong has the highest access value. Capacity component is lowest for Jalpaiguri and Puruliya districts while highest for Kolkata. Finally, the Environment component is lowest for Puruliya and highest for North 24 pargana. Moreover, resource component has got the highest value as compared to all other components among the twenty-three districts of West Bengal and Use component has the lowest value followed by Capacity. This means West Bengal has got the resources but is unable to utilize its resources fully and majority of the people are unable to get proper access to water.

We have considered water poverty intensity scale as shown below:

- 75–85 Very Low
- 65–75 Low
- 55–65 Medium Low
- 45–55 Medium

- 35–45 Medium High
- 25–35 High
- 15–25 Very High

Here, we have considered a maximum benchmark of 85 and a minimum of 15(Bonan et al., 2003). Basically, neither a 100 nor a 0 score is ever possible.

Water poverty intensity scale portraits North twenty-four pargana is in the range of low water poverty that means water situation is better in this district. Total of twelve districts ranges between medium low and medium which depicts them as neutral in terms of water situation. Maldah, Alipurduar, Uttar Dinajpur, Purba Medinipur, Birbhum, Bankura and Koch Bihar have medium high WPI.Puruliya, Jhargram and Dakshin Dinajpur have high WPI. Water situation in the districts varying in the range between medium high and high are very poor and developmental measures should be applied for reducing WPI otherwise it is clear from this circumstances that this situation will impose a serious threat on the water structure of the state in the upcoming years.

Conclusion

In this paper, we have tried to access the Water Poverty Index (WPI) for twenty-three districts of west Bengal using National Sample survey organization (NSSO) 76th round data and District wise groundwater level report (2018-19) as published by Central Ground Water Board (CGWB) data. The index considered data on five components – Resource, Use, Access, capacity and Environment. The five components of WPI comprises of a total of twenty variables (R1, R2, R3, A1, A2, A3, A4, A5, A6, C1, C2, C3, U1, U2, U3, E1, E2, E3, E4, E5).

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The WPI in twenty-three districts of west Bengal are varying from 29.54 to 67.77 with the lowest value in Puruliya and highest value in North twenty-four pargana. The majority of the districts falls in the 'medium' and 'medium low' water poor category. The result displays an overall illustration of water poverty situation of the districts of West Bengal, that can probably assist the policy makers to assess the threats and to take the possible measures to overcome the situation.Water poverty Index (WPI) assemblesthe inappropriate issues related to water by combining the aspects of physical, social, economic and environmental and coupling water issues to poverty.

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