Social Disparity in Drinking Water Facility: An Empirical Analysis

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The article makes an attempt to measure the extent of disparity in access to drinking water facility between slum and non-slum households based on both primary and secondary data. There are two levels of analysis; macro and micro level. In the first level, the disparity index reveals that the slum households have to face much hardships in access to adequate drinking water facilities as compared to non-slum households while in the second level, it examines the association between type of households and access to drinking water facility. The regression analysis shows that type of household is one of the most important determinants of access to basic amenities, even among slum households, non-notified slum dwellers have lower probability to access these facilities due to lack of legal recognition. The article suggests that the government should give legal status to non-notified slums to provide water supply infrastructure in non-notified slums.

Keywords: social disparity; drinking water facility; disparity index; slum households; non-notified slum dwellers.

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I. INTRODUCTION

Disparity is a relative concept and there are various types of disparity, namely social disparity, spatial disparity, gender disparity and inter-generational disparity. Social disparity refers to disparity between different groups of people living broadly in the same locality. In other words, it is the condition of unequal access to the resources of any society. In this article, social disparity in access to drinking water facility between slum and non-slum households is analysed. The world's urban population has increased from 45 percent in 1995 to 55 percent in 2018 and by 2030, 60 percent of the world population is projected to be urban (UN-HABITAT, 2016 & United Nations, 2018). Although, urbanization is accompanied by economic growth, industrialization and development, but it has also led to rising multiple forms of inequality, exclusion, deprivation and poverty. Slums[1] are the emerging human settlements of the 21st century. In developing countries, slum population has increased from 689 million in 1990 to 881 million in 2014 (UN-HABITAT, 2016).

India's urban population has increased from 23.3 percent in 1981 to 31.16 percent in 2011 (GOI, 2013). Urban expansion has placed cities of India in a challenging situation with limited infrastructure facilities. There has been continuous growth in slum population in India. The expanding slum population has exerted huge pressure on the existing civic infrastructure, especially drinking water and sanitation which adversely affect the quality of life of people especially slum dwellers. Various studies find that slums are characterized by insecurity of tenure, overcrowding, extreme poverty, lack of basic services especially water and sanitation (United Nations, 2003, Panda & Agarwala, 2013, Satapathy, 2014, UN-HABITAT, 2016, Sinharoy et al., 2019). The reason may be huge gap between the demand and supply of water in urban areas, which is also growing due to population and urbanization (GOI, 2007, Kumar, 2012). The problem of slums is now a common feature of almost all major Indian cities (GOI, 2010).

[1] Slums are often the only type of settlement that is affordable and accessible to the poor in cities, where competition for land and profit is intense (Basappa, 2014).

Drinking water is a basic necessity of life and human health depends on safe and sufficient amount of water. There is a vast body of literature that analyses the condition of drinking water and sanitation facilities in slums, especially since 2010 and find that accessibility to drinking water sources has been increased but household connections of piped water supply are still lacking (Satapathy, 2014, Bhar et al., 2017, Mukherjee et al., 2020). In this context, it can be argued that only accessibility to water sources may not provide a clear picture of drinking water facility in slum areas, analysis of other indicators such as in-house connection, regular supply, contamination-free water are also very important.

On the basis of the above background, this paper attempts to analyse the actual accessibility of basic needs and vulnerability of slum households through two levels. To present the macro picture of the existing situation, census data is used in the first level and further, in the second level, primary data is collected through small sample survey in Lucknow city to depict the seriousness of the problem. Although, the main focus of the article is on type of households which determines the drinking water facility within premises, but impact of other socio-economic variables such as income, education, caste are also analysed. Lucknow is the capital of Uttar Pradesh. Lucknow is situated about 500 km southeast of New Delhi in the heart of the state. It is situated on the banks of the river Gomti between 26°51' North latitude and 80°36' East longitude. The district is surrounded on the eastern side by district Barabanki, on the western side by district Unnao, on the southern side by Raebareli and on the northern side by Sitapur and Hardoi districts. In Lucknow city, there are eight zones comprising of 110 wards. Using the multistage sampling technique, 30 households are selected from each zone with a total of 240 households across all eight zones; 10 households from non-slum area, 10 households from notified slum and 10 households from non-notified slum. Random sampling method is used for selection of households. This study is performed in selected ward of each zone.

II. HYPOTHESIS & METHODOLOGY OF THE STUDY

The hypothesis of the study is that the type of household is an important factor to determine the accessibility of basic necessities. It is a well-known fact that slum households are in vulnerable condition in access to drinking water facility, but there is significant disparities in access to basic amenities even among different types of slums.

In the first half, vulnerability in access to drinking water facility at regional level[2] is analysed with the help of disparity index. Disparity index is constructed based on secondary data using modified Sopher's Disparity Index in terms of the logarithm of the odds ratio. The objective of taking log is to reduce the levelling off effect.

Modified Sopher's Disparity Index = Log (X_2/X_1) + Log $[(200-X_1)/(200-X_2)]$,

where X_2 is urban households while X_1 is slum households; the ideal value for the index for having no disparity is 0; a higher value of the index shows that the extent of disparity is higher, and vice versa; a positive value suggests that the situation are in favour of X_2 (urban households) and a negative value suggests that the situation is in favour of X_1 (slum households) (Kumar, 2017). The rest of the paper is based on primary field survey and a binary logistic regression analysis is conducted to measure the impact of type of households in access to drinking water facility.

III. RESULTS AND DISCUSSION

3.1 Disparity between Urban and Slum Households

Census data reveals that urban households and slum households have high access to improved water sources[3], but there is significant variation in access to sources of drinking water between urban and slum households across regions. It can be seen in case of tap water from treated source for

[2] India is divided into six regions; north, central. east, northeast, west and south.

[3] An improved source of drinking water includes bottled water, piped water into the dwelling, yard or plot, public tap or standpipe, tube-well or borehole, protected dug well, protected spring, and rainwater collection (NSSO, 2013).

north, central, east and northeast regions, however, slum households have better access to tap water in west and south regions (Table 1). In order to bring out the inequalities more clearly, a disparity index has been worked out. A positive value suggests that the situation is in favour of urban households and a negative value suggests that the situation is in favour of slum households. It may be noted that in case of tube-well, positive value of disparity index for northeast, west and eastern regions shows higher access to tube-well to urban households of these regions as compared to slum households while negative value shows that slum households have higher access to tube-well in north, central and southern regions as compared to urban households. The disparity index between urban and slum households is the highest in case of tap water from treated source for northeast region, followed by eastern region while it is highest for western region in case of tap water from un-treated source among all regions.

Table 1: Disparity in Access to Different Types of Drinking Water Sources between Urban & Slum Households

Regions	Tap water from Treated Source			Tap water from Un-treated Source		
	Slum Households	Urban Households	Disparity Index	Slum Households	Urban Households	Disparity Index
North	71.2	74.9	0.0347	10.1	8	-0.106
Central	43.2	46.5	0.0412	12.5	12.2	-0.0112
East	31	35.5	0.0706	5.7	5.9	0.0154
Northeast	39.9	46.2	0.0811	16.9	17.8	0.0247
West	84.3	80.8	-0.0314	6.5	7.5	0.0644
South	66.4	60.2	-0.0623	10.2	9.6	-0.0277
Regions	Hand-pump			Tube-well		
	Slum Households	Urban Households	Disparity Index	Slum Households	Urban Households	Disparity Index
North	10.3	13.9	0.1395	10.1	8	-0.106
Central	26.8	35.03	0.1374	12.5	12.2	-0.0112
East	36.6	45.4	0.1176	5.7	5.9	0.0154
Northeast	15.2	14.7	-0.0169	16.9	17.8	0.0247
West	3.5	6.1	0.2448	6.5	7.5	0.0644
South	4.1	10	0.4005	10.2	9.6	-0.0277

Source: Author's Calculations

Above analysis is based on only coverage figures and it does not reflect actual availability of drinking water. Availability of drinking water within dwelling or premises is a better form of facility as distance to the water source from the house affects the volume of water consumed. The accessibility in which the household members need to travel long distances for drinking water may not be treated as a desirable facility (NSSO, 2010). In general, the closer water can be supplied to the dwelling; the better it would be (Bajpai & Bhandari, 2001; Pushpangadan, 2006). In this regard, the distance of drinking water source is an important aspect. Sources of drinking water have been categorised into three aspects on the basis of location, such as: source within premises, near premises and away. It may be noted that the highest percentage of both urban and slum

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households having drinking water within premises is found in north region and the lowest percentage is found in central region for both types of households (Table 2). The reason may be less economic development of the states in central region as compared to states in north region. The positive disparity index for all regions reveals vulnerability of slum dwellers all over India which shows that urban households have more access to drinking water within premises as compared to slum households in all regions. One of the main reasons for the absence of tap water within premises in slums is due to inconsistence on providing valid ownership certificates by the departments responsible for drinking water supply in urban areas (Satapathy, 2014).

Table 2: Distribution of Urban & Slum Households in Access to Drinking Water within Premises and Disparity Index

Region	Slum Households	Urban Households	Disparity Index
North	75.3	84.5	0.0833
Central	48.8	61.3	0.1365
East	50.1	61.9	0.1275
Northeast	60.4	65.9	0.0553
West	66.5	82.7	0.1509
South	56.7	69	0.1242

Source: Author's Calculations

3.2 Status of Drinking Water Facility in Lucknow

Census data reveals that slum households have to face much hardships in access to adequate WASH facilities. Furthermore, the present survey data also reflects that slum households live in vulnerable conditions because of the differentiation in the aggregate level of education, per capita income, caste and housing characteristics (Table 3). For instance, about 96 percent non-slum households live in pucca house while the corresponding figures for notified and non-notified slums are 32.5 percent and 1.25 percent respectively.

Table 3: Summary Statistics by Type of Households

Household Characteristics	Non-slum Households	Notified Slum Households	Non-notified Slum Households	Total Sampled Households
No. of Households	80	80	80	240
Total Population	385	395	398	1178
Family size & Income				
Family size (Mean)	4.81	4.96	4.98	4.92
Family size (SD)	1.75	1.78	2.03	1.85
Per capita income (Mean)	14145.60	3465.73	2189.77	6600.37
Per capita income (SD)	9625.87	1627.98	787.83	502.35
Housing characteristics				
Owned	87.5	46.25	39.19	58.12
Rented	12.5	53.75	60.81	41.88
Kutcha house	1.25	12.5	57.5	23.75

Semi-pucca house	2.5	55	41.25	32.92
Pucca house	96.25	32.5	1.25	43.33
Education of household head				
Up to primary	3.75	51.25	85	46.67
Up to intermediate	20	45	13.75	26.25
Up to postgraduation	76.25	3.75	1.25	27.08
Caste				
General Caste	63.75	18.75	13.75	32.08
OBC	21.25	50	56.25	42.5
SC	15	31.25	30	25.42

Source: Primary Survey

Various studies confirm that only access to an improved drinking water source is not sufficient, but having safe drinking water source within premises is also very important for a household. About 63 percent households obtain their drinking water within premises in the study area (Table 4). The analysis shows that all non-slum households have drinking water source within premises while slum dwellers especially non-notified slum dwellers are discriminated against in the provision of safe drinking water within premises. Households belonging to the general category and Hindu religion have easier access to drinking water and sanitation facilities while illiterate and less educated households have to go far to obtain drinking water.

Table 4: Distribution of Households by Distance of Drinking Water Source (in percent)

Household Characteristics	Within Premises	Less than 0.2 Km.	0.2 Km to 0.5 Km.
Type of Households			
Non-slum households	100	--	--
Notified slum	67.5	27.5	5
Non-notified slum	22.5	41.25	36.25
Education			
Up to primary	34.82	37.50	27.68
Above primary	87.5	10.94	1.56
Caste			
General caste	89.61	5.19	5.19
OBC	49.02	26.47	24.51
SC	52.46	40.98	6.56
Religion			
Hindu	71.81	22.34	5.85
Muslim	31.38	25.49	43.14
All Households	62.91	23.33	13.75

Source: Primary Survey

IV. EMPIRICAL ANALYSIS

To see the impact of household type on drinking water facility, an empirical model has been developed on primary data as census data analysis reveals considerable disparity between slum and non-slum households in access to this facility. Besides type of household, socio-economic factors such as education, per capita income, household size, caste and religion are also considered as independent variables in the following model. The dependent variable 'drinking water facility within premises' is a binary variable and it takes a value 1 if the household has drinking water facility within premises and 0 otherwise. Because of the dichotomous nature of the dependent variable, binary logistic regression is used. The estimation is carried out for the samples drawn from Lucknow district.

V. DESCRIPTION OF INDEPENDENT VARIABLES

Variable	Description
Type of household	The type of the household head is classified into three distinct categories, i.e., non-slum household, notified slum and non-notified slum.
Education	It is a binary variable, having a value of 1 if the household head having education level above primary and 0 otherwise.
PCI	Per capita income of the household is a continuous variable.
Size	Family size of the household is a continuous variable.
Caste	The caste of the household is categorized into three distinct categories, i.e., General, OBC and SC.
Religion	The religion of the household is categorized into two distinct categories, i.e., Hindu and other religion.

The logistic regression result shows that type of household, education, income, family size, caste and religion have positive and significant influence on drinking water facility. The estimated coefficients reveal that the type of household plays a strong, positive and significant association with drinking water facility within premises (Table 5). The odd ratios confirm that the probability of having drinking water facility within premises is 30 times higher for non-slum households and eight times higher for notified slum households as compared to non-notified slum dwellers. Households of non-notified slums have a lower probability of having drinking water source within their premises. The reason is in urban areas, water delivery to poor households and slums is usually through handpumps and public standposts (Tiwari, 2017). These sources are situated far from their premises.

Education has strong and positive influence on drinking water facility, indicating that educated household heads have three times higher probability of having drinking water facility within premises as compared to those household heads that are educated till 5^{th} standard and below. Similarly, income also has a positive and significant influence on drinking water facility, indicating that households belonging to higher income group are comparatively more likely to have better facility. The small, though significant, positive estimated coefficient of the family size variable shows that the household size and composition significantly affect the drinking water facility.

Further, households belonging to the general category are positively related with drinking water facility than other social groups. This indicates that households belonging to socially lower

classes have 13 times less probability of having drinking water facility within premises as compared to upper caste. The effect of religion is also strong and positive. This indicates that households belonging to Hindu religion are more likely to have drinking water facility within premises.

Table 5: Results of Logistic Regression for Drinking Water within Premises

Variables	Description of Variables	Coefficient	Z	P value	Odd Ratio
HH type	Non-slum households =1, others =0	3.406	2.54	0.011	30.14
HH type	Notified slum household = 1, others =0	2.095	3.14	0.002	8.13
Education	Education above primary =1, others =0	1.136	2.31	0.021	3.11
PCI	Per capita income of the household	0.0008	3.24	0.001	1.00
Size	Size of the family	0.277	1.75	0.081	1.32
Caste	General =1, others =0	2.591	3.41	0.001	13.34
Caste	OBC =1, others =0	0.854	1.43	0.152	2.35
Religion	Hindu =1, others =0	1.551	2.44	0.015	4.71
Constant		-7.773	-4.34	0.000	
	Log Likelihood	-56.227			
	No. of Observations	240			
	LR Chi^2 (8)	220.24 (0.0000)			
	Pseduo R^2	0.6620			

Source: Computed by Primary Data

Thus, the type of household is a key determinant of access to drinking water facility and there is considerable variation among slums in access to basic needs. Caste and income is also important factors. Numerous studies find that access to basic amenities is limited among the households belong to disadvantaged and lower income groups (Phansalkar, 2007; Tiwari & Nayak, 2017, Kundu & Banerjee, 2018). Therefore, the logit model reveals that probability of drinking water source in premises is high if the person lives in non-slum areas and belongs to higher income group and upper caste. The reason may be two-way relationship: slums are mostly dominated by the lower castes and members of the lower castes are poor because they lack skills and resources. Therefore, significant efforts should be taken to improve education and skill levels of slum dwellers, so that they can increase their income and improve their living standards.

VI. CONCLUSION & POLICY IMPLICATIONS

The paper highlights the disparities in access to drinking water facility between slum and non-slum households in India at macro level and in Lucknow at micro level. The analysis shows that there is not much difference in access to different drinking water sources between urban and slum households, but positive disparity index in terms of drinking water within premises reveals

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vulnerability of slum dwellers in all regions of India. In other words, urban households have more access to drinking water within premises as compared to slum households in all over India.

Primary data indicates disparity in access to drinking water facility even in different types of slums. It is observed that numerous socio-economic indicators such as income, education and caste of the households determine the access to drinking water facility within premises, but the type of household is a key determinant. The analysis reveals that non-notified slum households are highly vulnerable and have less access to basic amenities as compared to notified slum dwellers. The reason may be lack of legal recognition as notification of slum is often required to access urban services, such as water supply infrastructure. A recent study also finds that legal status of a slum is positively related to access to basic services in India (Nolan, et al., 2018). This leads to the necessity of slum's notification in order to provide water supply infrastructure in non-notified slums.

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Conflicts of Interest

The author declares that there is no conflict of interest.

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