A Multidimensional Analysis of Regional Pattern of Water Scarcity using Water Scarcity Index in Delhi

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Abstract:

The use of the WSl (Water Scarcity Index) as a tool for monitoring Delhi's water sector is discussed in the paper. For both rural and urban areas, appropriate indicators are required for monitoring and assessing the development of the water sector. The Water Scarcity Index enables monitoring of several factors influencing water management such as water sources, capacity of people for for managing water, accessibility and use of water and impacts on environment. The index's applicability at regional level in Delhi is examined in this paper. A number of factors were selected for inclusion in the index following collection of data and evaluation in Delhi. Findings clearly distinguish between Delhi's rural and urban areas. The index was designed as a systematic instrument to analyze the water scarcity problem at the household and community levels. It was designed to assist decision-makers in highlighting the most pressing need for actions in the water sector.

Key words: Water Resource, Indicator, Scarcity, Regional Variation, Accessibility

1. Introduction:

Water is vital for both life and the majority of human activities. The preservation of human health, as well as the growth of the economy and society, are wholly dependent upon quick access to sufficient water resources (Bansil, 2004). There is a lot of strain on water resources as a consequence of the increasing demand for water brought on by population growth, urbanization, and economic growth (Bhole et.al, 2000). The world is rushing towards water shortage as the availability of water per person keeps declining. Water availability will likely vary more widely over time and space, which will likely contribute to the issue getting worse (European Commission ,2010). A primary issue on the global agenda has been the provision of a consistent and secure water supply for all people (Molden,2007). Water managers frequently have to balance competing and growing demands with lack of resources. Thus, policies and regulations for the development and management of water are essential today. Water management necessitates "a multi - sectorial, multi-objective and multi-interest study in a wide societal framework, incorporating socio- economic, environmental and ethical concerns" due to the combination of a huge number of variables associated to water and its distinctive nature (Sevenji,2000). Using water resources responsibly and allocating resources fairly are essential components of water management. There is a need for a specialized tool for identifying priority areas in order to adopt more equitable and environmentally responsible water management techniques. This ought to be able to pinpoint regions with water stress and shortage. Moreover, it must be able to

determine the degree of shortage so that comparisons between regions may be performed (Jemmali and Matoussi,2011). Since socio-economic factors as well as physical estimates of the availability of water have an impact on all water management programmes, it is necessary to use an inter - disciplinary management tool that combines the results of the physical and social sciences within a structural framework to produce an integrated assessment of water scarcity or poverty Lawrence et.al., 2003).

The Water Scarcity Index (WSI) was created with the intention of expressing an interdisciplinary metric that integrates household wellbeing with availability of water and the magnitude to which water shortage affects the human population. It enables organisations concerned with the provision and management of water to keep an eye on the resources available as well as the socio-economic factors that have an influence on their usage and accessibility (Mathur,2002). Water, a need for life, may be the biggest difficulty in the future because of mounting demand. Delhi's water demand is rising due to overuse, pollution, and declining supplies in both urban and rural regions, With growth in Delhi, both rural and urban regions are experiencing an increase in water demand. Growing tension and disagreements over control and distribution of water resources may result from this.

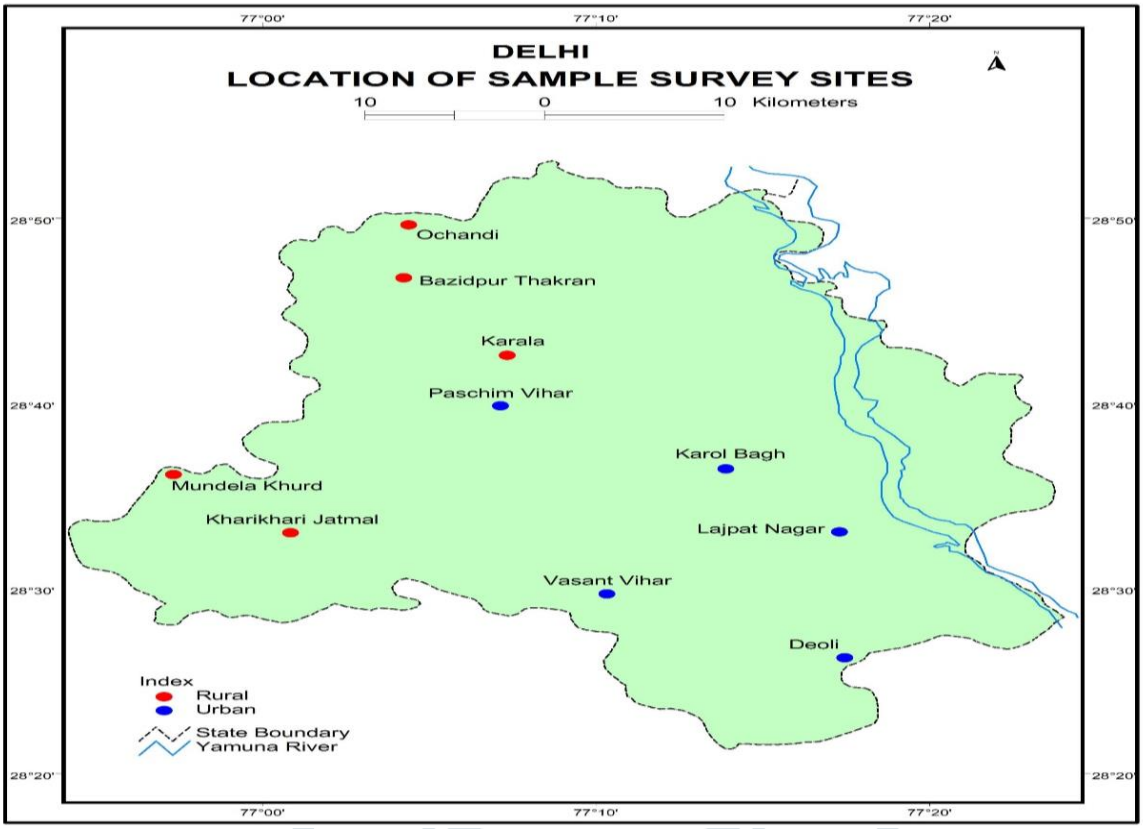
2. Objective of the Study:

The primary objective of the study are:-

1. To examine the status of availability of drinking water in both urban and rural regions.
2. To identify the geographical pattern of water shortages among regions.

3. Study Area:

Delhi is renowned for being a historical old city and India's capital. It covers a territory of 1483 square kilometers in northern India between the longitudes of 76°50 and 77°23 and the latitudes of 28°24 and 28°53 north on the Yamuna River and is a component of the Indo-Gangetic Alluvial Plains having its height upto 198 and 220 meters above sea level. It receives 720mm annual rainfall on average. Around 1152 million cubic meters (MCM) of water are available from surface water sources, including the Yamuna, Ganga river and Bhakhara reservoir, with the Yamuna river contributing for 60% of this total. Over 291 MCM of ground water is also used each year. Presently Delhi needs 3323 MLD (million liters of water) per day, but only receives around 2032 MLD. Delhi's average water usage is estimated to be 240 liters/person/ day (Ipcd) which is the highest in the nation . With its existing population of around 17 million, Delhi now needs 830 million gallons of potable water every day (MGD). 662 MGD of potable water are being supplied by the Delhi Jal Board's current facility (80 MGD from ground water). Groundwater's quality is also declining, and in certain areas it has been determined that it is unfit for human consumption. Around 20% of the population still lacks accessibility to piped water. In addition, if an underground sewerage system is provided, there is the issue of an uneven supply as 29 lpcd as contrasted to l25 lpcd. Yet, in certain places the water supply is 510 lpcd more than the set standards. They all point to a regional variation in water shortage in Delhi. (Figure 1).



Source: Cencus of India, 2011

Figure 1: Location of Sample Survey Sites in Delhi

4. Data source and Research Methodology:

The information generated by the field survey were used to execute the present study. The research's data is gathered from 10 study locations in Delhi 5- 5 urban and rural areas were selected by systematic sampling techniques to bring out the regional variation in water scarcity. Bajidpur Thakran, Karala, Ochandi, Kharkhari Jatmal and Mundela Khurd were the five villages chosen for the survey, whilst Karol Bagh, Paschim Vihar, Lajpat Nagar, Deoli and Vasant Vihar were the urban sample areas chosen for the household survey. A total of 500 households were surveyed—250 in the chosen urban areas and 250 in villages by randomly selecting 50 households from each chosen location. Field observations and a structured questionnaire were used to obtain the primary data. After sorting gathered data, different suitable statistical techniques were used to represent it.

5. Result and Discussion:

The WSI that's been suggested in this study draws inspiration from Sullivan's work. With a goal to accomplish an integrated evaluation of resource availability, socio-economic characteristics, and ecological component of Water Scarcity/poverty, the Water Scarcity Index suggested in the current study has a structure that is basically comparable. The main goal of the WSI is to give water managers a tool for holistically assessing the water condition in various regions.

5.1 Components and Structure of WSI:

To capture a more comprehensive view of the water management challenges, the framework and the component variables of the WSI were identified. These are the components:

a). Resources: Amount of water available, taking seasonal variation into consideration.

b). Access: Ownership of a water resource illustrates the degree of human access to water.

c). Capacity: The efficiency of a person's management of water depends on the price paid for water consumption.

d). Environment: the quality of the water.

The weights assigned to the WSI components are listed in Table 1 below.

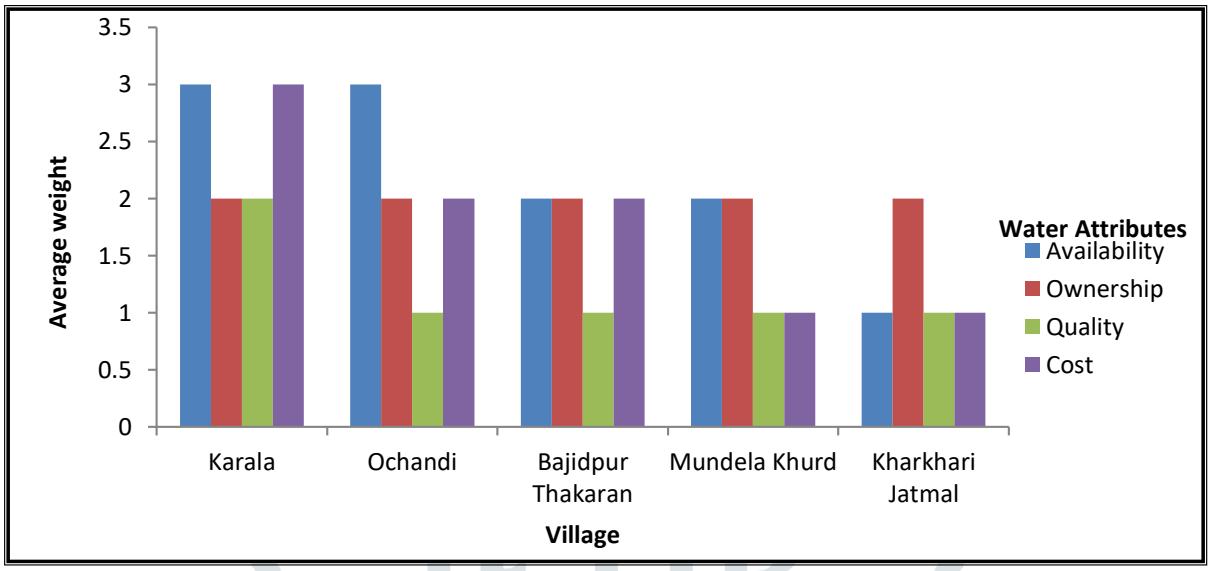
Table 1: Applied Weights of Components

S.No.	Components	Applied Weight
1.	Resource	Good Availability (almost all the Day)-4 Acceptable Availability (6-8 Hours)-3 Poor Availability (4-6 Hours)-2 Very Poor Availability (4-6 Hours)-l
2.	Access	Private Ownership-2 Common Ownership-l
3.	Capacity	Cost paid for only one source of water- 2 Cost paid for more than one source of water-I
4.	Environment	Good Water Quality-4 Acceptable Water Quality-3 Poor Water Quality-2 Poorest Water Quality-l

For a specific purpose, the weighted average of four components makes up the WSI score. The aggregate of the indicators should be divided by the total values of all indicators, which in this study is 12. This will standardize the data and yield a WSI value between 0 and 1. Thus, the WSI for each of the chosen area will display degrees of water scarcity ranging from 0 to 1. Greater WSI values indicate lesser levels of water shortage whereas lower WSI values indicate the worst conditions.

5.2 WSI Scores for Sample Villages and Municipal Wards:

Figure 2 and 3 represent the WSI scores for villages and urban wards based on field survey.



Source: Primary survey

Figure 2: Water attributes for the Villages

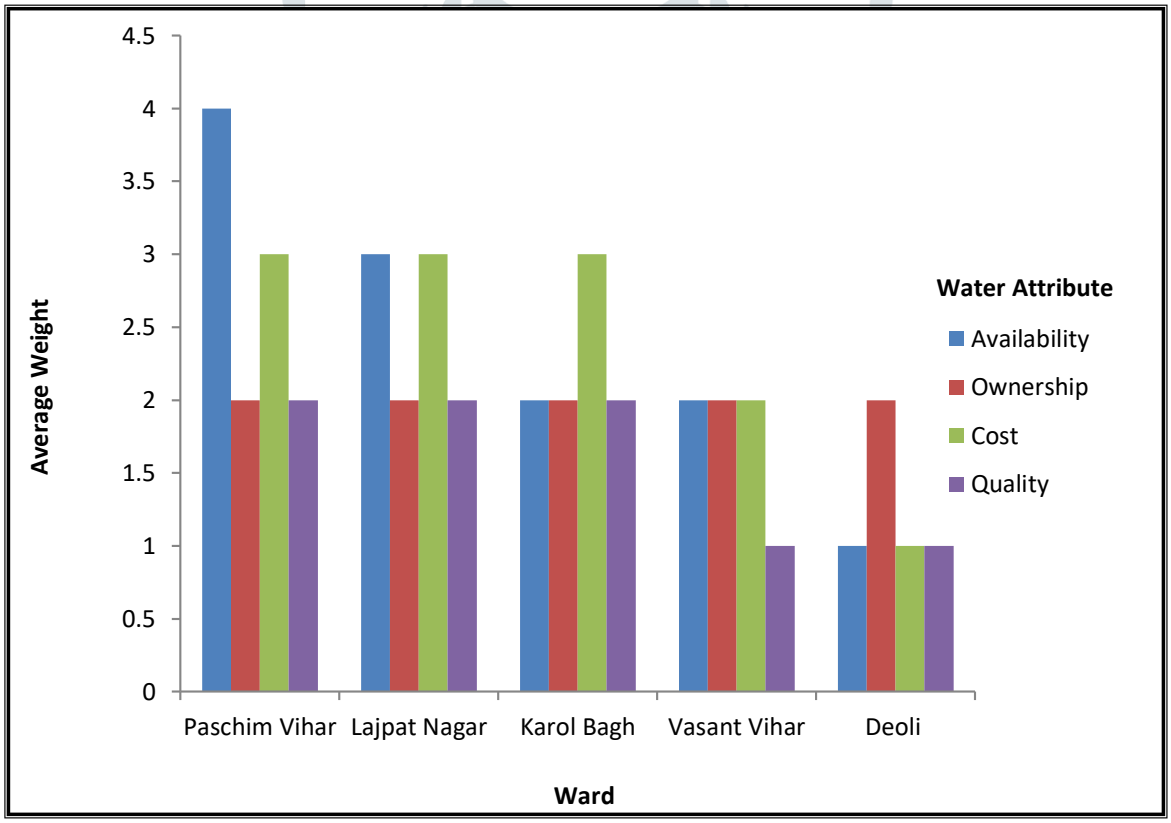


Figure 3: Water Attributes of Municipal Wards

The water situation differs greatly on several factors between rural and urban samples. Only Paschim Vihar receives supplies continuously, although Lajpat Nagar, Ochandi and Karala receive water supply for 6 to 8 hours each day. Water is scarce in Vasant Vihar, Karol Bagh, Bajidpur Thakran and Mundela Khurd and is only available for 4-6

hours daily. Water is supplied to Kharkhari Jatmal and Deoli for fewer than 4 hours each day. Despite the fact that all of the areas studied had a score of 2, having access to a water pipe was not enough to classify a home as "no water poor". The quality of the water that was provided differed from one place to another. Kharkhari Jatmal, Mundela Khurd and Deoli had very poor water quality a s they were receiving their water supply from ground water through tube wells which is very hard. As a result, households must pay for water filtration or utilize another water source for drinking purpose . As a result, households must spend more money to fulfill their water needs. The general water condition in these places looks poor, in contrast to the respondents' satisfaction with the quality of the water delivered in Paschim Vihar, Karol Bagh, Lajpat Nagar and Karala village. At Ochandi and Bajidpur Thakran, the water quality was much below acceptable standards, and the majority of those surveyed used various methods of water purification. The cost variables also vary depending on the location. For example, Paschim Vihar, Karol Bagh, Lajpat Nagar and Karala only need to pay for one source of water to meet their needs, whereas Deoli, Vasant Vihar, Bajidpur Thakran, Ochandi, Mundela Khurd and Karkhari Jatmal households must pay more just for water either since they have to use an alternative source or because it costs more to purify it.

5.3 Comparison of WSI score for Rural and urban Samples:

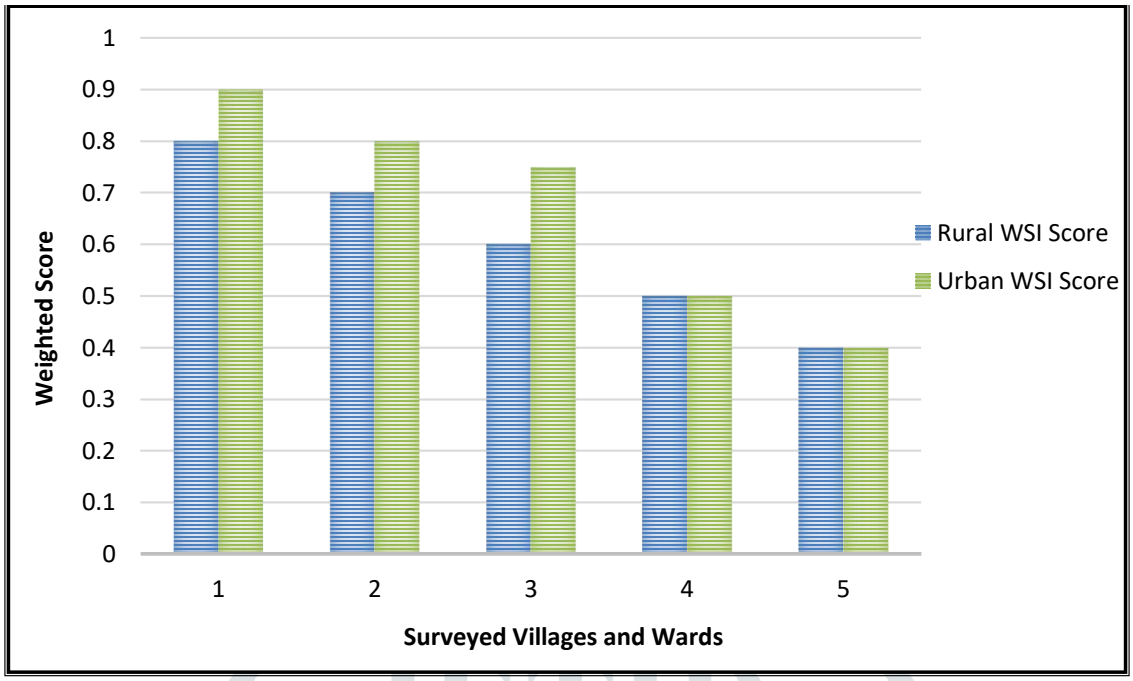
Table 2 compares the water Scarcity index between rural and urban locations.

Table 2: Comparative values of different sample sites

Villages	Rural		Ward	Urban	
	Total value	WSI score		Total value	WSI score
Karala	10.0	0.8	Paschim Vihar	11.0	0.9
Ochandi	8.0	0.7	Lajpat Nagar	10.0	0.8
Bajidpur Thakran	7.0	0.6`	Karol Bagh	9.0	0.75
Mundela Khurd	6.0	0.5	Vasant Vihar	6.0	0.5
Kharkhari Jatmal	5.0	0.4	Deoli	5.0	0.4
Rural Overall Total	36.0	3.0	Urban Overall Total	41.0	3.35

Source: Primary Survey

The table demonstrates that, among villages with the finest water conditions, Karala has the greatest WSI value of 0.8, whereas Paschim vihar, the top-ranked urban ward, has a total of 11 and receives a weight for WSI of 0.9. Three villages in rural sample namely Bajidpur Thakran, Kharkhari Jatmal and Mundela Khurd have a total of seven or less. On the other hand, only two wards in urban samples viz Vasant Vihar and Deoli have a total of fewer than seven. In terms of rural samples, Ochandi came in second with a total of 8, following by Bajidpur Thakran with a total of 7, while Lajpat Nagar placed second with a total of 8, preceded by Karol Bagh with a total of 7. The two rural samples with the lower WSI totals are Kharkhari Jatmal and Mundela Khurd both with a score of 6; whereas Deoli, with a score of 5 and Vasant Vihar with a score of 6 in urban samples. These last two samples exhibit the poor component scores on environment and resource capacity, which contribute to the low aggregate WSI score.(Figure 4).



Source: Primary Survey

Figure 4: Comparative Rural-Urban WSI Scores

In addition to the final WSI ratings, a quadrate diagram is used to further demonstrate the differences between the rural and urban sample sites for dissemination purposes. Higher scores imply a lesser degree of water shortage, as seen in Figures 5 for sample villages and Figure 6 for sample wards.

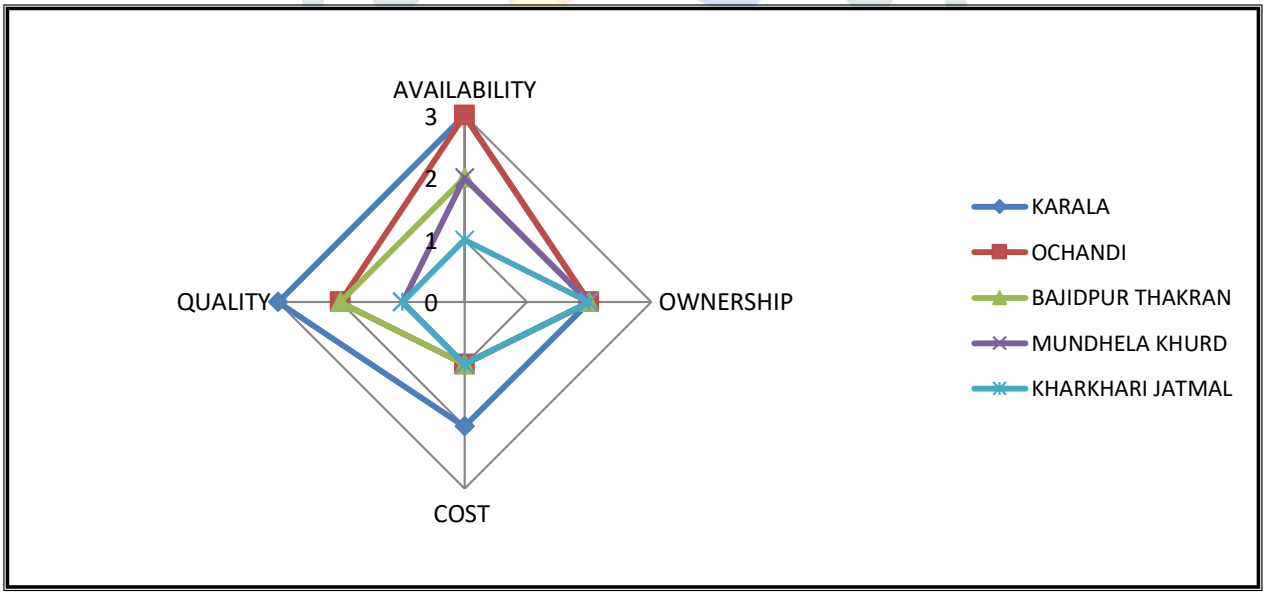


Figure 5: WSI Matrix for Villages

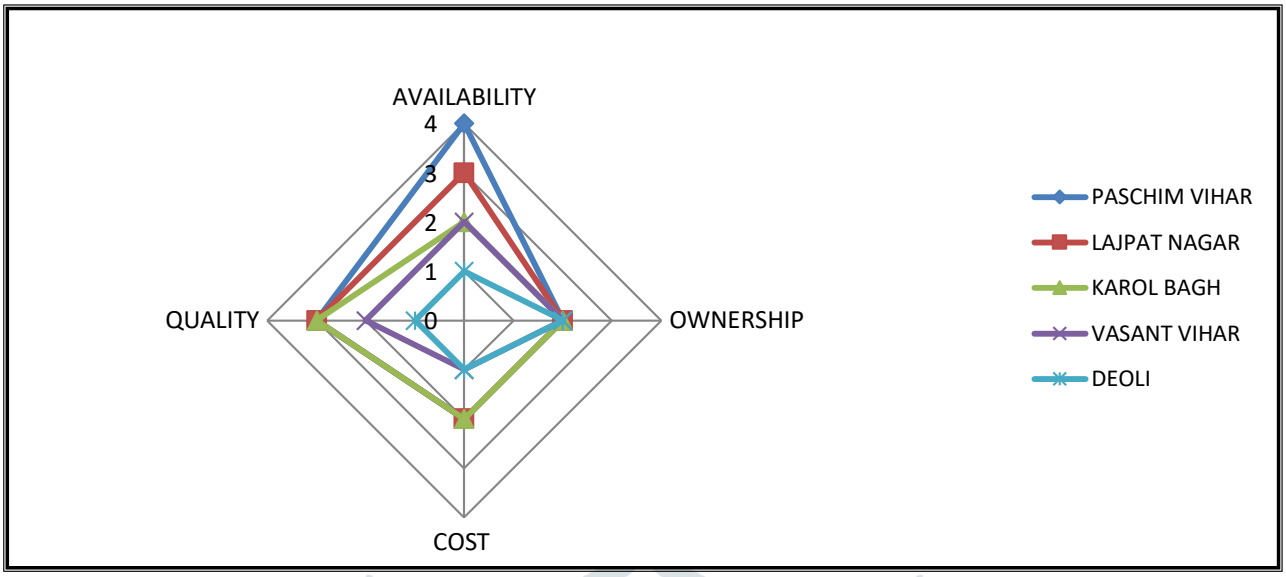


Figure 6: WSI Matrix for Wards

The quadrate diagram displays the component scores, which highlight each location's weaknesses and strengths. Paschim Vihar, for instance, clearly receives the greatest score for the resource component, but the environmental effect of water consumption in the Mundela Khurd, Kharkhari Jatmal and Deoli samples appears to be extremely severe, as seen by the scoring Low on the environment axis in Figures 2 and 3. Since access alone is insufficient to qualify as "no water poor," the access component ratings are nearly identical across all sites. The capacity element demonstrates use of funds to fulfill the demand for water. Figures 2 and 3 illustrate that, the water scenario is worst in the Deoli and Kharkhari Jatmal and that these places require the most immediate intervention since they have poor ratings across the board.

6. Conclusion:

A sufficient supply of clean potable water is a need for existence. The state government's and other organizations' efforts, meanwhile, have not been sufficient to reach all residents in Delhi. WSI values have been produced for 10 distinct sites in Delhi, including both rural and urban areas, using a test bed of specifically acquired data. Throughout the discourse, it became clear that the water situation in rural and urban areas differs. The output of the WSI calculation was examined using a quadrate diagram. A thorough look at the graphic indicates that, in contrast to rural samples, where just one village falls into this group, there are five wards in the city that do not experience water scarcity. Due to the low quality of the water Bajidpur Thakran and Ochandi are areas with medium water stress but Mundela Khurd and Vasant vihar are areas with high stress owing to both availability and quality indicators. The scenario in the Deoli urban area and in the village of Kharkhari Jatmal is completely different. It demonstrates that there is a water shortage in both places. The cause of this is that they receive relatively low weight for cost, quality, and availability indicators. They are located in an area with extreme water constraint. According to the calculated results, three urban areas scored overall higher than rural areas. The results of the WSI computation might serve as a

starting point for identifying water issues in different areas and accordingly developing Delhi's water supply policy with the sustainable management of water resources in Delhi.

References:

Bansil, P. C. (2004), *Water Management in India*, Concept Publishing Company, New Delhi.

Bohle, H.G., Buttner, H., Dillen, S. and Mayer, M. (2000), 'Water Conflicts and Environmental Entitlements, Local Level Experience from South Asia', *IGU Bulletin*, **50** (1): 39-46.

European Commission (2010), *Water Scarcity and Droughts in the European Union*, available at http://ec.europa.eu/environment/water/quantity/scarcity_en.htm

Jemmali, H. and Matoussi, S. M. (2011), 'A Multidimensional Analysis of Water Poverty at Local Scale: Application of Improved Water Poverty Index for Tunisia', *Working Paper 730, The Economic Research Forum*, Giza (Egypt).

Lawrence, P., Meigh, J. and Sullivan, C. (2003), 'The Water Poverty Index: An International Comparison', *Keel Economic Research Papers 2002/19*, Keele University, Stafforshire, U.K.

Mathur, V. (2002), *Political Ecology of Water Scarcity in Lucknow Disctrict*, Ph.d Dessertation (Unpublished), Delhi University, Delhi.

Molden, D. (2007), 'Water responses to urbanization', *Paddy and Water Environment*, **5** (4): 207-209.

Savenije, H. H. G. (2000), 'Water Scarcity Indicators: The Deception of the Numbers', *Physics and Chemistry of the Earth, Part B*, **25**: 199-204.