

## GIS APPLICATION IN URBAN HYDROLOGY

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**Abstract-** Urban hydrology deals with total water available on earth, rainwater, groundwater, and wastewater generated contribute all in urban hydrology. It is a special case of hydrology which is applied for cities i.e. the area with a very high level of human interference with natural processes. As we know the human population is increasing day by day which creates a scope of hydrological studies. Today, due to the increased population we are facing problems in finding and utilizing new water sources to satisfy the need. After problem identification, land use/ land mapping study was carried out using GIS for Islampur city, we found that due to an urbanizing; water scarcity will be faced and needs to utilize new water sources, hence it is required to provide the different method of conservation of water to reduce water issues. GIS helps to know future development in the city as compared to previous years.

**Keywords-** Urban hydrology, Land use, urbanization

### I. INTRODUCTION

Urban hydrology deals with the surface as well as groundwater. Urban hydrology is the interdisciplinary science of water and its relationships with urban habitats. Human activities produce waste that can find their way into and degrade the quality of natural water of the area; hence hydrology of urbanized areas differs notably from that the same land in its preceding rural condition. [2] It deals with problems of ecology, environmental protection, conservation and the rational use of earth's water resources. [9]

Today rapid concentration of population in certain areas is causing heavy demand of water for domestic, industrial and recreational purposes with the consequent increase in the construction of water supply and drainage facilities, with the increase in population, demand for water is increasing. Sustainable water management in cities includes management of urban water cycle on a worldwide base, provide alternative technologies to meet the demand of urban hydrology and develop models to optimize each level globally. [7] It deals with population shifting from rural to urban areas which results in radical changes in land use, and this

urbanization is an interaction between the land and water.

Rainwater conservation is a small part of urban hydrology which is the collection and deposition of rainwater for reuse, rather than allowing it to run off. Rains are the main source of water and if rainwater is conserved, the scarcity of water can be reduced. The use of this conservation system will help to overcome local erosion and flooding caused by runoff from impervious area i.e. covered area (pavement, covered parking etc) same rainwater is captured and stored. [1] Rainwater harvesting plays important role in conservation method of water resources. Rainwater harvesting can be undertaken in two ways

1. Surface rainwater collection.
2. Rooftop rainwater collection.

Rooftop rainwater harvesting which is one of the optimistic and economically visible method used for conservation of water. Rooftop rainwater allowed to percolate water in the ground which increase the level of groundwater aquifer. [6] This water from rooftop or surface either it allowed to percolate or store into the tank which helps to reduce water issues in future. This project is related to study the urban hydrology of Islampur city and to study the covered and uncovered area; from this, we understand future and current resources of Islampur city, their system of conservation and also its impact on various areas. The rapid growth of urbanization has led to increased water demand. As we know much urban area in India does not have ample water resources to full fill the demand, so an attempt here has been made to study urban hydrology and provide the solution to overcome the issue.

### II. URBAN HYDROLOGY

Urban hydrology is the science of water and its relationships with urban habitats. It is part of land hydrology which investigates hydrological cycle, water regime, and quality of water in the urban area. [9] With the increasing Urbanization and rapid development of cities, the problem of urban hydrology becomes more complex.

Components of urban hydrology are:

- Increased water demand by people.

- Pressure on the neighboring areas for water and other natural resources.
- The land use pattern in which covered, uncovered area.
- Reduction in groundwater recharge.

Urun-Islampur is a Municipal Council city in Sangli district from Maharashtra state which is located on 17° 2' 42.46" N and 74° 15' 42.97" E. Islampur is the Tehsil headquarter of Walwa Tehsil in Sagali District. The total area under the jurisdiction of Municipal Council Uran- Islampur comprises of whole revenue village of Uran admeasuring 3343.0645 hectares and Islampur admeasuring 696.9439 hectares, totaling about 4042.0084 hectares.

### III. Land use and land cover analysis

The land is one of the most important natural resources, which comprises of soil, water, and other associated flora fauna, thus involving the total ecosystem into it. As the result there is development in terms of increase in the industrialization, urbanization, and forest to agricultural land conversion, the land resource has exploited to the greater extent which loading to land degradation. [3] Land use/land cover is one of a basic survey which is important for analysis. Study of existing land use and their distribution over the area included in the Municipal limits helps the planner in understanding the town and its activities. Land use/Land cover is important for the development planning of the city.[5] Land use mapping and related information are used to analyze the current pattern of development and serve as a framework for formulating how land will be used in future. Total covered area (Developed area, Paved surfaces, covered parking) and the total uncovered area is required to study under the land use analysis. Existing land analysis information from Municipal Corporation of Islampur surveyed in the year 2012 given in following Table no.1

Table No. 1. Existing Land use analysis of Islampur

Sr No.	Land use	Area(Ha)	%develop area	% total municipal area
1	Residential	1040.51	78.89	25.74
2	Commercial	41.80	3.16	1.03
3	Industrial	31.86	2.41	0.78
4	Public / Semi Public	138.09	10.48	3.42
5	Public utility and services	13.92	1.05	0.34
6	Garden, Parks, Playground	52.10	4.011	1.30
7	Traffic and transport	253.43	-	-

From the existing land analysis and other surveys, it is revealed that the Uran Islampur town is growing along State Highways namely Peth-Sangli road and along Takari road, Bahe road, Kapuskhed road, and Kameri road. While formulating the zoning proposal it is necessary to see how the town is existing and direction in which it is developing, and how much land is available for development etc. Land use mapping is used to study the runoff characteristic. Runoff is the part of water cycle in which the water flows over the land as surface water rather than be absorbed into groundwater. This runoff can be calculated from the area which was mapped shown in fig no.1 that calculated runoff and its characteristics will help to determine conservation methods for storage of water in future.

The mapping for Islampur city was done with the help of GIS shown in fig no.1, which helps to determine developed and undeveloped area of the city

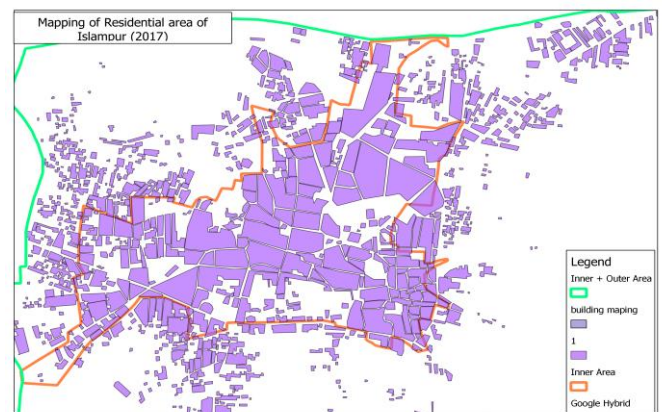


Fig No.1 Mapping of the developed area of Islampur(2017)

The geo-referencing for the collected map of Islampur city was done in Quantum GIS and developed area was marked which was shown in above fig (Fig No.1). From this mapping, we get the total area under residential, commercial, public, utility user. The total developed area from the mapping is about 899.6194 Ha in the year of 2017. From the analysis of land use mapping we understand that developed area of Islampur in 1998 is about 697.52 ha and in 2017 it is about 899.6194 ha, so there is 5% increase in the development area. With the analysis of land use, Islampur city is increasing towards the East- South direction of Islampur city.

### IV. Population analysis

The information collected regarding the population of Uran Islampur is given in Table No.2. The area of Uran Islampur is about 40.4 km<sup>2</sup> and density of population in that area is about 1667/km<sup>2</sup> in the year 2011.

Table No. 2 Population of Islampur Source: Census India

Year	1951	1961	1971	1981	1991
Population	11613	20826	27116	33016	42459

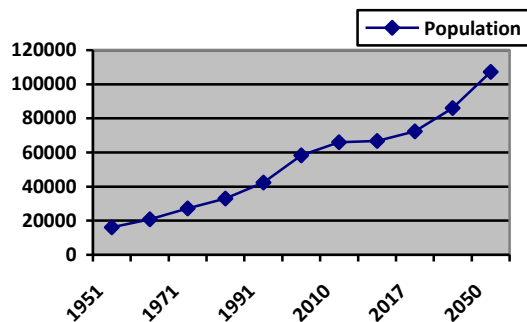
Year	2001	2010	2011
Population	58330	65942	66787

As per 2011 India's census, Islampur had a population of 66787. Incremental Increase Method is used for forecasting of the population which was 72301 for the year 2017, for 2021 it will be 86120 and for year 2050 it will be 1, 07,226. For the area of 40.4 km<sup>2</sup>, density will be about 2654/ km<sup>2</sup> in 2050.

*Table No. 3 Population Prediction by Incremental increase method for year 2050.*

Year	2017	2021	2030	2050
Population	72301	86120	95780	107226

Fig No 2 shows population graph of Uran Islampur. From the year 1951 it is observed that population growth is slightly increasing up to the year 1991 to every decade. After that from 1991 the population growth percent increases as compared to previous decade. It happens because of development of the city, industry area, infrastructure, facilities, improved lifestyle, so people are attracting towards city also the education facilities are increasing.



*Fig. No. 2 Population of Uran Islampur, Source-Census India*

Urun-Islampur has one of place for stabilized market, chance of job opportunity, new business setup, which are able to complete the requirements for peoples, to develop the entire urban eco-system and development of institutional, physical, social and economic infrastructure, but due to these reasons, city has a prime importance and scope of development in various areas.

The growth of population and expansion in the urbanization, industrialization is creates growing in demand and increasing pressure on water resources. Rainwater which is very important to make sure that there is no shortage of water will come in future. [4] This rainwater can be captured by rainwater harvesting system. In old days Islampur water supply was done by three tanks, Mantri tank (Kot talav), Phul bag tank and Fakir tank in Islampur city. These are fed by Khadi tank by way of an open channel. Public health dept completed water supply scheme at Bahe, the pipeline is laid out from Bahe. The pumping station up to elevated service reservoir at Islampur.

Today's water supply by Municipal Corporation for the domestic purposes is about 14MLD, from which 10 MLD is used for domestic purpose and 4 MLD for hotels and other purposes. This water

supply is for the population of 72301 people. As we know due to increase in the population, the demand of water is also increasing day by day. From the past records; the water demand in future (year 2050) will be 21 MLD for population of 107226 peoples. In some cities, the groundwater extraction has reached up to a very high level which brought problems like reducing water table day by day, failure of well/ tube well and the quality and quantity of water goes down. [8] In this condition, it rainwater harvesting could prove to be one of the best method for solving this issue. It is required to make conservation system to reduce the problem of water scarcity in future.

#### IV. CONCLUSION

1. Land use analysis shows that as compared to 1998, the covered area has been increased by 5 %
2. Run-off characteristic was analyzed to determine conservation method.
3. Future growth of Islampur city is increasing towards the East -South direction, which was analyzed using population growth and spread trends.
4. Rainwater harvesting and recharge can effective Conservation technique for Islampur city

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