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REMOTE SENSING AND GIS APPLICATION TO ASSESS THE RAINWATER HARVESTING POTENTIAL IN NORTH SOLAPUR TAHSIL, SOLAPUR DISTRICT, MAHARASHTRA

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Abstract:

Rain Water Harvesting and Conservation, is the activity of direct collection of rain water collected can be stored for direct use or can be re-charged into the Ground Water. Solapur district is received less amount of rainfall during monsoon season. The groundwater is highly depleted and receives less amount of water from rain. The North Solapur tahsil is dry area and belongs to over exploited category. Solapur city is belongs to smart city along with NH- 65 and NH - 9 identified as suitable area for global city project. This will increase demand and pressure on already depleting water resource many folds. Studies need to be conducted for identification of catchment areas with good storage recharge potential and ground water aquifers with good retention and community level projects be developed & implemented, so that sustainability of water resource can be assured. Due to rapid urbanization and industrialization in the study area, demand for water consumption has increased at an unprecedented rate. Statistics on water availability in the study area has already revealed that water table has gone down remarkably in last 2-3 decades. Nevertheless, the area has sufficient potential to feed on the ever increasing demand of water if harvest and conserve properly. Site selection for RWH is carried out by overlying the slope, soil, landuse/land cover & buffered stream order maps. The study area is having full scope for percolation tanks, farm ponds and check dams. Produced map will help in the selection of the suitable location of harvesting structures and hence, help in water conservation in water depleted area.

Keywords: Rain Water Harvesting, groundwater, RS and GIS, Solapur etc.

Introduction

1. Water is the life of any society. It is a necessary component in every aspect of life and must be esteemed and safeguarded. It is essential for the food, environment and sustainable development. All civilization has growing with water source as their base. Water supply is the main important source of urban services. Drinking water and requirement of sanitation practices are the essential minimum requirements for all healthy living. Rainwater is a prime source of freshwater and the movement of accumulating rainwater directly for useful or recharging it into the ground to recover groundwater storage in the aquifer is known as rainwater harvesting (RWH). The groundwater demand has increased tremendously (1,2). When there is a total imbalance between the natural recharge and over pumping of water over a period of time, the decline of the water table becomes important with decrease of yield [3]. India is blessed with sufficient rainfall but many regions are dry and drought prone. In many areas the quality of groundwater is not good. Solapur region having quite even rainfall but there is also problem of a severe scarcity of drinking water. This is because we have rainfall in small spells of more intensity. Due to this intensity and small duration of heavy rain, majority of the rain falling on surface tends to flow away rapidly and leaving very slight for the recharge of ground. Therefore, it is essential for users to store and collect rainwater.

Study Area

Solapur is a city located in the south-eastern region of the Indian state of Maharashtra. Solapur is located on major road and rail routes between Mumbai and Hyderabad, with a branch line to the cities of Bijapur and Gadag in the neighbouring state of Karnataka. It is well known for textile production such as bed sheet, blanket, towels etc. It is 49th most populous city in India and 43rd largest urban agglomeration. Solapur city lies between 17^0 36'0" N to 17^0 44' 0"N latitude and $75^0$48'0" E to $76^0$4'0" E longitude (fig.1).

Materials and Methods

2. The study area lies in the geological survey of India (GSI) toposheet no. 47 O/13 and 56 C/01.The toposheets are 1:50000 scale with contour interval of 20 meter. Erdas Imagine - 2011 has been used for image classification. ArcGIS Desktop 10.0 for Vector and Raster based analysis such as Map Overlay, Proximity Analysis, Local and Zonal Function, Rainfall

Interpolation and for generating Raster Stream Network and Stream Order map. The used dataset for current research is Sentinel image (January, 2017) resolution 10m, Carto – DEM (resolution 30m), Soil Map, Hydrogeological Map and Rainfall Data etc.

Results and Discussion

3. The use of remote sensing and GIS for assessing the rainwater harvesting potential in North Solapur tahsil of Solapur district have discussed here and all maps have been generated using ArcGIS software (fig. 2-3).

Rainfall Data Interpolation: Study area has only 3 rainfall gauging stations. A dense network is required to estimate accurately spatial distribution of rainfall of a given area. Therefore, 3 stations in Solapur district are used for interpolation on the entire district and then interpolated rainfall map of the study area was clipped. The interpolated raster map shows increase pattern in Average Annual Rainfall (45 to 50cm) from south to north (Fig. 2e).

Soil Map: The study area lacks an elaborate soil map. The soil map of the study area was digitized from Solapur district soil map (NBSS, Nagpur). Further improvements were carried out with the help of literature (Fig. 3b).

Strahler Stream Order: The method of stream ordering was proposed by Strahler in 1952. Stream order only increases when streams of the same order intersect. Stream Order Raster was generated using Stream Order tool (fig.3a).

Land Use Land Cover (LULC) Map: Sentinel, January, 2017, imagery is used for LULC classification. The Supervised Classification tool was run in Erdas Imagine 2011. The resulted imagery was re-coded further using vector files that were digitized using Google Earth. There are total four classes; these are settlement, water body, Barren land and Vegetation (Fig. 3b).

Runoff Coefficient: The method used to calculate runoff coefficient is Rational Method. The major factors affecting the rational method runoff coefficient value for a watershed are the land use, the soil type and the slope of the watershed. Thus the runoff coefficient must have a value between zero and one (fig.3c).

Rain Water Harvesting Potential (RWHP): The total amount of water i.e. received in the form of rainfall over an area is called the Rain Water Endowment (RWE) of that area. Out of this the amount that can be effectively harvested called the Rain Water Harvesting Potential.

Rain Water Harvested Potential (RWHP) = Rainfall Endowment of the area X Runoff Coefficient X0.8 (constant coefficient)

RWE: It was calculated for each pixel by multiplying pixel area with the interpolated rainfall value (in meter) of that pixel (4).

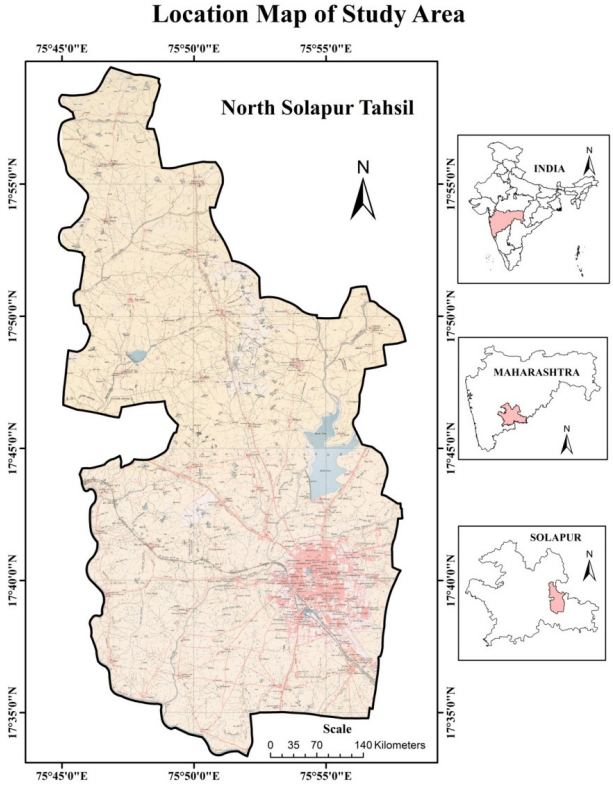


Figure 1: Location Map of the Study Region.

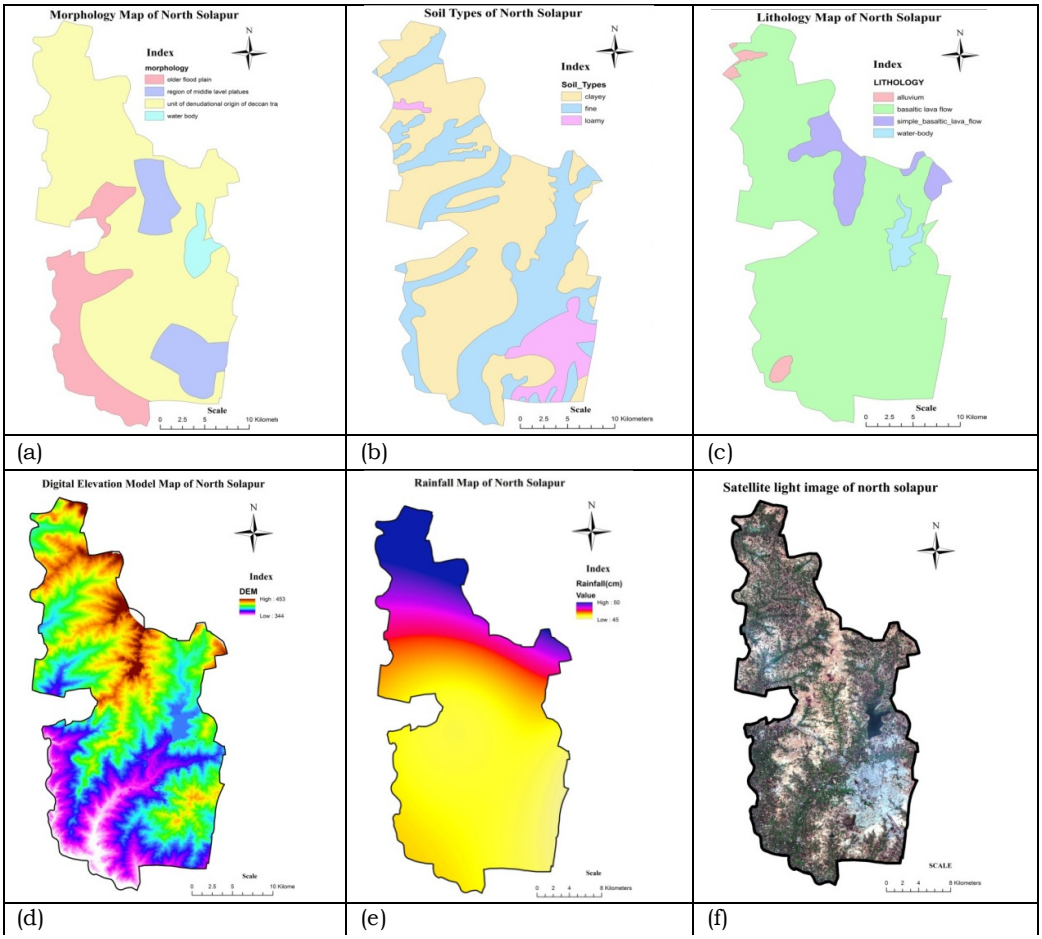
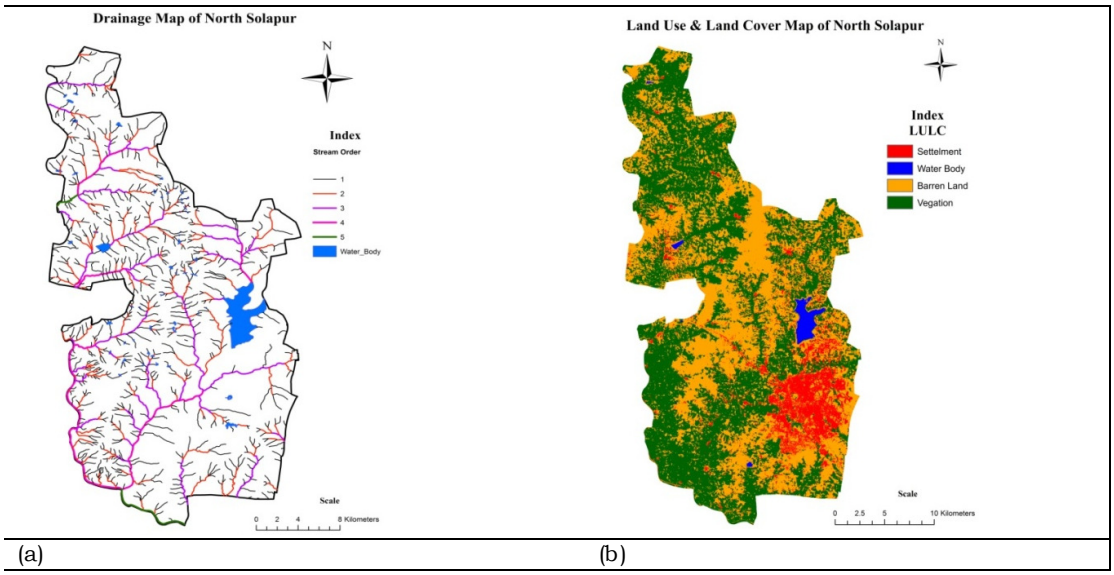
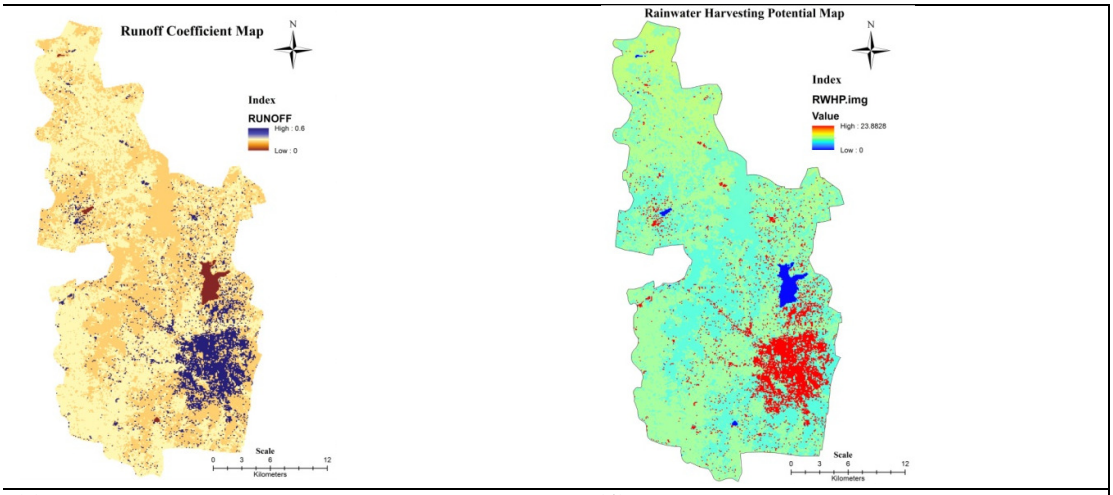


Figure 2: Images of the Study Region.





(c) (d)

Figure 3: Images of the Study Region.

Conclusion

RWHP map (fig.3d) is created by the weighted overlay operation. Total calculated RWHP of the study area is 2,39,100.8 cubic meter or 23,91,00,800 liter. The RWHP of the study area is useful for the collection and percolating the rainwater received from south – west monsoon.

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