

Extraction of surface imperviousness from land use land cover analysis for part of Hyderabad city

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Introduction

Surface imperviousness of watershed is a vital parameter in performing all hydrologic simulations and it work as a needle to track environmental and physical changes (Deng et al. 2012). The impervious surface of a watershed is frequently expressed as percentage of total impervious surface area of watershed. Increased urbanization exerts a lot of pressure on land use which results in rise in total impervious surface (Chithra et al. 2015). The surface imperviousness varies from 2 to 10 percent in rural areas to 70 to 90 percent in densely populated urban areas (Schueler and Claytor 1997). The rise in surface imperviousness of a watershed initiates a chain of events affecting urban water and air resources and thus it is a prime concern to hydrologist and environmental engineers. Impervious surface restricts the entry of rainfall water into natural soil thereby increasing the runoff volumes. The runoff volume of fully developed urban watershed my rise up-to six times and runoff peaks up-to 1.8-8 times leading to flooding situations (NDMA, 2010).

Several research studied in past shows the consequence of increased surface impermeability on various resources in urban watersheds and explain the need of acquiring the recent spatial information in performing analysis (Zhihong et al., 2009; Yuan 2008). Such studies are a common task to the hydrologists in developed countries while only few studies are reported on estimation of surface imperviousness of watershed in developing countries due to lack of basic data, procedure manuals and guidelines. The paper presents a methodology to extract surface imperviousness of an area by processing high-resolution imagery and developing land use land cover map. Zone XIII of Hyderabad being one of critical flood prone zone, is picked in this study to extract percentage permeability from land use land cover map.

Materials and Methods

Fig.1 shows the flow chart explaining the methodology to calculate surface imperviousness of watershed. The surface imperviousness of watershed is determined by estimating the pervious and impervious parts of watershed. The land use and land cover maps of study area are prepared in Arc GIS 10.1. ETM+ and LISS III satellite imagery for year 2001 and 2016 is downloaded from United States Geological Survey Earth Explorer and processed in Arc GIS environment. Four training classes of land use (built-up area, barren and, water bodies and shrubs) are defined to develop land use and land cover of study area.

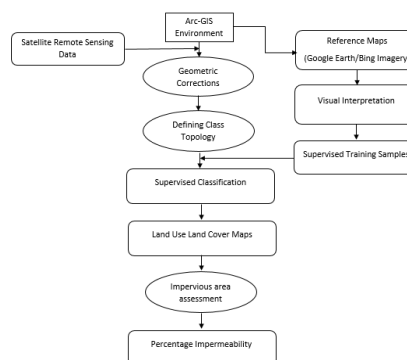


Figure 1. Flow chart of methodology.

Results and Concluding Remarks

Fig. 2 shows the land use land cover maps of study area for time period of 2001 and 2016. The area falling under each class is calculated and matched with total area of watershed to get surface imperviousness of study area for respective time period.

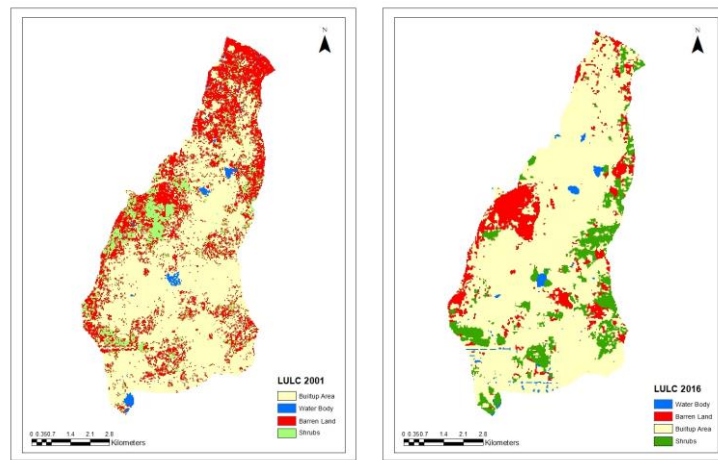


Figure 2. Land Use and Land Cover Map for year 2001 and 2016

The surface imperviousness of study area for year 2001 and 2016 extracted from respective land use land cover classification results is presented in table 1. The results show rise in overall imperviousness of Zone XIII watershed from 46.73% to 65.81%.

References

- Chithra S V, Harindranathan M V Nair A, Anjana N S (2015) International Journal of Engineering Science Invention 4(5): 27-31. ISSN (Online): 2319 – 6734.
- Deng Y, Fan F, Chen R (2012) Extraction and Analysis of Impervious Surfaces Based on a Spectral Un-Mixing Method Using Pearl River Delta of China Landsat TM/ETM+ Imagery from 1998 to 2008. Sensors (12), 1846-1862. <http://doi.org/10.3390/s120201846>.
- NDMA (National Disaster Management Authority) GOI, Guidelines on Urban Flooding in India (Government of India, New Delhi, 2010)
- Zhihong G, Lu Z, Mingsheng L (2009) Estimating Urban Impervious Surface Percentage With Multi-source Remote Sensing Data. 2009 Urban Remote Sensing Joint Event, 978-1-4244-3461-9/09©2009 IEEE.
- Schueler, T.R. and R. Claytor. (1997). Impervious cover as an urban stream indicator and a watershed management tool. In Effects of watershed development and management in aquatic ecosystems: roceedings of an engineering workshop. L.A. Roesner (ed.). ASCE, New York. pp513-529.
- Yuan F, Wu C, Bauer M E (2008) Comparison of spectral analysis techniques for impervious surface estimation using Landsat imagery. Photogrammetric Engineering and Remote Sensing 74 (8), 1045–1055. <http://doi.org/10.14358/PERS.74.8.1045>.