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SITE SUITABILITY ANALYSIS FOR WATER CONSERVATION MEASURES IN WATERSHED USING REMOTE SENSING AND GIS

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ABSTRACT

In the present study, attempt has been made for suggesting suitable sites for water conservation measures in micro watershed located in Rahata, Shrirampur and Newasa tahsil of Ahmednagar district using Remote Sensing and GIS. Delineation of watershed is carried out using DEM. Various thematic maps such as runoff potential map, slope map and soil erosion map were prepared using IRS-P6 LISS-III satellite image through ArcGIS 9.3 software and overly operation was carried out for suggesting suitable sites for water conservation measures map with criteria given by Integrated Mission for Sustainable Development (IMSD) of ISRO and suggested by National Institute of Hydrology. The study suggested 92 conservation sites, highest sites point out for Newasa tahsil, clearly indicated that there is urgent need to put the steps to implement conservation measures suggested by study for sustain the water balance of watershed.

Keywords: Suitable site, Remote Sensing, GIS

INTRODUCTION

Water is essential for all, plays a vital role not only in fulfilling basic human need for life and health but also in socio-economic development. Rainfall is key source of water, so it becomes necessary for us to conserve it. But the rainfall in India is highly erratic and about 80 per cent annual rainfall is received within three to four months while reaming in eight to nine months with highly scattered. In other hand water table is rapidly decline due to over exploitation. According to World Bank Report (2012), India will be in water stress zone by the year 2025 and in water scare zone by 2050. Thus we must conserve and storage the water with different conservation measures and minimizes wastage of rain water. Remote Sensing and GIS is the powerful tool for identifying suitable sites for water conservation in watershed after formulating different criteria (Ravindran et. al., 1992).

Many scholars studied the selection of suitable sites for water conservation measures in watershed but very few work carried out using Remote Sensing and GIS (Khan, 1992; Sarangi et. al., 2004; Kalra, 2005; Saptarshi and Rao, 2010; Gavde et. al., 2011). Thus the present study investigate suitable sites for water conservation measures in watershed covering Rahata, Shrirampur and Newasa tahsil using Remote Sensing and GIS.

STUDY AREA

The present study has been carried out area located in Northern Ahmednagar District of Maharashtra including tahsil Rahata, Shrirampur, and Newasa. The entire area falls in Pravara River Basin between extents of 19 015' to 190 50' N and 74 017' to 75012' E. The slope of the area is varying from 5 % to 9 % (up to 5 degrees) and the aspect of the area is generally directed towards North East direction. The area is generally plane with the elevation variation ranging from 695 meters to 465 meters. As per National Bureau of Soil Survey and Land Use Planning, Nagpur; the soil in the study area can be classified into three categories, silty, shallow and medium loamy black soils, deep clayey black soils. The climatologically, area is semi-arid and temperature varying from 90C to 430C whereas relative humidity for the area varies from 40 % to 80%. The annual rainfall varies from west to east between 540 mm to 500 mm.

DATABASE & METHODOLOGY

In present study the S.O.I toposheet for the area were digitized to obtained contour of 20 meter interval

and raster tools were used to generate DEM. The depression free Digital Elevation model was applied for automated eights sub basins delineation. The raster layers of slope, runoff, and soil erosion were reclassified as low, medium, and high categories; the output raster layer arrived after the raster integration process was analysed based on the criteria specified in IMSD for different water conservation measures to suggested suitable sites for various conservation measures. The conservation sites were verified on ground by conducting field inspection to ensure validation of the GIS suggested sites.

RESULT & DISCUSSION

The runoff potential calculated using annual average rainfall for eight watersheds, entire study area demarked in low, medium and high runoff potential (Fig. 1). It also observed that a built-up area is high runoff potential so not suitable for water conservation sites only moderate and low runoff potential zones are suitable. Slope map was prepared base on DEM (Fig. 2), with high, medium and low slope zones. Soil erosion is very complex process, however in order to understand the complex processes of erosion, the Stehlik Soil Loss Models is more appropriate. Soil erosion was calculated using slope-length, climatic factor, petrology factor, erosion factor of the soil and vegetation factor layer and Stehlik soil loss equation. The entire study area delimited in high, medium and low erosion zones; the highest soil erosion was observed in most part of Newasa tahsil while lowest observed in Shrirampur tahsil (Fig.3).

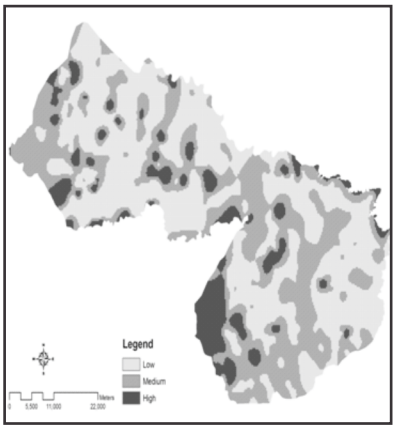

Fig. 1: Runoff Potential Map of Study Area

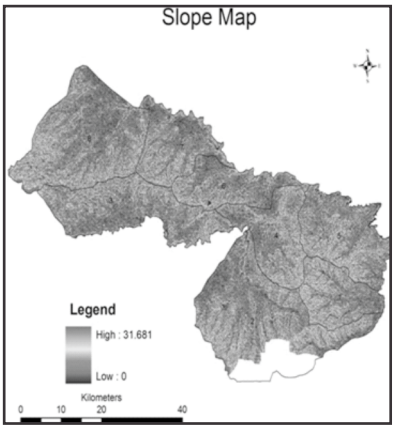

Fig. 2: Slope Map of Study Area

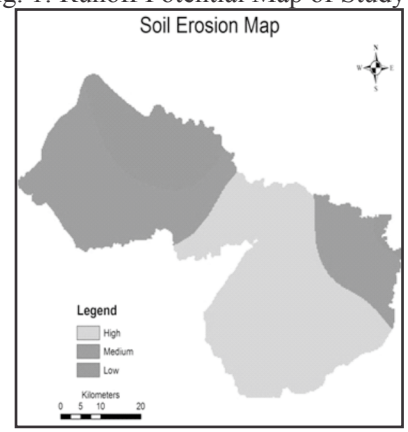

Fig. 3: Soil Erosion in Study Area

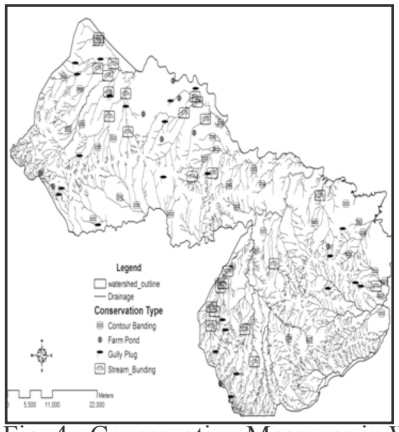

Fig. 4: Conservation Measures in Watershed

Suitable sites for water conservation measures

With using the runoff potential map, slope map and soil erosion map, overly operation was carried out for suggesting suitable sites for water conservation measures. The site suitability of structural conservation measures are chosen for different conservation measures by taking into consideration criteria given by Integrated Mission for Sustainable Development (IMSD) of ISRO and suggested by National Institute of Hydrology (Table 1) and presented through site suitable map (Fig. 5).

Table 1: Criteria for Site Suitability of Conservation Sites

Sr. No	Type of Conservation	Run off Potential	Slope	Soil Erosion potential
1	**Contour Bunding**	Medium	Low	High
2	**Gully Plug**	High	Medium	Low
3	**Stream bunds**	Medium	Low	Medium
4	**Farm Pond**	High	Low	High

Table 2: Soil and Water Conservation Measures Sites Suggested for Study Area

Sr. No.	Name of Conservation Measures	Shrirampur	Rahata	Newasa	Total
1	**Stream Bund**	06	09	11	**26**
2	**Gully Plug**	05	09	10	**24**
3	**Contour Bunding**	08	07	18	**33**
4	**Farm Pond**	04	03	02	**09**
	Total	**23**	**28**	**41**	**92**

(Source: Computed by Researcher)

The eight delineated watersheds showing the suggested conservation measures such as Stream banding, Contour bunding, Gully Plug and Farm Pond. The suitable sites were evaluated using AHP model and Remote sensing LISS-III data. For Shrirampur tahsil, 06 stream bunding, 05 gully plugs, 08 contour banding and 04 farm pound are suggested while for Rahata tahsil 09 stream bunding, 09 gully plugs, 07 contour bunding and 03 farm pound are suggested. The eastern tahsil Newasa has been suggest 11 stream banding, 10 gully plugs, 18 contour bunding and 02 farm pounds for sustainable watershed development.

Conclusion :

The integrated watershed developmental programs are aimed at suggesting sites for conservation of water and soil using different models, the result of the present study has have confirmed that GIS techniques is an effective approach for site suitability analysis. In this context the site suitability analysis for different watershed based conservation measures can be carried out for three tahsil. There are 33 sites suggested for contour banding in entire study area; 18 for Newasa, 08 for Shrirampur, 07 for Rahata tahsil. While 26 stream banding sites are suggested among them 11 in Newasa, 09 in Rahata and 06 in Shrirampur tahsil. Gully plugs are also suggested 10 for Newasa, 09 for Rahata and 05 for Shrirampur tahsil. Farm pound sites have been suggested 04 in Shrirampur, 03 in Rahata and 02 in Newasa tahsil. It is clear point to that Newasa tahsil have facing highest soil erosion problem therefore 41 suitable sites are suggested. Whereas 28 sites for Rahata and 23 sites for Shrirampur are suggested on the basis of suitability analysis.

The important steps should be done in construction of those conservation measures at sites

suggested by GIS techniques in this study for sustainable watershed development.

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