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Site Suitability Analysis for Water Conservation Structures for Target Areas of MGNREGA using GIS

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Abstract

Development of Indian villages is critically dependent on the availability of water and it's judicious use, especially in the context of fast altering climatic trends and land degradation. This paper concentrates on selecting suitable sites for the implementation of natural resource management activities and aims to choose tentative sites for the planning of water conservation activities like Check Dams. The approach is done by considering the rules and regulations of an Indian labour act called Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA) designed at improving the rural inadequate and to make resilient resources of mission water conservation. Here, multi thematic geo spatial data sets of Narasapuram mandal of west Godavari district are considered. The inputs used are Land Use Land Cover (LULC), Digital Elevation Model (DEM), Road map, Drainage map, slope map and other topographical features. These layers are tested using allowable thresholds for understanding sensitivity of decisions.

Keywords:

MGNREGA;
Check Dams;
DEM and
Weighted Overlay.

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1. Introduction

Rural Employment Creation is the vital process in mitigating economic delinquency of rural poor and should be tackled using best of the technological paradigm available. So, the Central Government formulated the Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA). The MGNREGA notified on September 7, 2005, aims at enhancing livelihood security of households in rural areas of the country by providing at least 100 days of guaranteed wage employment in a financial year to every household whose adult member's volunteers to do unskilled manual work. As per the MGNREGA, creation of durable assets and strengthening of livelihood is an important objective of the scheme.

This paper concentrates mainly on the planning of suitable sites for mission water conservation activities using GIS The data analysis in this paper is done using spatial analysis, decision support system, overlay tools, conversion tools and other advanced geo processing techniques. The entire approach is done using the core principle of ridge to valley which means that the ridges are treated first and then progressively approaching the valley. This would help in reducing the velocity of water, prevention of silt deposition in water harvesting structures and soil conservation in the downstream sites. There are three categories in it i.e.,

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Ridge treatment, Drainage treatment and Area treatment. As per MGNREGA, there are 141 NRM works which comes under 17 concentrated areas of improvement. These include development of rural infrastructure, water harvesting, soil and moisture conservation, ground water recharge structures, water management etc. The verification and validation of planning sites is provided by one of the applications of web GIS called BHUVAN. Bhuvan is a software application which allows users to explore a 2D/3D representation of earth. It offers detailed imagery of Indian locations with spatial resolution ranging up to 1 meter. The satellite scenes of LISS-III data is used as the input imagery for the analysis part.

2. Study Area

The study was set to West Godavari in Andhra Pradesh. It occupies an area of approximately 7,742 sq km and Eluru is the headquarters of it. The district was situated between 80º 50′ and 81º 55'E, of the eastern longitudes and 16º 15′ and 17º 30'N, of northern latitudes. Khammam District lies to the north, East Godavari District to the east, the Bay of Bengal to the south, and Krishna District to the west. The district is located in delta region of the Krishna and Godavari rivers. The district has population of 39,34,782 as per the 2011 census. The average annual rainfall of west Godavari district is 1078mm which specifically proves it's a rain fed area. Te average elevation of study area is 22 Meters from mean sea level.

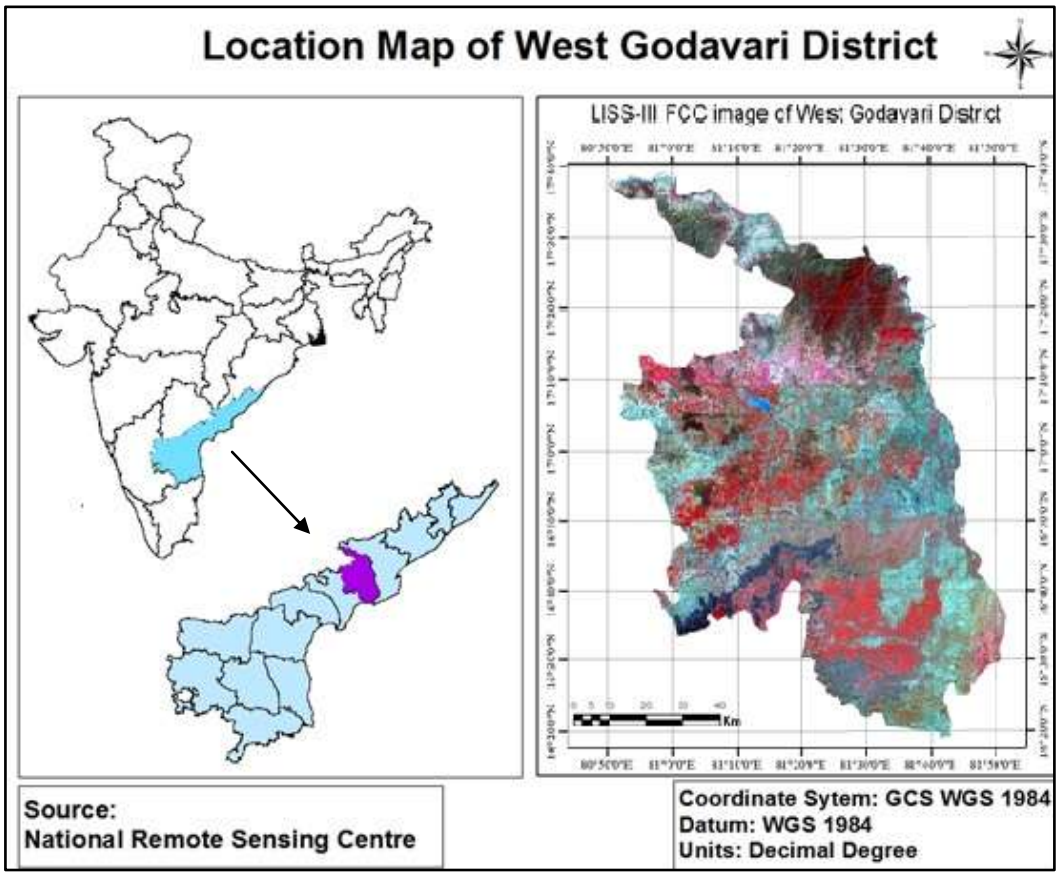


Figure 1 Study Area of West Godavari District

3. Methodology

Work flow for planning suitable sites:
Stage 1: Select an area to implement planning based on ridge to valley principle.
Stage 2: Consider multi thematic dataset of four layers

i. Land use land cover
ii. Road network
iii. Drainage network
iv. Digital elevation model

Stage 3: Use the DEM map for understanding the relief features of the terrain and classify the area into different zones.
Stage 4: Get the Slope Map from DEM

Stage 5: Calculate the Euclidean Distance of both Road and drainage network and Reclassify them
Stage 6: Calculate the Weighted Overlay Model by giving reclassified Slope, LULC, Road, Drainage networks as inputs.
Stage 7: Delineate the Suitable sites to identify the check dams. This derived data for acquisition of Check dams which are neither undertaken by MGNEGA nor by IWMP.
Stage 8: Extract the suitable sites for suggesting various NRM activities like Check Dams and their accessibility for implementation.

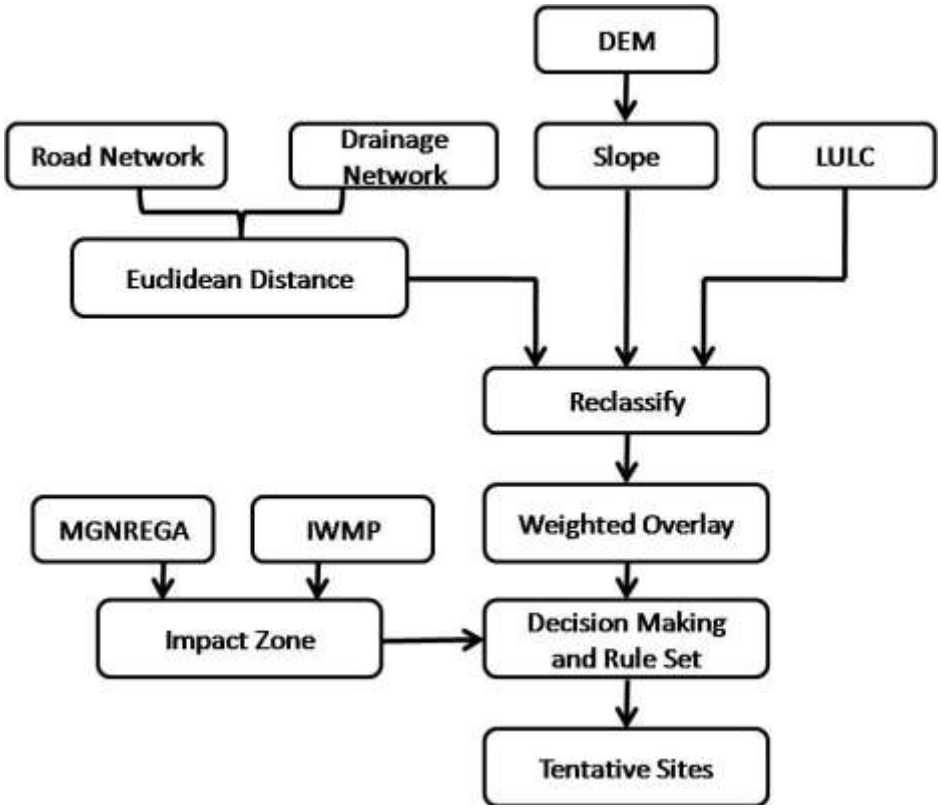


Figure 2 Methodology to implement planning of activities

Input thematic layers

LULC: LULC pertaining to the study area has been considered. First level LULC classification is being done by considering the following thematic layers: agricultural land, forest land, built up, wasteland and water bodies. This theme is tested every time for checking the suitability to plan each NRM activity and to assign the weighted value of site based on suitability criteria to a particular activity.

Road Network: Roads play an important role in planning because they serve the purpose of rural connectivity to implement the activities (both labour and machinery). The road map for the study area contains five major categories State High way, Village road, Cart road, District road and foot path.

Drainage Network: Drainage network is a key to implement mission water conservation activities. The flow direction estimate is primarily decided by its drainage pattern and number of streams with their respective order.

Digital Elevation Model: To better understand the elevation of the terrain at each pixel, the DEM points its exact altitude from the mean sea level. The maximum elevations for the study area are 199 meters from MSL. All the discussed input thematic layers with their specifications are shown in the figure [3].

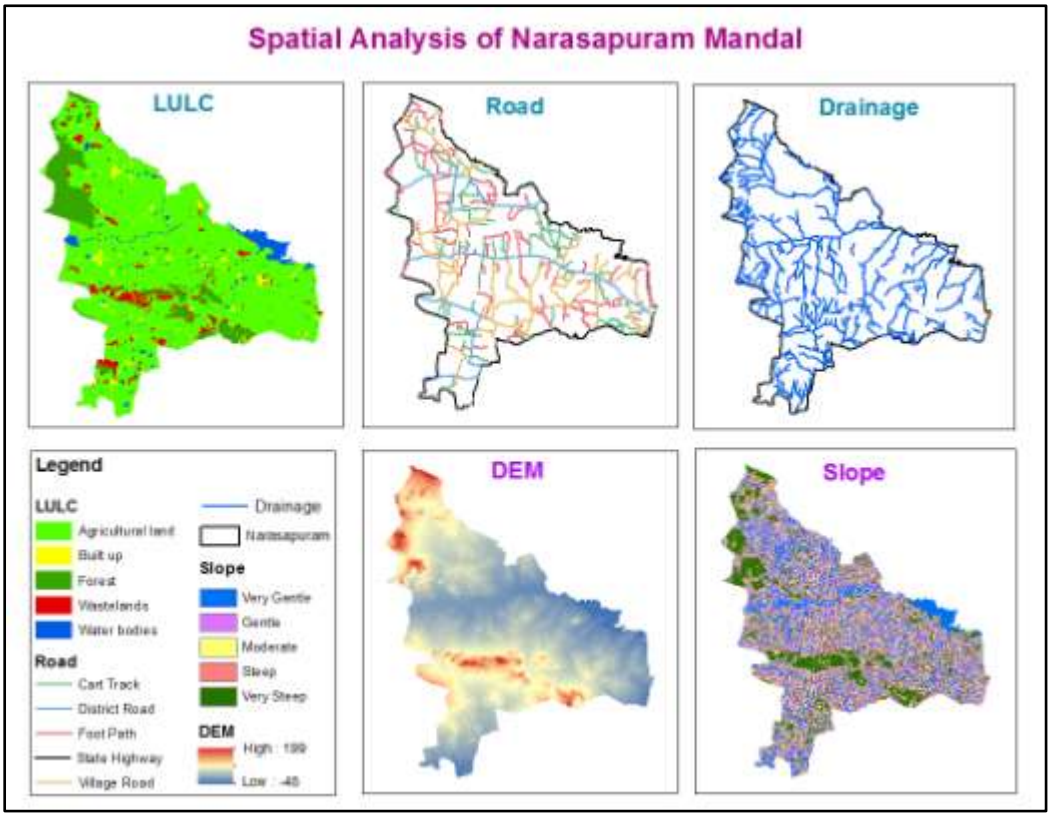


Figure 3 Input Thematic layers

3. Results and Analysis

Sectorwise assets created and geotagged in West Godavari:

The total assets in West Godavari district are categorised into different fields based on the type of activity taken place. The activities that are covered in West Godavari district are: Micro Irrigation works (24057), Rural Sanitation (10072) and Drought Proofing (3961).

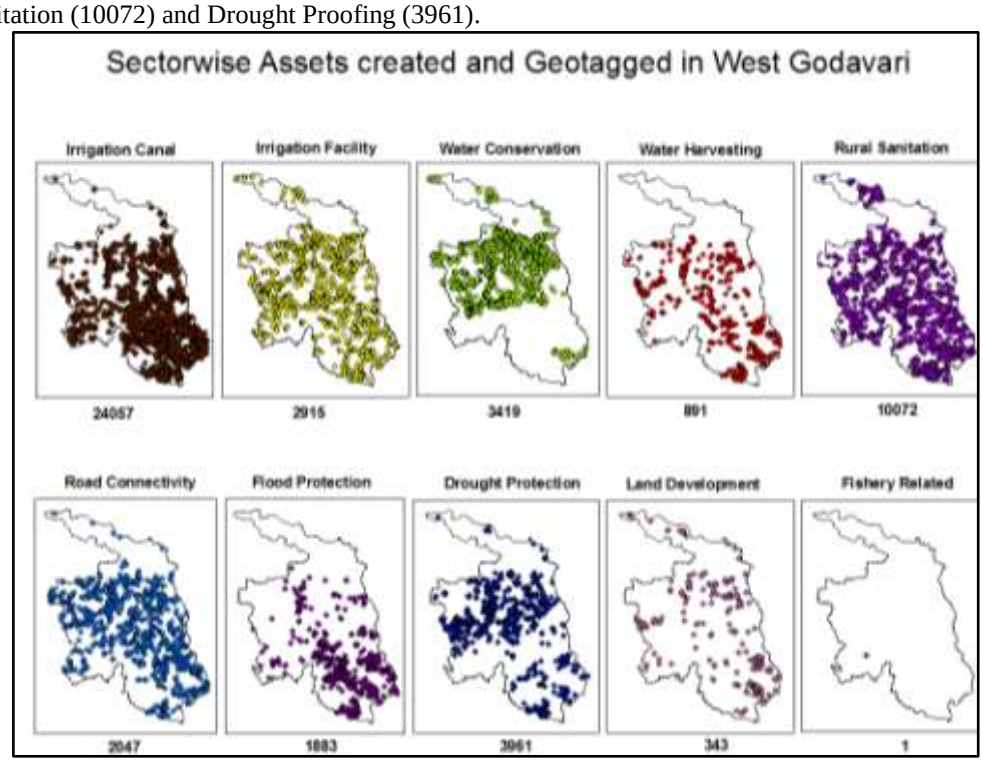
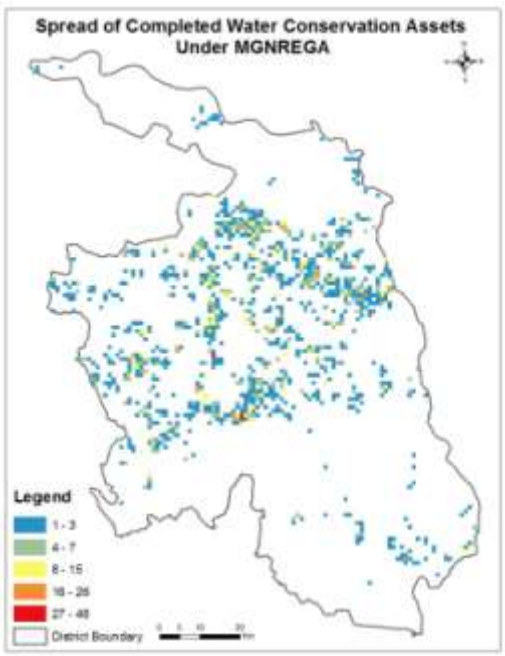


Figure 4 Sectorwise assets created and geotagged in West Godavari

I. Grid Based analysis of understanding the spread of completed assets geotagged in West Godavari district:

In order to combat the problems associated with different sizes and shapes of geographical regions, uniform grids (or quadrats) can be drawn in a GIS as a layer over the study area and thematically shaded. Therefore, all areas used for thematic shading are of consistent dimensions and are comparable, assisting the quick and easy identification of density of assets. Here, the grid size choosen is of 1 Sq. Km. for Water Conservation (WC), the range is 1-46 and for Water Harvesting (WH), the range varies from 1 to 182.



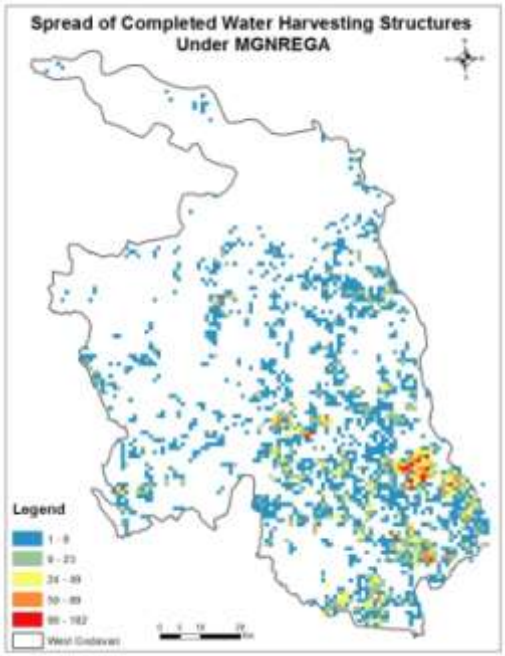


Figure 5 Completed Assets of Water Conservation under MGNREGA in West Godavari
Figure 6 Completed Assets of Water Harvesting under MGNREGA in West Godavari

I. Sites for Check Dams:

The Remote Sensing and GIS technology are one of the easy and comfort way to find out optimum check dam location. Check dams are to be planned in an area having an annual rainfall around 1000 mm. and the site should be along the drainage channel (preferably on the second and third order streams).The water way should be on the slope of not more than 30 degrees. Height of the check dam must be in between 2 to 3 feet and its length varies between 6 to 10 meters (samarthya-2015). The spacing between the check dams must be in such a way that toe of the upstream check dam is equal to the elevation of the downstream check dam's crest. This is taken with reference to the general scenario of the rock check dam with a weir height of 2 feet and having a slope of less than 20 percent the other check dam must be constructed at a distance of 100 feet.

a. Input Thematic Maps

After taking the slope, elevation from mean sea level, drainage pattern, rainfall, road network, LULC and hydrology into consideration, 5 suitable sites are planned for the construction of check dams for the considererd Narsapuram Mandal. This output is shown in the figure [7]

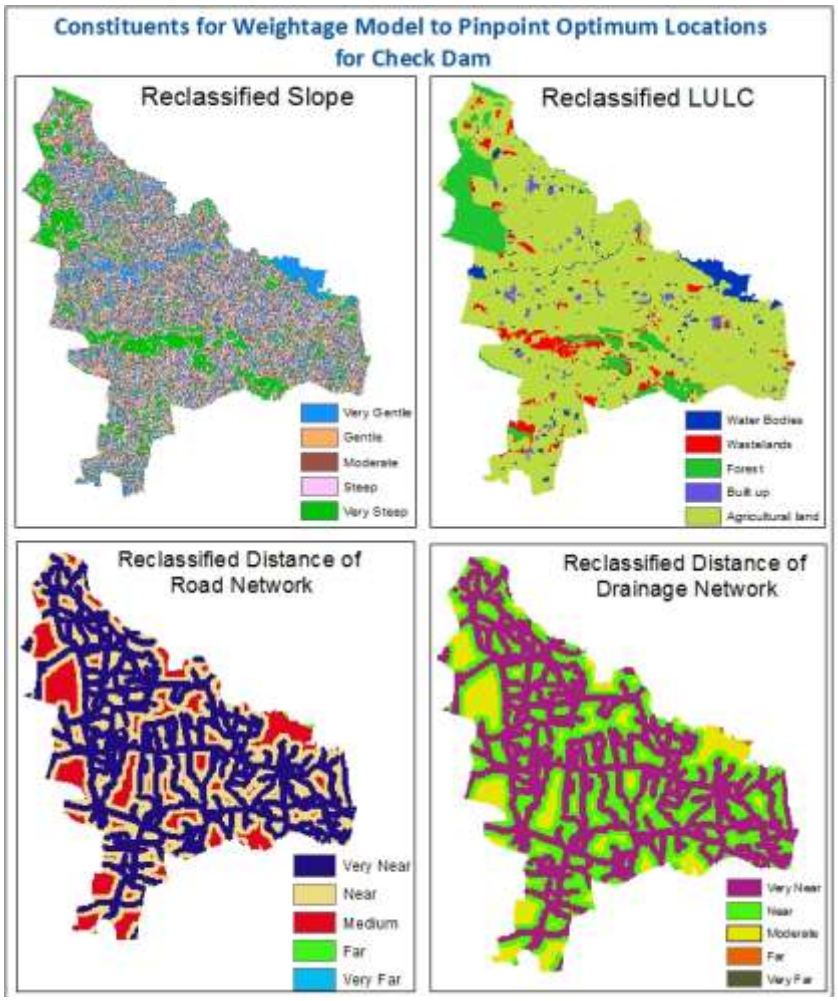


Figure 7 Input Thematic Layers for the Planning of Check dams

b. Tentative Sites for the Planning of Check Dams

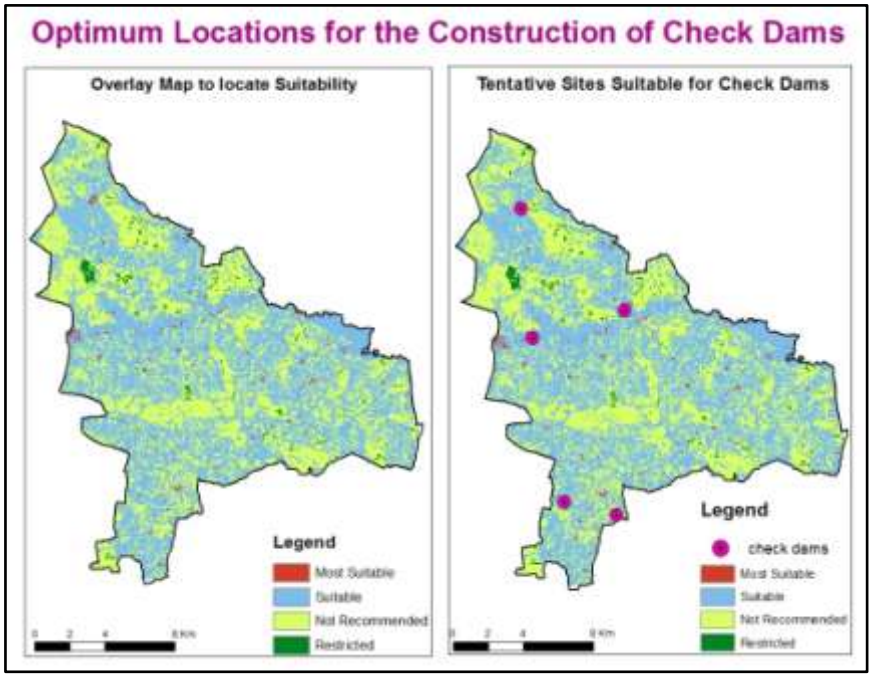


Figure 8 Optimal Suitable Sites for Check Dams

c. Weighted Overlay

Explanation

From the above figure [9], the suitable sites for the planning of Check Dams are obtained by computing percentage influence and weighted values with reference to each layer as shown in the table. Red colour patches are the most important sites which contribute for high suitability and the further suitability is explained colour wise as shown above

Raster	% Influence	Field	Scale Value
Reclassified Roads	10	Value	
		Very Near	2
		Near	1
		Medium	3
		Far	4
		Very Far	5
		NODATA	NODATA
Reclassified Drains	40	Value	
		Very Near	1
		Near	1
		Medium	2
		Far	3
		Very Far	4
		NODATA	NODATA
Reclassified Slope	25	Value	
		Very Gentle	2
		Gentle	1
		Moderate	1
		Steep	4
		Very Steep	5
		NODATA	NODATA
Classified LULC	25	dscr1	
		Water Bodies	2
		Built up	5
		Agricultural land	5
		Forest	5
		Wastelands	3
		NODATA	NODATA

Figure 9 Weighted Overlay values of each layer with their Ranks

Conclusion

All the thematic maps such as Land use land cover, soil map, slope map and stream network are overlayed and cross operation has been done using GIS and best suitable location for check dams are suggested in the study area and 5 sites for check dams are proposed in the Narasapuram Mandal of West Godavari district. The suggested sites are in the areas of T. Narasapuram, Makkinavarigudem and Rajupothepalli.

References

[1] Singh J.P., Singh D., Litoria P.K., 2009. Selection of Suitable Sites for Water Harvesting Structures in Soankhad Watershed, Punjab using Remote Sensing and Geographical Information System (RS&GIS) Approach- A Case Study. J. Indian Soc. Remote Sens; 37: 21–35.

[2] Srivastava R.K., Sharma H.C., Raina A.K., 2010. Suitability of soil and water conservation measures for watershed management using geographical information system. Journal of Soil and Water Conservation; 9(3):148-153.

[3] Subasini A., Shanmugasundram K., Ravikumar V., 2016. Optimal allocation of check dam using remote sensing and geographical information system – a new approach. American Research Thoughts; 2(6):31-42.