SPATIAL TECHNIQUE IN IRRIGATION POTENTIAL EVALUATION AND CROP SUITABILITY ANALYSIS IN AMRAVATI PEDHI CATCHMENT, MAHARASHTRA

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ABSTRACT

The study aims at evaluation of land use suitability of Pedhi catchment, Amravati area for surface irrigation using GIS. The evaluation of land in terms of the suitability classes was based on the method as described in FAO guidelines for land evaluation. Multi-criteria decision evaluation method is used to evaluate the physical land characteristics of the study area for surface irrigation. There are techniques, which are used to weight and standardized the factors, which are used to evaluate the land in the study area. Different types of data are utilized to attain the objectives in this research work. Crop suitability analysis and irrigation suitability for the area of interest using spatial technique have been explored with the available digital data and field data.

INTRODUCTION

The study aims at evaluation of land use suitability for surface irrigation by using GIS. The evaluation of land in terms of the suitability classes is based on the method as described in FAO guideline for land evaluation. Multi-criteria decision evaluation method is used to evaluate the physical land characteristics of the study area for surface irrigation. The factors that are considered for evaluation of the land for surface irrigation is slope, soil drainage, soil texture, soil depth, soil type and land use. After evaluating the physical land capability for surface irrigation, irrigation suitability map is developed. This map is classified in to five suitability classes based on FAO guideline. The land in the study area is evaluated for suitability of crops. Temperature and rainfall amount of the study area are the factors in addition to the factors mentioned above used for surface irrigation evaluation. Oranges and cotton are selected to evaluate the land of the Pedhi catchment, Amravati. Suitability maps for both oranges and cotton are developed. The suitability crops maps are classified in to five suitability classes. In this study,

the method which is used to evaluate the land suitability for surface irrigation and crops is based on FAO guideline (FAO, 1976). In this paper attempt has been made to adhere to the guidelines of FAO making use of the satellite and ancillary data for derivation of the crop and irrigation suitability.

OBJECTIVES

To evaluate the physical land characteristics and its quality of the study area for suitability of surface irrigation potential and crops in GIS environment using multi-criteria decision evolution (MCDE) method.

Specific Objectives

a) To evaluate the slope gradient of the land for surface irrigation
b) To evaluate the soil drainage properties of the catchment
c) To develop physical land suitability map for irrigation of the Amravati Pedhi catchment
d) To study major kinds of crops which are suitable for the land and develop suitability maps

THE STUDY AREA

The study area has been taken as depicted at Figure 1.

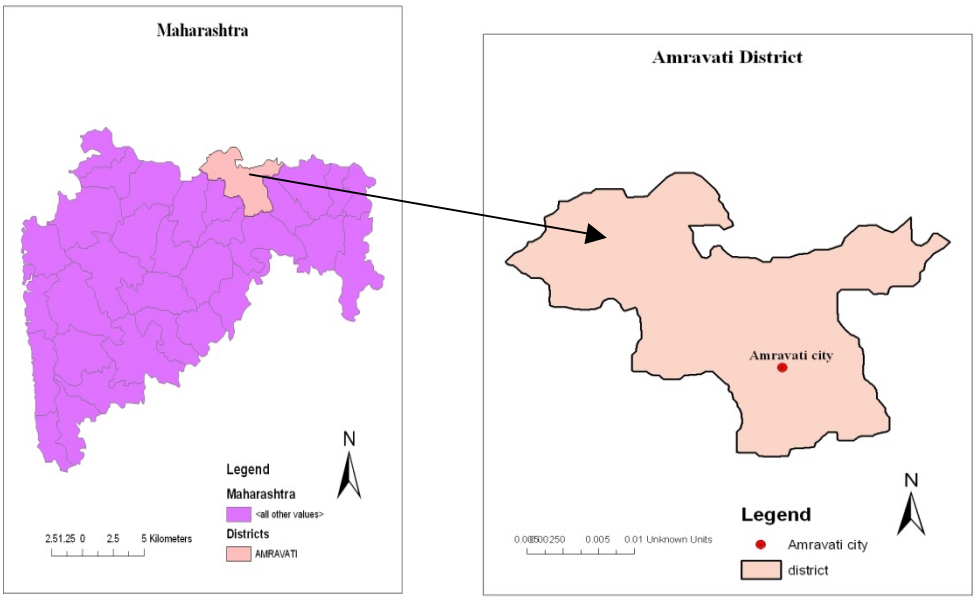


Figure 1- Location Map of the study area

METHODOLOGY

The study aims at evaluation of land use suitability of Pedhi catchment, Amravati area for surface irrigation using GIS. The evaluation of land in terms of the suitability classes was based on the method as described in FAO guideline for land evaluation. Multi-criteria decision evaluation method is used to evaluate the physical land characteristics of the study area for surface irrigation. There are techniques, which are used to weight and standardized the factors, which are used to evaluate the land in the study area. Different types of data are utilized to attain the objectives in this research work.

For the evaluation of physical land suitability of the catchment for irrigation, sets of factors that influence the capability of physical land and water resource for surface irrigation in the study area were first established. From these factors, the possibilities and constrains for surface irrigation were analyzed. The following factors, which were discussed before, were considered for the evaluation of the physical land suitability for irrigation:

1. Slope gradients
2. Soil texture
3. Soil depth
4. Soil drainage
5. Present land use of the catchment
6. Soil type of the catchment

The procedure is derived from FAO guideline to find out i) the specified kind of land use, which areas of land are best suited, ii) for any given area of land, which kind of use is it best suited. The work is envisaged to have study of land-use types, selection of land qualities and land characteristics, mapping of land units and their characteristics, setting limiting values for land-use requirements, factors determining surface irrigation potential, topographic characteristics, slope gradient, slope suitability, physical properties of soil, soil texture, depth, soil depth suitability, soil drainage and physical land suitability mapping for irrigation. Based on the above, the land suitability map would be classified into two classes i.e. suitable and not suitable. These suitable and not suitable classes are further classified based on their benefits and limitations.

DEVELOPING SUITABILITY MAPS FOR ORANGES AND COTTON

Weighted Linear combination method was used to create suitability map (Ronald Eastman J., 2001). In this technique, the eight important factors were mapped and reclassified into four classes. These were ***Very Suitable (S1), Suitable (S2),Marginally Suitable (S3) and Unsuitable*** **(N**). Each factors map was multiplied by weighting factors and sum together to get the suitability maps for **Oranges** and **Cotton**. Finally, one and zero respectively to obtain the final result map for suitability of Oranges and Cotton multiplied the result map and constraints map.

$$S\ m=\Sigma WiXj \quad (1)$$

$$Sc=\Sigma WiXj \quad (2)$$

Where,

S m= 0.27D+0.21SD+0.12 ST +0.15 SP +0.11TP +0.08RF+0.04 ST+0.02 LU

S c =0.28 SP + 0.21 ST + 0.16 SD +0.12 D + 0.10 TP +0.07 RF +0.08 ST+0.02 LU

and

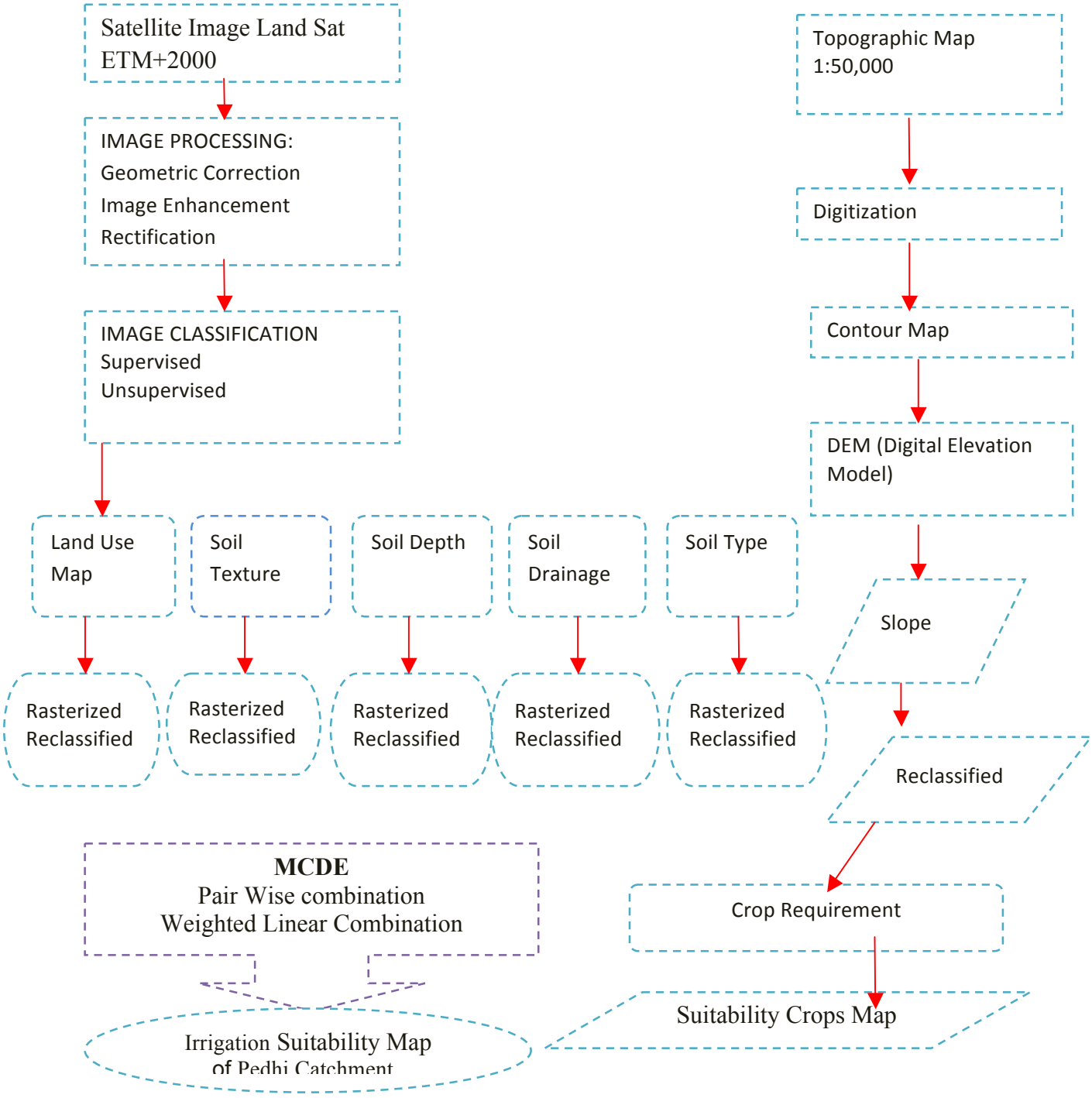
S m = Suitability map for Maize,

S c =Suitability map for Cotton, SD = soil drainage

D= Soil depth, SP= Slope, RF =Rainfall, TP= Temperature, T = Soil texture, ST = Soil type, and

LU = Land use

METHODOLOGY FLOWCHART



FACTORS MAP FOR CROPS SUITABILITY

The GIS maps depict the factors for mapping crop suitability.

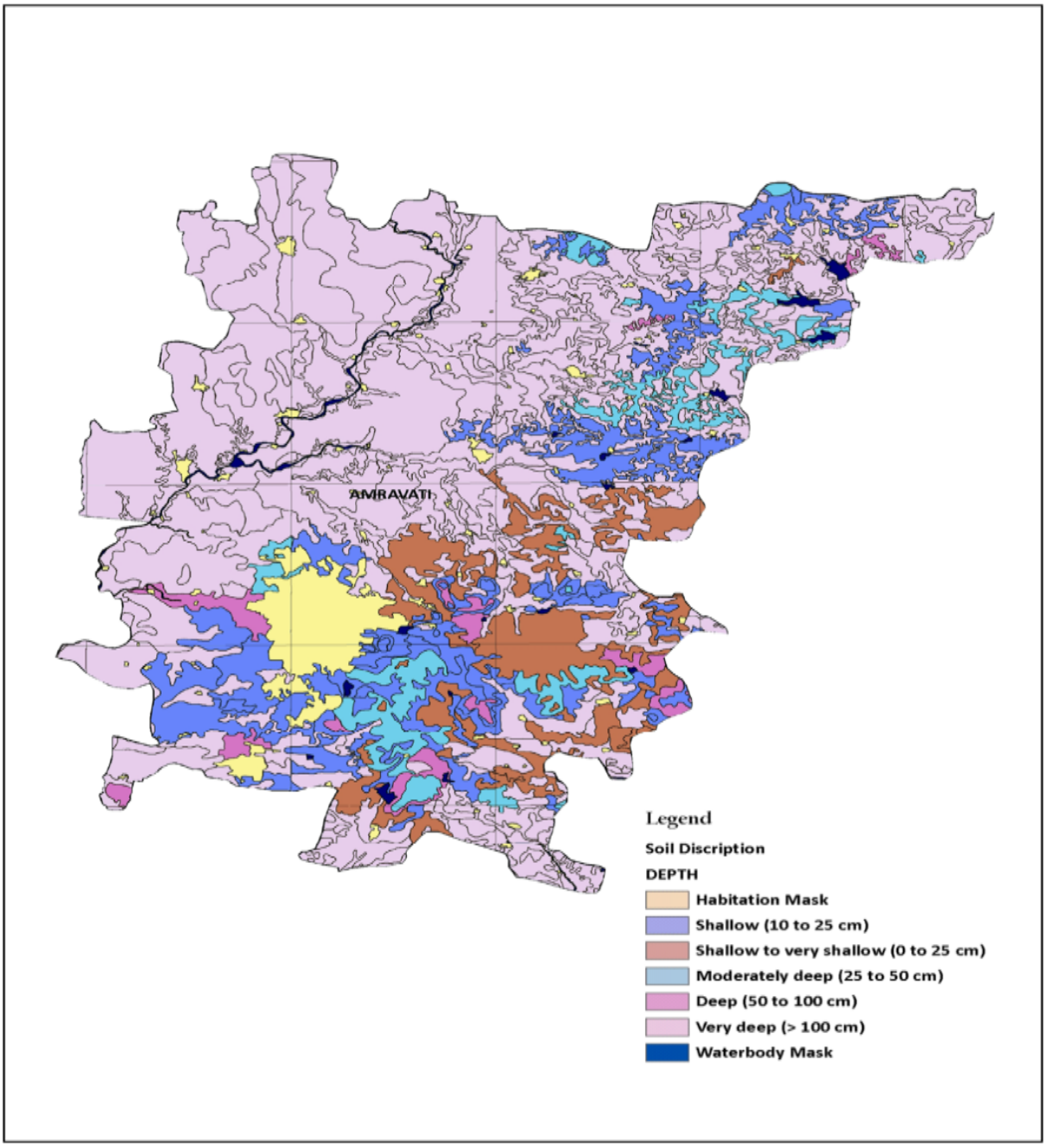


Figure 2 Soil depth of Amravati district

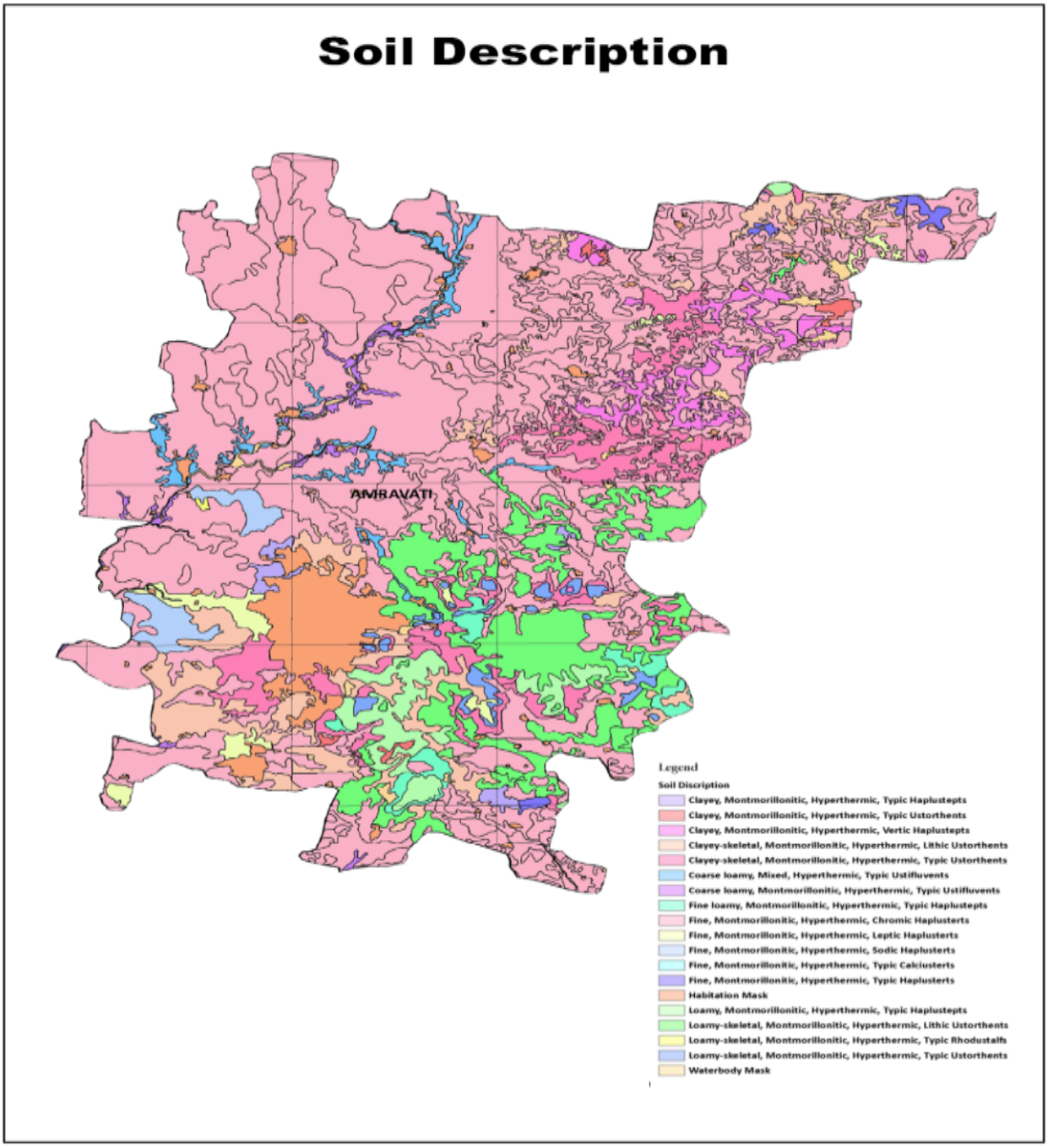


Figure 3 Soil description of Amravati district

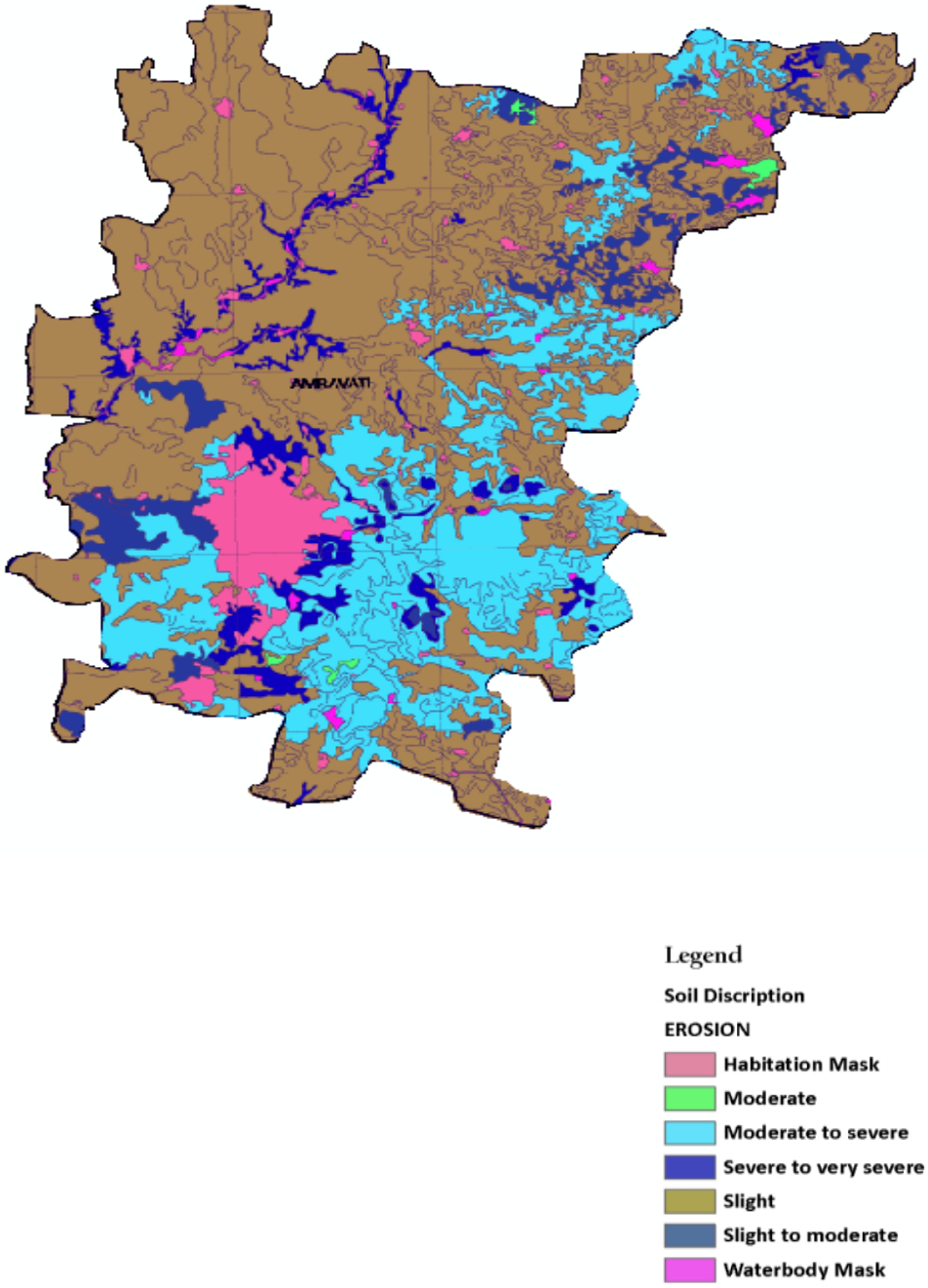


Figure 4 Soil erosion of Amravati district

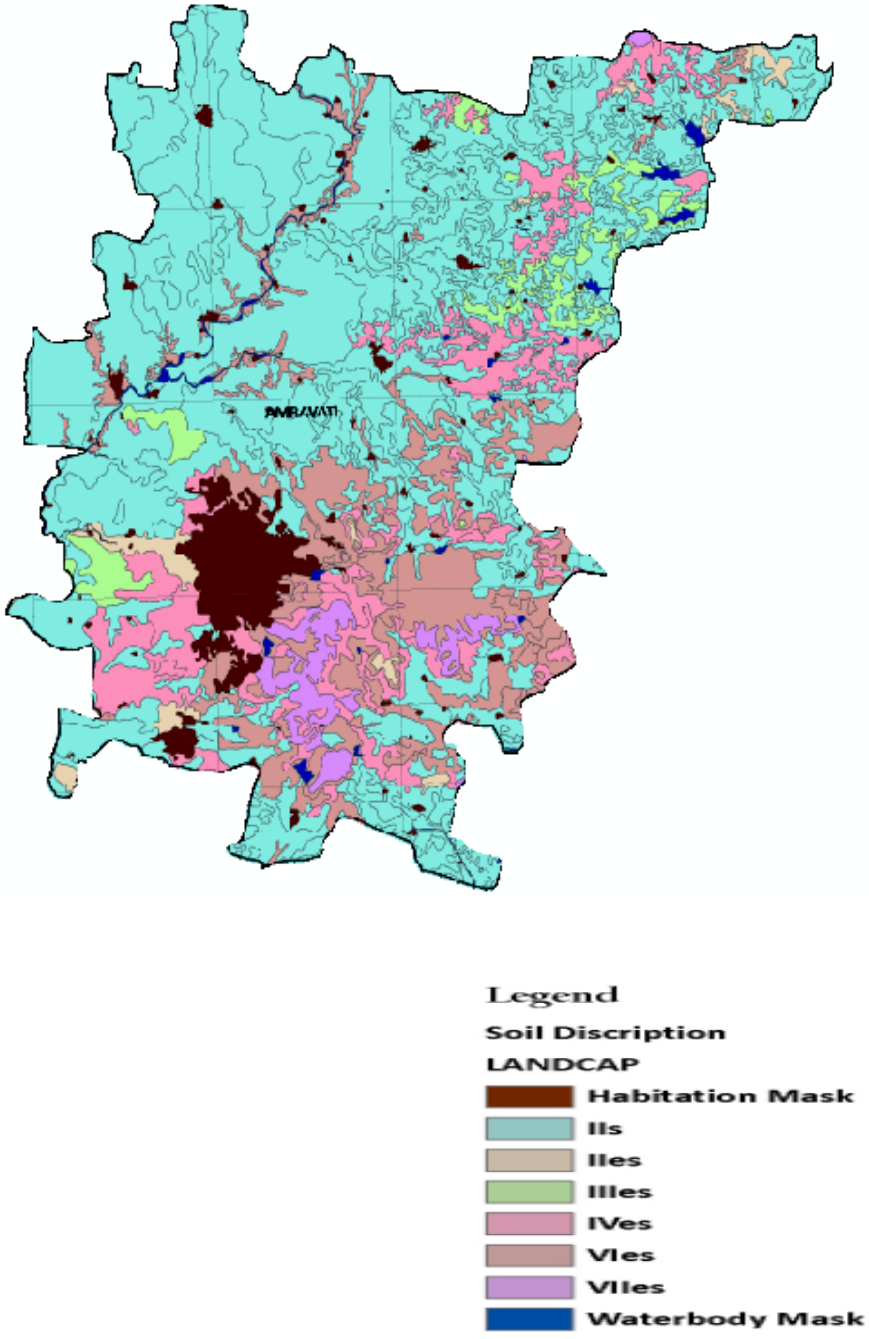


Figure 5 Soil landcap of Amravati district

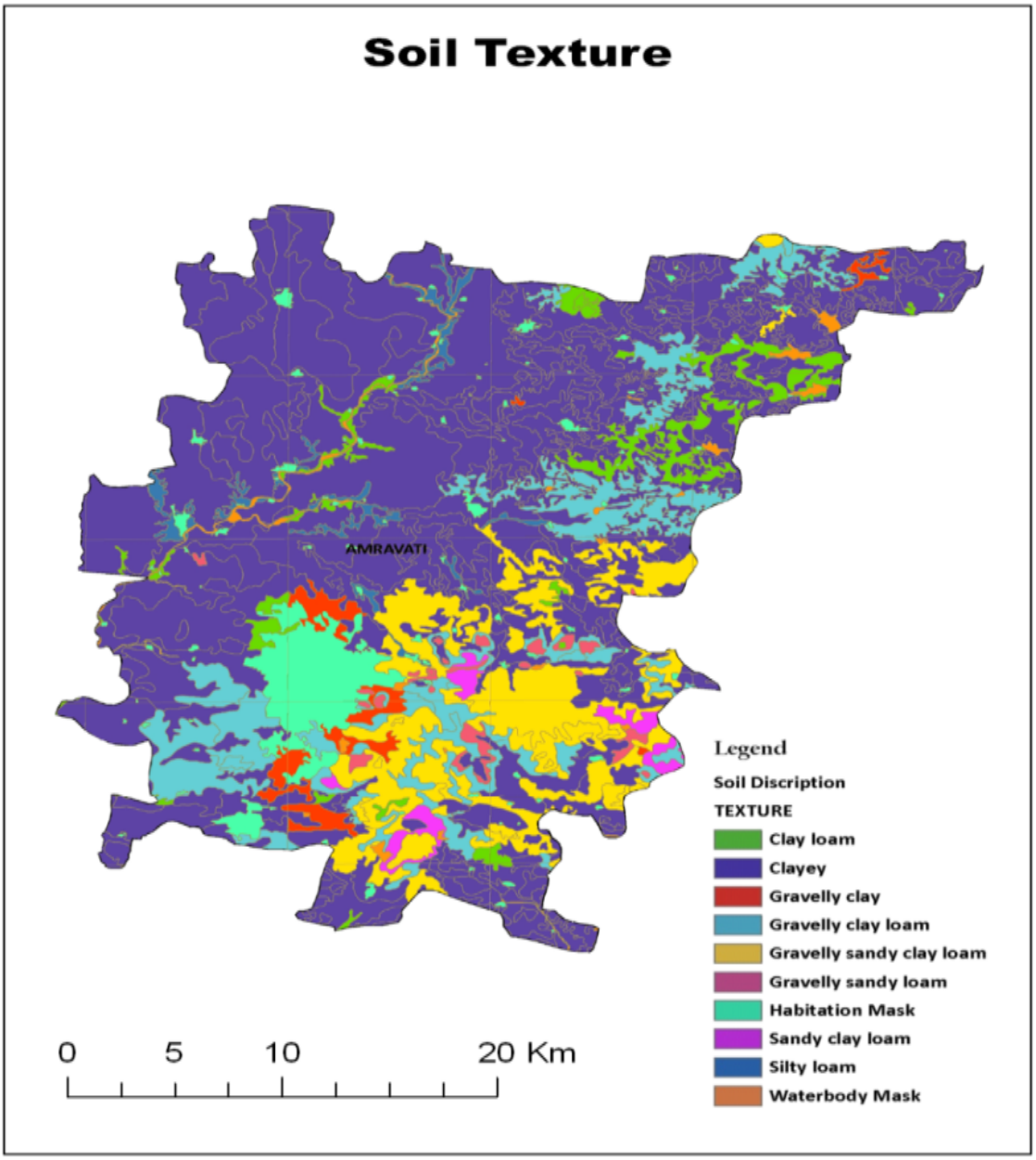


Figure 6 Soil texture of Amravati district

RESULTS AND DISSCUSSIONS

From the total land of the basin 12,149.7 km^2 (10.7%) was Very Suitable, 11,581.6 km^2 (15.1%) Suitable, 43,328 km^2 (32.6%) marginally suitable, 1,302 km^2 (11.5%)Marginally Not Suitable and 41,208 km^2 (30.1%) was permanently not suitable for **Cotton crops**.

From the total land of the basin 12,149.7 km^2 (8.2%) was Very Suitable,11,595.2 km^2 (15.2%) Suitable, 45,568 km^2 (35.3%) Marginally Suitable, 10,243 km^2 (10.6%) Marginally Not Suitable and 49,928 km^2 (30.4%) was permanently **not** suitable for **Orange crops**.

Agricultural land use system of the area should meet the demands of food supply for increasing population. Therefore, irrigation should be considered as an important investment for improving rural income through increased agricultural production in the area.

GROUND TRUTH IMAGES

Groundtruthing was done to validate the actual scenario with the satellite derived facts.

Pedhi River of Amravati District

Irrigation practices for the crops

Development stage of the orange

Developed stage of the Cotton Crops

CONCLUSIONS

The total land under the study area which is suitable for surface irrigation is which is 108.43 km^2 (71.2%) of the Pedhi Catchment. The other 30.37 km^2 (28.8%) is not suitable for surface irrigation due to slope limitation dominantly. However land suitability evaluation was done by combing different factors. The slope gradient found in this unsuitable area is greater than 13%.The land evaluation of physical land qualities of the study area indicates that Pedhi catchment has great potential for surface irrigation. The factors which were considered for evaluation of the land for surface irrigation of the study area are slope of the land, soil depth, soil texture, soil type, land use land cover and water resource such as drainage nature and climate. These factors were also used for suitability of crops under the study area. The selected crops for evaluation of physical land characteristics are oranges and cotton. The most critical factor that determines surface irrigation is slope gradient.

REFERENCES

1. FAO. 1976. A framework for land evaluation. Soils Bulletin, No. 32.
2. FAO. 1978. Report on the agro-ecological zones project. Volume 1: Methodology and results for Africa. FAO, Rome.
3. FAO. 1986. Irrigation in Africa south of the Sahara. FAO Investment Center Technical Paper 5. Rome.
4. FAO. 1987. Irrigation and water resources potential for Africa. FAO report AGL/MISC/11/87, Rome.
5. FAO. 1995. Agro climatic database. Rainfall and evaporation figures. FAO. Rome
6. FAO.1995. AGROSTAT PC diskettes on population, crop production and land use. Rome
7. Ronald Eastman J. 2001.Idrisi 32 Guide to GIS and image processing, volume 1**.**World Bank.1993. Private sector development in agriculture. Report 9686-BU.Washington.
8. Sys Ir C, van Ranst E, Debaveye J. 1991. Land evaluation. Part I. Principles in land evaluation and crop production calculations. International training center for postgraduate soil scientists, University Ghent.
9. Thorne D.W. and Peterson H.B., (1949) Irrigated Soils, their fertility and Management, New York, The Blackston Company, Inc. Toronto.