

A GIS Based Study on Land Evaluation in Rasipuram Block, Namakkal District, Tamil Nadu

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ABSTRACT: The main objective of this study is to identify an appropriate land suitable for cultivation in a scientific land evaluation manner. This kind of analysis gives a proper idea for the farmers to do the land management practices and helps to increase land productivity. A GIS based multi-criteria decision making (MCDM) is used to achieve this objective to assess the suitable area for the cultivation of crops. Overlay analysis has generally taken the form of weighted overlay depending on our perspective. The main objective of weighted overlay is to calculate a new set of values for the complete coverage based on a combination of input values. This operation processes the complete data sets, so boundaries from all inputs layers will be retained. The study area taken for this study is Rasipuram block of Namakkal District. The District lies in the interior part of Tamil Nadu. The layer used in decision making system is soil parameters such as texture, production potential and climatic parameters such as rainfall, physical parameters such as drainage density, slope and geomorphology. All these layers are ranked properly based on the expert advice and literature then suitable weights are assigned to do the overlay analysis method to delineate suitability classes. Finally, the Study area has been classified into five categories such as highly suitable (S1), moderately Suitable (S2), marginally Suitable (S3) and temporarily not suitable (N1) and permanently not suitable (N2). The cartographic works are prepared by using GIS technology.

KEYWORDS: GIS, MCDM, pH, EC, Irrigability, Rainfall, Land Evaluation, Suitability classes.

I. INTRODUCTION

Due to rapid growing of population and need for secure food, human beings should give much attention to the physical environment mainly soil and climate. One of the ways to provide food for the human being is to increase the production in unit area and to use the land in appropriate way based on the potentiality of the land. Environmental conditions, land use type and management determine the production limit of the land. Any land if we utilize more than its capability will cause degradation and reduces the yield. The present study was undertaken to demonstrate the usefulness of RS and GIS technologies coupled with soil data to assess crop suitability in order to implement sustainability for crops in the study area. The potential of the integrated approach in using GIS and RS data for quantitative land evaluation has been demonstrated earlier by several researchers (Beek et al., 1997 and Merolla et al., 1994). In MCDM approach: GIS are best suited for handling a wide range of criteria data at multi-spatial, multi temporal and multi-scale from different sources for a time-efficient and cost-effective analysis. Therefore, there is growing interest in incorporating GIS capability with MCDM processes.

II. RELATED WORK

To assess the suitability of land for agricultural production, not all criteria affecting land suitability for that some criteria need to be considered together and that should have equal levels of significance, various methods were used in determining the weights of these criteria and the scores of the sub-criteria (Prakash, 2003). The parameters such as soil texture, soil moisture, soil consistency, soil pH, soil drainage, organic matter content and slope in agricultural land suitability analysis (Perveen et al. (2007). The overlay procedures play a central role in many GIS applications (O'Sullivan and Unwin, 2003) including techniques that are in the forefront of the advances in the land-use suitability

analysis such as: multicriteria decision analysis (MCDA) (Diamond and Wright, 1988; Carver, 1991; Thill, 1999). To create visualized suitability map for users and decision makers, the integration of MCDA and GIS has been widely promoted for solving spatial problems in urban assessment and planning (Phua and Minowa 2005).

III. STUDY AREA

Namakkal district lies in the interior part of the Tamil Nadu and comprises of 15 blocks. In that Rasipuram is one of the block. The study area is bounded by Vennandur in the north, Namagiripet in the east, Puduchatram in the south, and Mallasamudram in the west. The block lies between 78°06'E to 78° 15' E and 11° 23'N to 11°31' N. The study area consists of one municipality, two town panchayat and 23 villages. The study area occupies 105.82sq.km. The total population of the study area is 128834 as per 2011 census. The block is characterised by sub-tropical climate with moderate temperature. The maximum temperature ranges from 24° C to 39° C and the minimum is 13° C to 28° C. There is no major reservoir or tank in this block.

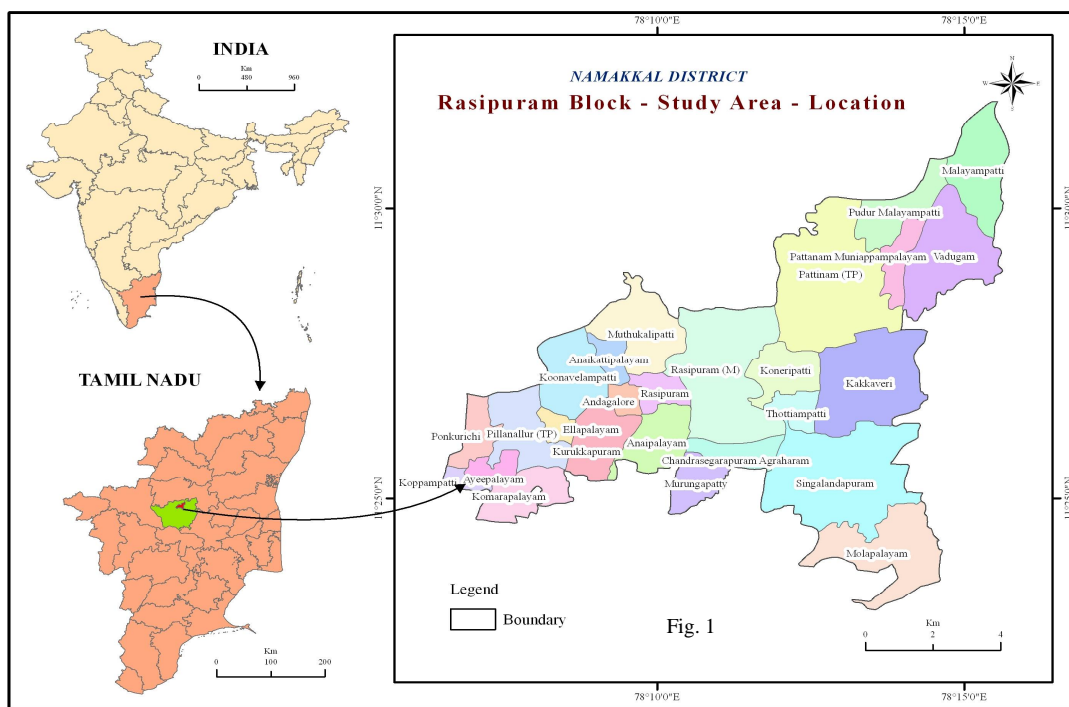


Fig.1. Study area – Location.

IV. OBJECTIVE OF THE STUDY

The main aim of this study is to determine the physical land suitability for agricultural land using Multi-Criteria analysis for Rasipuram block of Namakkal District.

V. METHODOLOGY

The most fundamental step in land suitability analysis is the data preparation. A GIS based multi criteria decision analysis is used to evaluate land suitability. To do this analysis the following datasets were prepared. The geomorphology map was taken from the Geological Survey of India. The drainage map is prepared by using toposheet bearing the numbers 58 I/2, 58 I/3 and 58 I/6. The settlement is demarcated by preparing land use map from LISS – III satellite image acquisition on October 2013. Slope map is created by using ASTER image having the resolution of

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30m. The soil texture and production potential map is collected from the Tamil Nadu Agriculture University (TNAU), remote sensing department. The data on rainfall for the year 2013 is collected from the department of Economics and Statistics. The weightages and ranking method is very important step in multi-criteria analysis. The weightage and ranks are shown in the table.1

Table. 1. Weightage Analysis for Land Suitability for Rasipuram block.

Parameters	Weight	Classification	Rank
Production Potential	0.25	Good	15
		Average	7
		Poor	2
		Ex-Poor	1
Geomorphology	0.2	Denudational Hill	0
		Pediplain	15
		Structural Hill	5
Soil Texture	0.15	Clay	8
		Loam	6
		Sandy Clay	2
		Silty	0
Rainfall	0.15	Medium	20
		Low	4
Slope	0.15	<10	7
		30-Oct	5
		30-60	3
		>60	1
DD	0.1	High	1
		Medium	2
		Low	4
Land Use	0	Settlement	0
		Waterbody	0

VI. RESULTS AND DISCUSSION

A. DRAINAGE DENSITY

The drainage density is highly related with the intensity of the rainfall in the area. If rainfall is high the drainage line is also high. In the study area the drainage density is classified into four categories such as low, medium high and very high. The density is very high in the north eastern part of the region. The low density is found dominant mainly in the northern, western and eastern part of the study area. The ranks are given based on the importance in the land suitability classification. High rank is given to the low density level and low rank is given to the high density regions. The drainage density map is shown in the fig.2

B. GEOMORPHOLOGY

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Geomorphology of the study area is very important for to prepare land suitability. The salient geomorphic features present in the study area are Pediplain, Structural hill and Denudational hill (Fig. 3). The study area is dominated by the Pediplain and it covers almost entire part. The pediplain occupies nearly 97.07% of the total land area. The Denudational hill is found in the south eastern and as a small patch in north western part of the study area. The Structural hill is found here and there of the entire area.

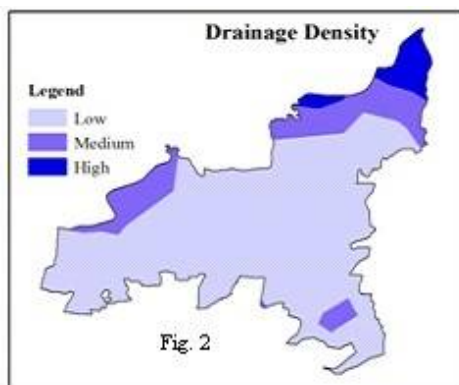


Fig.2.Drainage Density

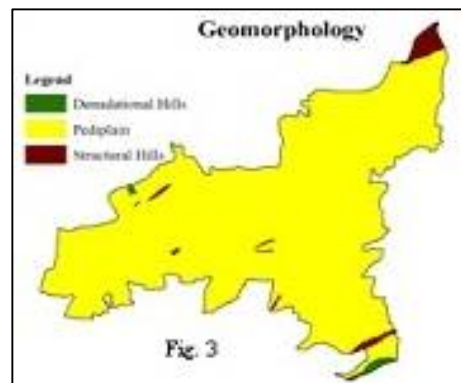


Fig.3. Geomorphology

C. PRODUCTION POTENTIAL

The production potential is broadly classified as Good, Average, Poor and Ex-Poor (Fig. 4). Nearly 31.90% (33.76sq.km) of the area comes under poor production potential. It is mainly found in the central and eastern part of the study area. Only 0.01% (0.018sq.km) of land comes under Good production potential category. This category is found like a small patch in the north eastern part of the study area. Next to Good category, Average production potential occupies second rank. Extremely poor and poor production potential is found dominantly in the entire study area and occupies 49.44% and 31.90% respectively. Extremely poor production potential category is found in the western and central eastern part of the study area. Poor production potential is found in the central and eastern part of the study area. Other includes settlement and tank area.

D. RAINFALL

Rainfall is one of the most important parameters in the land suitability classification. Rainfall determines the surface water flow in any region. This region gets rainfall both from north east and south west monsoon seasons. This region gets maximum rainfall during the month of October during 2013. The entire region is broadly classified into two categories such as Low and High. The rainfall is high over the central and eastern part of the study area. Low rainfall is found in the western part. The classified map is shown in the fig.5

E. SLOPE

Slope can be defined as the angle, inclination, steepness, or gradient of a straight line. Slope often is used to describe the steepness of the ground's surface. Slope is categorized in to four different classification based on the percentage such as gentle, moderate, steep and extremely steep. In this region the gentle slope is dominantly found and occupies 95.82% (101.4sq.km). It ranks first in the land suitability classes. Next to gentle slope, moderate, steep and extremely steep slopes are found and ranked based on the importance. In my study area extremely steep slope is found in the north eastern part and occupies only 0.04% (0.04sq.km) of the entire region. In the steep slopes cultivation of land is low so it ranks last in this slope classification for land suitability. The resultant map are shown in the fig.6

F. TEXTURE

Soil texture is one such aspect. Nearly, four classes are found in this study area they are Clay, Loam, Sandy clay and Silt. Clay ranks first in the overlay method because its retain moisture for a long time and good for agriculture if land management practice is carried properly. The concentration of clay is mainly found in the central and eastern part of the Rasipuram block (fig.7). Loam is considered ideal for agricultural uses because it retains nutrients well and retains water while still allowing excess water to drain away. This soil mainly found in the north eastern, south eastern and a small portion found in the western part of the study area. Sandy clay occupies 58.59% (62sq.km) of the total area.

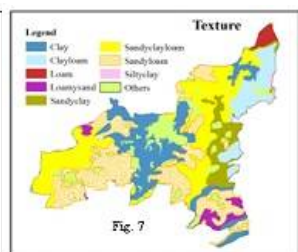
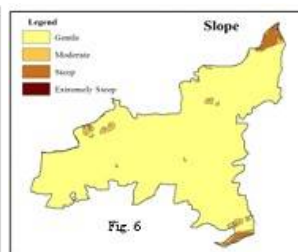
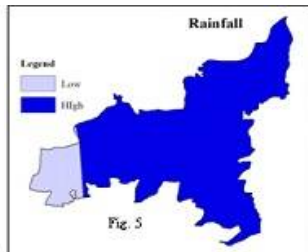
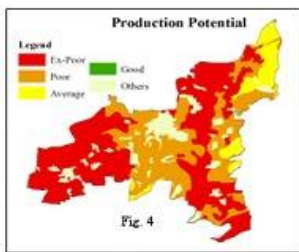


Fig. 4. Production Potential

Fig.5. Rainfall

Fig. 6. Slope

Fig. 7. Texture

G. LAND SUITABILITY ANALYSIS

The result for land suitability has been derived by using multi-criteria decision making (MCDM) technique. After providing proper weight and rank to the parameters a weighted overlay technique has been used extensively and the result has been portray in five categories. The result is shown in the fig.8. The classified map shows that only 0.7% of the total area is investigated as highly suitable. 9.9% as moderately suitable, 38.7% as marginally suitable, 44.1% comes under temporarily not suitable and 6.6% is under permanently not suitable. Geographically, 82.8% of the total area comes under marginally and temporarily not suitable classification.

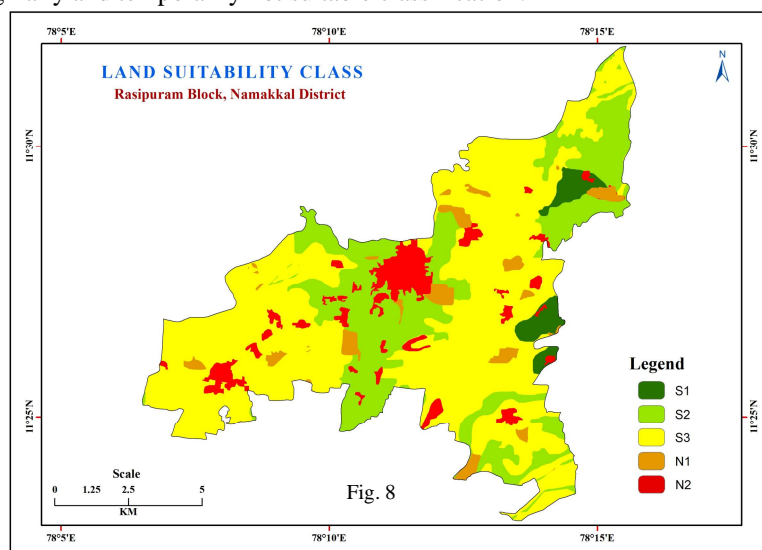


Fig.8. Land Suitability Class for Rasipuram Block.

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VII. CONCLUSION

This analysis is highly informative for the planners and decision makers particularly for agriculturalist and farmers to do proper management in the land mainly to get awareness and proper yield. Now a day's most of the agricultural lands are converted into residential and other secondary activities, it is become a threat to agriculture and allied activities. A GIS based decision making approach is most useful method because it integrates large quantity of data. Depending upon the purpose of analysis the weightage and ranking criteria have been varying. If the quantity of the data is high the precision in the result is also high. This method of analysis is not only for specific purposes but it also provides solution to a variety of decision making problems.

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