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Soil Analysis Including the Status of Ground Water Availability for Increasing Crop Production

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Abstract: *This study aims to carry out spatial analysis of soil properties and ground water availability status using LISS III image and toposheet of Madhubani district of Bihar. Soil is one of the main natural resources for the cultivation of crops. Soil property analysis and ground water availability are the main prerequisite to achieve optimum utilization of land resources for sustainable agricultural production. An important problem in Madhubani district is to improve agricultural land management and cropping pattern to increase crop production with efficient use of land resources. The aim of present study is to determine land suitability for different crops using multicriteria decision technique and GIS approach for optimum use of land resources. The study was carried out in Madhubani district of Bihar state. Maximum area of Madhubani district comes under flood or flood prone. Soil mapping and ground water mapping are very important to know the status of soil and water resources for better planning to increase the agricultural production in this area. This research will provide information to local farmers to select better cropping pattern and suitability. Toposheet of Madhubani district has been digitized. Different soil samples were collected from all blocks of Madhubani district and these soil samples were tested to get their properties such as N, P, K, OC, EC and pH. After getting soil properties, these data were linked blockwise showing as different points on the digitized blockwise map of Madhubani district. Different maps related to soil properties such as nitrogen (N), phosphorous (P), Potassium (K), pH, Organic Carbon (OC), Electrical Conductivity (EC) and ground water availability have been developed. These maps may be used to analyze land suitability for different crops in Madhubani district that may be used for better land use planning for the increase of crop production in this area.*

Key words: *soil samples, soil properties, toposheet, digitization, mapping*

INTRODUCTION

Land suitability analysis for crops is an essential requirement for optimum utilization of the available land resources for sustainable agricultural production (Parveen *et al*, 2007). Land suitability for rice cultivation based on different variables such as soil physical and chemical properties, temperature, rainafall and land accessibility has been done in Papua New Guineaa **(**Sailesh *et al*, 2011**)**. One of the most useful applications of Remote Sensing (RS) and Geographic Information System (GIS) for planning and management is the land use suitability mapping and analysis (Mc Harg *et al*, 1969). Land use suitability analysis broadly defined as identifying the most appropriate spatial pattern for future land uses according to requirement, preferences, predictors of some activity (Hopkins *et al*, 1977**).** The integration of Multicriteria decision making methods (MCDM) techniques with GIS has considerably advanced the conventional map overlay approaches to the land suitability analysis (Carver *et al*, 1991). GIS based MCDA(Multicriteria Decision Analysis) can be thought of as a process that combines and transforms spatial and non spatial data (input) into a resultant decision (output). The MCDM procedures (or decision rules) define a relationship between the input maps and the output maps. The procedures involve the utilization of geographical data, the decision maker's preferences and the manipulation of the

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data and preferences according to specific decision rules. A number of multicriteria decision rules have been implemented in the GIS environment for taking land use problems. The decision rules can be classified in to multiobjective and multiattribute decision making methods (Malczewski, 1999). The multiobjective approaches are mathematical programming model oriented methods, while multiattribute decision making methods are data oriented.

Crop land suitability analysis was done to determine physical land suitability for rice crop using a multicriteria evaluation (MCE) and GIS approach in Haripur Upazila, Bangladesh. To generate present land use cover map, Terra/ ASTER 22 March 2003 satellite image was classified using ERDAS IMAGINE 8.7 by means of supervised classification **(**Farida Parveen *et al,* 2003). Land suitability for various crops and for generating cropping pattern for summer and winter seasons in Kheragarh tehsil of Agra has been done (Mustafa, *et al,* 2011). Kheragarh tehsil suffers from many types land degradation such as salinity, waterlogging, ravines, degraded hills and rock quarries (AIS & LUS, 2000). The database on soil, land use/ land cover was generated from data derived from IRS-P6 remote sensing satellite and soil survey to perform an integrated analysis in the geographic information system environment. Agricultural and non agricultural lands were delineated using the Decision Tree Classifier (DTC) and non agricultural areas were masked for removal from future analysis. One such technique is the analytical hierarchical process (AHP). The analytical hierarchical process is developed by Saaty (Saaty, 1980). The AHP has three basic steps. It begins by decomposing the overall goal (suitability) into a number of criteria and sub-criteria. The goal itself represents the top level of the hierarchy. Major criteria comprise level two, sub criteria map up level three and so on. A case study for land suitability analysis for Lam Ha district, Lam Dong Province of Vietnam was done using AHP (Tran Trong Duc, 2006).

The land units that were under citrus and soybean have been identified as a potential area for crop diversification in Seoni district, Madhya Pradesh (Bobade *et al,* 2010). The soil base GIS data was compiled and interpreted for land use suitability and fertility assessment. No research has been done for spatial land suitability taking water availability, climate (temperature and rainfall), soil physical and chemical properties, etc. in to consideration for different crops including underutilized land delineation and management in Bihar state. There is research gap in this area. So there is a wide scope of this type of research in these areas because this type of land suitability analysis has not been done in the above said areas.

The present research aims to classify the images of study area in to a number of land use and land cover classes or themes of features mainly in pre-monsoon and post-monsoon season to identify the land use and land cover patterns. Land use and land cover patterns mainly includes natural land cover such as agricultural/ non agricultural area, cropped area and underutilized lands. The study area taking in to consideration is Madhubani districts of Bihar state. In this research project, land suitability maps will be created for different crops in these districts taking different parameters into consideration that are soil physical and chemical properties, water availability, etc. using remote sensing and GIS. Using this land suitability maps, agricultural productivity may be increased because land suitability analysis will provide a more suitable cropping pattern in the research areas. So this research will be very useful for increasing agricultural productivity in the Madhubani districts of Bihar.

MATERIALS AND METHODS

Study area is taken in to consideration is Madhubani district of Bihar. Different soil samples were collected from all blocks of Madhubani district and these soil samples were tested to get their properties such as N, P, K, OC, EC and pH. Toposheet of Madhubani district has been georeferenced and digitized. Different maps related to soil properties such as nitrogen (N), phosphorous (P), Potassium (K), pH, Organic Carbon (OC), Electrical Conductivity (EC) and ground water availability have been developed. These maps were developed blockwise. Blockwise soil properties and ground water availability were shown in the maps. These

maps may be used to analyze land suitability for different crops in Madhubani district. After getting soil properties, these data were linked blockwise showing different blocks as different points on the digitized blockwise map of Madhubani district. Same as above, blockwise ground water availability was also shown on the map of Madhubani district.

RESULTS AND DISCUSSION

Digitized maps of different soil properties and ground water availability

Block wise different maps of Madhubani district related to soil properties such as nitrogen (N), phosphorous (P), potassium (K), pH, organic carbon (OC), electrical conductivity (EC), ground water availability and flood area were developed. These maps may be utilized to develop different land suitability maps that can be used for agricultural planning and development of agricultural production in the study area.

Soil properties analysis

Different soil samples were collected from twenty blocks of Madhubani districts from different locations. These soil samples were tested in the institute laboratory to get their chemical properties viz. nitrogen, phosphorous, potassium, pH, organic carbon and electrical conductivity. Data about block wise ground water availability and flood area were also collected from different sources. Land suitability analysis and better crop planning may be done with the help of water availability and soil properties.

Spatial data analysis

Tables having data about latitude, longitude, nitrogen, phosphorous, potassium, pH, organic carbon, electrical conductivity, ground water availability and flood affected area were linked with the blockwise digitized map of Madhubani district. These spatial data are visible blockwise on the map of Madhubani district of Bihar.

CONCLUSION

In this study, remote sensing and GIS techniques were applied to identify blockwise availability of N, P, K, pH, OC and EC of soil, ground water availability and flood affected areas. We can easily get the above information in the map form that may be very useful to develop land suitability maps for different crops and to do better crop planning. Better land use planning may be done to increase agricultural production in the study area. So this information may be very useful to agricultural scientists and farmers for the development of this area.

REFERENCES

A.A. Mustafa, Man Singh, R.N.Sahoo, Nayan Ahmed, Manoj Khanna, A.S.Sarangi and A.K.Mishra. 2011. Land suitability analysis for different crops: A Multi-criteria Decision Making Approach using Remote Sensing and GIS. Indian Agricultural Research Institute, New Delhi.

AIS & LUS 2000. All India Soil and Land Use Survey Organization (AIS & LUS 2000): Inventory of degraded lands of Agra district, U.P. using technique, IARI, New Delhi.

Bobade, S.V., Bhasker, B.P., Gaikwad, M.S., Raja, P., Gaikwad, S.S., Anantwar, S.G., Patil, S.V., Singh, S.R., Maji, A.K.2010. A GIS based land use suitability assessment in Seoni district, Madhya Pradesh, International Society for Tropical Ecology, 51(1): 41-54, 2010.

Carver, S.J. 1991. Integrating multicriteria evaluation with geographical information systems. International Journal of Geographical Information systems 5(3), 321-339.

Hopkins, L. 1977. Methods for generating land suitability maps; a comparative evaluation. Journal of American Institute of Planners 34(1), 19-29.

Maiczewski, J.1999. GIS and Multi criteria Decision Analysis, Wiley, New York.

Mc Harg, I.L. 1969. Design with Nature, Wiley, New York.

Mst. Farida Perveen, Ryota Nagasawa, Md. Imtiaz Uddin, Hossain K.M. Delowar. 2003. Crop land suitability analysis using A multicriteria evaluation and GIS approach, Tottori University, Japan.

Parveen, F., Ryota, N., Imtiaz, U., Hssain, K.M.D. 2007. " Crop land suitability analysis using multicriteria evaluation and GIS approach, 5th International Symposium on Digital Earth" The University of California, Berkeley, USA, pp 1-8.

Sailesh, Samanta, Babita Pal and Dilip Kumar Pal 2011. Land Suitability Analysis for Rice Cultivation Based on Multi criteria Decision Approach through GIS. Int. J. Sci. Emerging Tech. Vol. 2 No. 1 October 2011.

Saaty, T.L. 1980. The analytic Hierarchy Process, RWS Publications, USA.

Trang Trong Duc 2006. Using GIS and AHP Technique for land use suitability analysis, International Symposium on Geoinformatics for spatial Infrastructure Development in Earth and Allied Seciece, 2006.