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Land Suitability Analysis for Identification of Summer Paddy Cultivation Sites Based on Multi Criteria Evaluation through GIS

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Abstract:

Land suitability analysis is a prerequisite to achieve optimum utilization of available land resources for sustainable agricultural management. One of the most important agriculture related issues in the state of Assam is to improve the agricultural output with an efficient use of available land resources. Agriculture is the prime economic activity for most of the people of Assam but the overall production figures for different agricultural crops are stand at a notably lower level compare to the national average. Due to such a kind of production shortage Assam can't not meet the need of its rapidly growing population mass. The aim of the present study is to assess the physical land suitability level for seasonal summer paddy crop using a Multi-Criteria Evaluation (MCE) with the help of geospatial tool. Parameters relevant to Physiography, Climatic condition and Soil types were analyzed and put weightage values in MCE process. Landuse/Land cover scenario was also prepared to analyze the existing nature of crop distribution which played a very

important role in demarcating potential summer paddy growing sites in Kamrup district. According to the landuse/land cover analysis of the year 2013, summer paddy was cultivated in 356.58 sq.km of land out of the 4088.86 sq.km of total area. Suitability map for summer paddy rice was ultimately prepared with the help of spatial analysis operation in GIS environment. Analysis shows that the summer paddy growing sites are mostly concentrated in the Rangia and Boko agricultural sub-division and in certain river adjacent fertile tracts of Brahmaputra river.

Key words: Summer paddy, Kamrup district, Landuse/Land cover, Multi-Criteria Evaluation (MCE), Land suitability.

Introduction:

Agricultural resources are considered to be one of the vital renewable and dynamic natural resources. Comprehensive, reliable and timely information on agricultural resources are very much necessary at primary level. Increasing population pressure and other natural factors like flood, drought, soil erosion and several other climatic disturbances are continuously hampering the growth rate of agricultural production in the North-Eastern part of India. In the present study an attempt has been undertaken to monitor and analyze the pattern of agricultural landuse in the Kamrup district of Assam. Similarly an approach has been undertaken to analyze the different sets of factors which are responsible for the dwindling nature of agricultural productivity in the region. Limited agricultural productivity and declining agricultural output has made the researchers and government authority to think about the improvement and implementation of some effective measures to meet the people's need in coming years. In the state of Assam, current landuse pattern is not suitable therefore there is an urgent need to use the existing land in a more rational and possible way. In that case, geospatial

technology coupled with GIS & Remote sensing technique offers a dynamic tool for the multidimensional process of landuse/land cover pattern evaluation and analysis. Geospatial technology provides a perfect base to perform landscape analysis more synoptically, repetitively and precisely. It's a very important source for the evaluation of spatial information such as landuse/land cover, drainage, topography and agri. related components. Similarly, GIS is also a powerful tool for different sets of geo-environmental analysis and appraisal of natural resources. It helps the user to integrate the multisource data base generated from different agents including remote sensing into a single platform.

Suitable areas for agricultural landuse are determined by sets of parameters like climatic parameters, soil & topographic, environmental parameters and the understanding of local biophysical setup. In such a type of situation many variables are involved and each of these variables should be assigned with weightage values according to their relative influences on the optimal growth conditions for crop through Multiple Criteria Evaluation (MCE) method.

One of the most important features of the geospatial analysis is the availability of "spatial analysis" tool. The overlay analysis operation specially helps a lot in analyzing different sets of parameters based on certain criteria and ultimately brings them into common assured structure. However, the overlay analysis procedures don't enable one to take into account that the underlying variables are not equally important (Janssen and Rietveld, 1990). So, one particular approach that can help in overcome such a kind of ambiguity is the Multi Criteria Evaluation method (Caver, 1991). The objective of using multi criteria evaluation technique is to find out the solution for decision makers characterized by multiple alternatives, which can be evaluated by means of decision making criteria (Jankowski et al., 2001). The primary aim of this research is to find out and delineate the suitable areas for

seasonal summer paddy cropping sites of Kamrup district using relevant information.

Study Area:

Present study was carried out in Kamrup district which is located in the lower Assam belt of Brahmaputra valley. Geographically it is located in between $25^0 40' 00''$ N to $26^0 30' 00''$ N latitude to $91^0 0' 00''$ E to $92^0 0' 00''$ E longitude. It is bordering with Baska and Udalguri district in the north, Nalbari and Goalpara district in west, Morigaon district in the east and by the state of Meghalaya in the southern part. The total surface area of the district is approximately 4088.86 sq.km. Kamrup district falls in the fertile agrarian plains of Brahmaputra valley. Topographically the district is almost flat in the middle and northern part whereas presence of a series of scattered hill is visible in the southern part. The average elevation ranges in between 55 m to 70 m in most of the areas but in southern part the elevation raises upto 500 m in hill areas adjacent to Meghalaya plateau. The study area has a sub-tropical with semi-dry summer and a cold winter climatic pattern. Mean annual rainfall ranges in between 1500 mm to 2600 mm, which is mostly occurs in the months of June to August. Average annual temperature varies in between a minimum of 7^0 C in winter months to maximum of 38.5^0 C during summer months. Taxonomically, the study area has been divided into 19 soil taxonomic classes. Most of these groups are slightly acidic in nature with pH ranges between 4.5 to 6.0. The hydrological conditions are quite suitable for agricultural drainage. The major surface water sources are mainly rivers, canals, beels (temporary water logging area) and ponds etc. However, there is a significant potentiality for increased irrigation facilities from available surface and ground water sources. In the entire study area rainfed agricultural activities are practiced throughout the year. Kamrup district has been divided into

three agricultural sub-divisions namely (i) Guwahati agricultural sub-division (ii) Rangia agricultural sub-division and (iii) Boko agricultural sub-division.

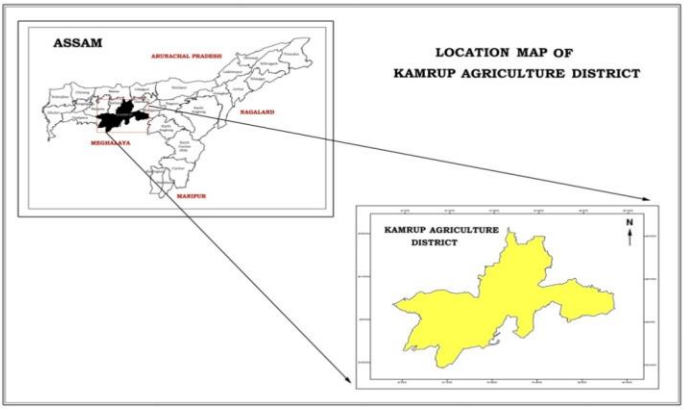


Figure-1

Materials and Methodology

Landuse / Land cover

The entire landscape of Kamrup agricultural district was extensively surveyed from August, 2013 to February, 2014. Ground Control Points (GCP) were collected using an E-Trex Global Positioning System (GPS) receiver. A total of 150 GPS points were collected from different locations in the district. From every GPS points the following information were collected (i) Coordinates of the area (ii) Elevation (iii) Type of landuse and (iv) Types of agricultural cropland. For the analysis of landuse/land cover pattern an IRS P6 LISS-III satellite data of 28th January 2013 was used during the study. The 1:50000 scale Survey of India topographical sheets No. 83 N 1,5,10,11,12,16 were followed in the preliminary processing of the satellite data. A False Colour Composite (FCC) was generated using different bands of the satellite data. The satellite imageries were rectified and geometrically corrected

using Ground Control Points (GCP) obtained from topographical sheets and from the fields. Points such as intersection of the roads, river junction have been choosed on the topographic sheet as GCPs. Using polynomial equation the satellite data were geometrically corrected and georeferenced into Universal Transverse Mercator (UTM) projection and WGS 84 datum system. For the better interpretation of different landuse classes along with a micro observation of the agricultural areas the pixels were re-sampled using the Maximum-Likelihood algorithm, finally the study area was extracted from the image using district mask procured from Assam Remote Sensing Application Centre (ARSAC). Sub-pixel level image to image accuracy was achieved through repeated attempts. Histogram equalization and matching operations were performed to eliminate the radiometric errors in the image. GCP's training sets were widely used to generated the signatures for different landuse/land cover classes, later the image was classified based on combination of visual and digital classification system. The output resolution of the classified landuse/land cover map is at 23.5 m.

Topographic database

An original ASTER G-DEM dataset was applied to analyze the slope and aspect pattern and overall physiographic expression of the study area. Using the "3D analyst" tool of Arc GIS software a Digital Elevation Model (DEM) was generated. Slope analysis function of Arc GIS 10.1 helps in calculating the maximum rate of change between each cell and its neighbors. Every cell in the output raster map has a slope value. The lower slope value indicates a flatter terrain and the higher slope value denotes a steeper function. Simultaneously, aspect identifies the steepest down slope direction from each cell to its neighbors. It can think of as a slope direction or the compass direction generally a landscape faces. Aspect is measured clockwise in degrees from 0, due north to 360 degree, again

from due north to coming full circle. Flat areas having smooth surfaces are usually better for rice cultivation as it facilitates even and better circulation of water flows. Both of these parameters were studied to find out the suitable sites for probable summer paddy cultivation.

Soil Parameters

The distribution pattern of different soil parameters in the study area have been prepared by considering the soil classification scheme developed by National Bureau of Soil Survey & Landuse Planning (NBSS & LUP). After the completion of sample collection process all the soil samples have been analyzed in the lab environment. The generation of attribute relevant to the soil parameters was performed in GIS environment. The "Spatial Analyst" tool in Arc GIS software helps in delineating the soil parameters of the study area. "Natural neighbor" interpolation tool was applied to map the distribution pattern of different soil paramaeters. Three most important soil parameters i.e. Soil texture, soil pH and soil drainage were added to polygon attribute table in GIS environment and thematic layers were prepared for each of the parameters for the better understanding of the soil distribution pattern. Amongst the major soil determinants pH is one of the important components for land-crop suitability analysis. pH of the soil is defined as the negative logarithm for the hydrogen-ion concentration of the soil solution. Slightly the acid soils having a pH value of 6 to 7 are generally better for the summer paddy cultivation. However, sometimes it has been found to be grown at a pH value of 4 to 8.

Climatic database

Temperature, rainfall and humidity are the three most important meteorological components which are generally used to control the growth and distribution of agricultural crops. As summer paddy is normally grown in a high temperature

condition ranges from 20 degree to 30 degree celsius and an available rainfall condition of 1250 mm to 2000 mm. Though in some cases more than 30 degree celsius temperature is also suitable for the growth of summer paddy cultivation. Meteorological information pertaining to different parts of Kamrup district was collected from "India Water Portal" (www.indiawaterportal.com) an online data storage site. Similar to the soil distribution analysis the "Nearest neighbor" interpolation tool was also applied to prepare the climatic zonation map of the study area, which later shows the prevailing Agro-Climatic pattern of the region and the availability or combination of both moisture content and temperature zones.

Image processing for crop mapping

For the analysis and monitoring of prevailing cropping system the visible Near Infra Red (NIR) band of IRS P6 LISS III data with a spatial resolution of 23.5 m has been analyzed in Erdas Imagine 9.3 software. Initially, an unsupervised classification operation was performed using a spatial statistics (e.g. ISODATA algorithm) to classify the particular image into available number of classes in the study area. Later, after the completion of ground truth verification process supervised classification operation was performed using Maximum – Likelihood algorithm method from the already selected Green, Red and NIR bands. In the post classification period the accuracy of the classified classes were assessed by using the "accuracy assessment" tool of Erdas Imagine software based on "Kappa coefficient" algorithm. In order to assess the accuracy of the classified images, random reference samples of 150 points of verification were selected from different landuse classes. Besides, the digital image processing technique for the final identification of cropping areas a visual interpretation technique was followed from a high resolution IRS P6 LISS IV satellite data with a spatial resolution of 5.6 m.

Land suitability analysis

According to the degree of favorable condition for summer paddy crop, a simple statistical weightage index was used for all the variables leading to multi-criteria decision support approach. We contrived three rating systems, like "1" as Suitable, "2" as moderately suitable and "3" as Unsuitable for all variables. Suitability rating regarding different factors were assigned after a detail observation of the all the factors and their level of preference by the cultivators. All the details regarding the different topographic, climatic and soil parameters are given from Table.1 to Table.5

Table.1 Topographic suitability rating for summer paddy cultivation

Slope (in Degree)	Rating	Aspect Direction	Rating
Less than 15	1	Flat, North, N-East &North-West	1
15 to 30	2	All direction more or less than 15 degree slope	3
More than 30	3		

Table.2 Soil texture suitability rating for summer paddy cultivation

Textural Class	Description	Rating
Clayey	Sand <45%; Silt <40% and clay >40%	1
Coarse Loamy	Sand 40-80%; Silt <50% and Clay < 20%	2
Loamy	Sand 20-50%; Silt 30-50% and Clay < 30%	1
Loamy sand	Sand 70-90%; Silt <30% and Clay<15%	2
Fine	Clay 40-100%	1
Silt Loamy	Sand,50%, Silt 50-85% and Clay <30%	1

Table.3 Soil depth and available soil water holding suitability rating for summer paddy

Soil Depth	Rating	Water holding capacity	Rating
Extremely stony/rocky	3	Low(<3cm)	3
Partly stony/rocky	2	Moderate (5-10cm)	2
Moderately	2	High (10-15cm)	2

stony/rocky			
Not stony/rocky	1	Very high (> 15cm	1

Table.4 Soil pH availability and suitability for summer paddy cultivation

Soil pH	Rating
< 4.5	3
4.5-5.0	3
5.0-5.5	3
5.5-6.0	2
6.0-6.5	2
6.5-7.0	1
> 7.0	2

Table.5 Climate suitability rating for summer paddy cultivation

Temperature (in degree celsius)	Humidity (in percentage)	Rating
35 – 39	70 - 80	3
30 - 35	70 - 75	2
27 - 29	30- 40	1
19 - 22	< 30	1

Erdas Imagine 9.3 and Arc GIS 10.1 softwares were used to prepare the Topographic (slope & aspect), Climatic (temperature & humidity) and Soil physico-chemical properties (pH, texture & depth) and their relevant layers. During the study period a relevant "Index model" was generated using "Model maker" tool of Erdas Imagine software, similarly the multi criteria decision making approach was undertaken for the proper representation of all the parameters. All those variables in Figure-2 were used as input layers in the index model. In the first phase of the analysis the "Topographic suitability" model was generated using the slope and aspect parameters as reference database. Thereafter, the "Soil suitability" model was formulated by considering the layers like soil pH, soil texture and soil depth. Thirdly, the "Climatic suitability" model was generated by considering the inputs like temperature and humidity dataset. In the next step of the analysis all the mentioned spatial layers were stored in an output file. Finally

we used them as a memory input file for conducting the entire suitability analysis for Kamrup agricultural district.

Figure.4, 5 and Figure.7 have shown all the important variables necessary for the suitability analysis namely topography, climatic parameter and soil parameters, which all are used for the formulation of suitability model. It has already been mentioned it that GIS based "Spatial Analyst" tool in Arc GIS software has been used to achieve the output. After the final analysis of all the parameters a reclassification operation was carried out to calculate the area wise extent of different parameters. The statistics of each of the rating classes has been calculated for all the twelve variables as shown in Table.7

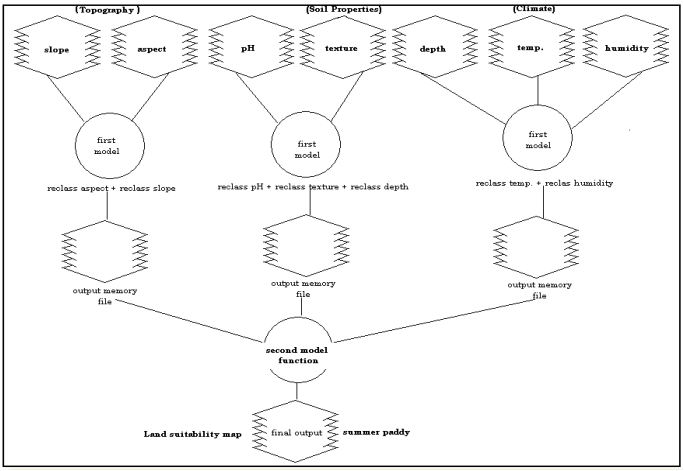


Figure.2 Flowchart showing the Spatial Model prepared for land suitability analysis

Overlay analysis and suitability map

A Normalize Difference Vegetation Index (NDVI) analysis was performed using an IRS P6 LISS III satellite image of 28th August 2013. The NDVI analysis showed the overall growth and distribution pattern of green vegetation cover for the entire district, later it helped in delineating the probable agriculture growing sites beyond the present cultivation limits. The present NDVI map and the crop-land suitability maps were overlaid to

identify the differences between the vegetation pattern and the potential cropping sites in the district. In such a way we can gather the useful information concerning the spatial distribution pattern of different suitability classes. This particular analysis helps in getting the proper picture regarding how the summer paddy crops can be practice in different suitability levels.

Results and Discussion

Landuse/Land cover analysis

It has already been mentioned that landuse/land cover analysis is an important component for the formulation of land suitability strata. The landuse/land cover statistics for different agricultural sub-divisions of Kamrup agricultural district has been given in Table.6 and Figure-3

Table.6 Landuse/Land cover Pattern in different agricultural sub-divisions of Kamrup agricultural sub-divisions

Landuse Class	Rangia	Boko	Guwahati	Total landuse
Agril. Land	316.56	292.84	670.06	1279.46
Built-up	32.56	16.83	137.18	186.57
Rural Habitation	129.37	396.9	183.81	710.08
Forest	32.61	412.8	681.7	1127.11
wasteland	51.91	75.91	68.71	196.53
Grassland	32.59	115.85	89.56	238
Water body	16.98	27.98	98.99	143.95
Sandy	11.87	88.73	105.88	206.48
Total	**624.45**	**1427.84**	**2035.89**	**4088.18**

The LULC analysis shows 9 different landuse classes which were prepared based on the spectral properties of the satellite data and the available landuse categories on the ground. The prominent landuse/land cover classes in the study area are- (a) Agricultural land (summer paddy & mustard) (b) Rural habitation (c) Forest land (d) Wasteland (e) Shifting cultivation (f) Grassland (g) River sand (h) Water body and (i) Built-up land. Few landuse classes like Agricultural land (1279.46

sq.km), Forest land (1127.11 sq.km), Rural habitation (710.08 sq.km) and Sandy area (206.48 sq.km) are occupying a significant portion of land in the overall geographical land. Entire landuse/land cover classification statistics for Boko, Rangia and Guwahati agricultural sub-division have been presented in Table.6. "Accuracy assessment" tool of Erdas Imagine software helped in refining the overall landuse classification work. The post classification process showed an overall 90 per cent accuracy level for each of the landuse/land cover classes. Presently, a significant portion of plain area has been using as an agricultural land except the rugged hilly tracts of the southern part. In the southern part agricultural practice in mainly confined to the narrow corridors located in between the lofty hills and the plain land. Multi criteria evaluation process and the "index model" helps a lot in delineating the existing unutilized agricultural land which can be use for the further use and make optimum use of the available land resources.

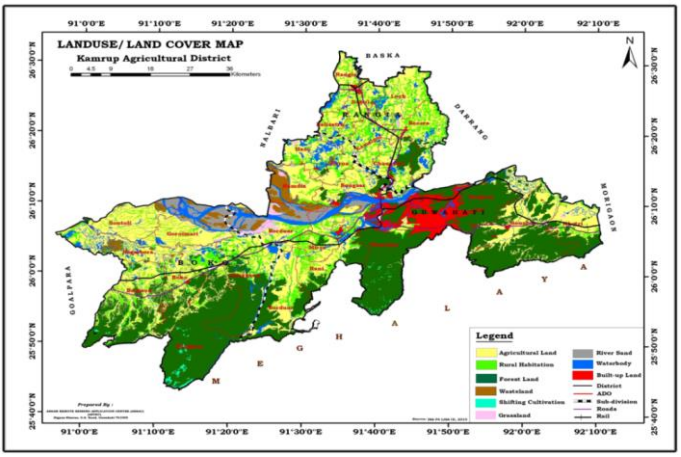


Figure-3 Multi criteria evaluation process landuse/landcover and suitability

A Multi Criteria Evaluation (MCE) process was developed and choosed to analyze the distribution pattern of all the three

categories of land suitability classes in the study area. The observation and integration of all the multi criteria factors in the index model has helped us in tracing the extent of each land suitability classes. Analysis shows it that suitable stretches of land area were mainly observed in the cropland areas, narrow corridor located in between the hills and the flood effected plain and some of the areas located in the presently existing marshy tracts.

"Suitable areas" (1) has been further categorized into two types (a) Very highly suitable and (b) Highly suitable area; these two areas are mainly characterized by a slope category between 5.6^0 - 7.8^0, soil pH ranges in between 5.6 to 7.1, soil texture class varies in between clay to clay loam, topographically these areas are flatland area where elevation is in between 35 to 48 m above msl. In Rangia sub-division though a sizeable portion of agricultural land area is in high land and not that much submergible buy seasonal flood but in some places like Hazo, Ramdia and in Bongsar a marginal portion of land used to left unutilized because of seasonal flood and water logging. Average annual temperature ranges in between 25 Degree Celsius to 30 degree celsius throughout the year.

Secondly, the "Moderately suitable " (2) areas have been classified into three different types- (a) Moderate high suitability (b) Moderate suitability area and (c) Moderate low suitability area. Most of these areas are located in between the slope category of 5^{0-} 30^0 slope, humidity is in between 25 – 65 per cent, pH ranges between 4.0 – 5.1, soil texture is in between coarse silty to coarse loamy. Drainage pattern varies from very poorly drained to well drained. Most of the places in Rangia and Boko agricultural sub-division fall under this type suitability class. More precisely certain places like Rangia, Baihata Chariali, Bezera, Changsari, Mirza and Sonapur etc. are mainly comes under this category.

"Marginally suitable" (3) areas are the areas which are completely deprived of any sorts of major agricultural activity.

In the existing landuse/land cover scenario parallel lofty hill ranges located in the southern part of the district, numerous numbers of small and medium sizes of wetland areas located in both the sides of river Brahmaputra and other wasteland patches created by seasonal flood are normally fall under this category of suitability class. The soil taxonomic condition of this category of land is also not suitable for cultivation purpose. Presence of more amounts of clay and silt content has made these areas as the least suitable category of land. However, some kind of remedial measures like "Integrated watershed management programme " and "Wasteland development" programme can be very much helpful in making these areas utilizable for agricultural purpose. Besides, these three categories of suitability classes another category of land has been identified by the index model, these are the areas which is completely utilizable for agricultural purpose. These kinds of places have been categorized as "Unsuitable" land.

The potential areas which falls under unsuitable land has been identified by using a method developed by Corbett,(1996).This method suggests an approach of "Overlay operation" based on GIS based platform. The two different layers of summer paddy and mustard crops were overlaid on the present landuse/land cover layer with the help of "Spatial analyst" tool of Arc GIS software. A clear presentation regarding the location and distribution of different suitability classes has been highlighted in Figure-6. Area wise distribution pattern of different multi criteria factors has been analyzed through three different ranks varies from "Rank-1" to "Rank-3" where Rank-1 stands for the best suitable portion of land Rank-3 for the least suitable areas. Spatial analysis and linkage of all the different parameters in GIS environment has shown it that though a substantial portion of land area falls under the Rank-3 category but most of the land of Kamrup agricultural district still falls under Rank-1 and Rank-2 suitability category.

Table.7 Area wise distribution of different land suitability rating zone for summer paddy cultivation in Kamrup district

Parameters	Categories	AREA PERCENTAGE		
		Rank-1	Rank-2	Rank-3
Topographic parameters	Slope	72.24	21.55	7.10
	Aspect	70.26	--	30.21
Climatic parameters	Temperature	18.45	68.10	13.45
	Humidity	20.33	49.89	30.20
Soil parameters	Soil pH	12.44	61.12	27.11
	Soil texture	21.54	79.27	---
	Soil depth	81.32	20.32	---
	Water holding capacity	89.23	11.21	---

Present Landuse/Land cover under Summer Paddy cultivation

The present landuse/land cover map shows it that the area being used for summer paddy cultivation is 356.58 sq.km. This category of land includes both the seasonally flood affected areas and upland agricultural tracts located in the northern part of the district. The riverine fertile tracts of mighty Brahmaputra and the areas that engulf the places like Nagarbera, Sontali, Goroimari, Rampur, Ramdia, Hazo, Rangia and Bezera agricultural development circle produces a significant portion of summer paddy rice in the entire district. Similarly, the mustard cropping areas are mostly concentrated in and around Nagarbera and Sontali agricultural blocks. A substantial portion of the area usually falls under the not suitable category. The rice cultivated areas includes both the out growers block and the scheme areas.

NDVI and land suitability

It has already mentioned in the methodology section that the vegetation cover map and the crop suitability maps were overlaid to monitor the degree of interrelationship between the presence of vegetation cover and the extent of suitability zones.

After the completion of overlay analysis a cross table was obtained in between the areas of suitable land suitability zones and overall vegetation cover pattern. Such a way we obtained the necessary information concerning the spatial distribution and extent of different suitability classes in the Kamrup agricultural district. The overlay analysis was performed between the summer paddy suitability map and the NDVI map which later helped in better understanding the interrelationship between the summer paddy grown areas and vegetation cover concentration zones. An "Index model" was prepared in Erdas Imagine software which highlights that most of the well grown vegetation covers areas are concentrated in the southern part of the district. Hilly areas located towards the eastern part of the district also bear some of the well vegetated areas. But most of these areas are mainly reserved forest tracts which are hardly used for any sorts of agricultural activity. The analysis also shows a significant concentration of the well growth vegetation cover areas those are scattered in the eastern part of the district adjacent to like Sonapur and Satgaon locality. Whereas, all the medium, medium-low and low suitable areas are laid under dense vegetation cover where more than 50% canopy cover exist. Table.8 highlights the locational pattern of summer paddy cultivation sites and the NDVI distribution scenario in the study area. In the present study the NDVI analysis shows five different classes of vegetation growth zones ranges from -0.74 to 0.73. NDVI values ranges from -0.14 to 0.73 usually shows a sign of good vegetation cover whereas less than -0.14 signify areas which bears no vegetation cover zones.

Table.8 Relationship between the summer paddy cultivation and vegetation cover

Land suitability	**Land area (in percentage)**	**Vegetation cover (in percentage)**
High	4.10	0 to <50
Medium-high	19.45	

Medium	47.65	51 to 75
Medium-low	25.32	75 to > 80
Low	4.20	

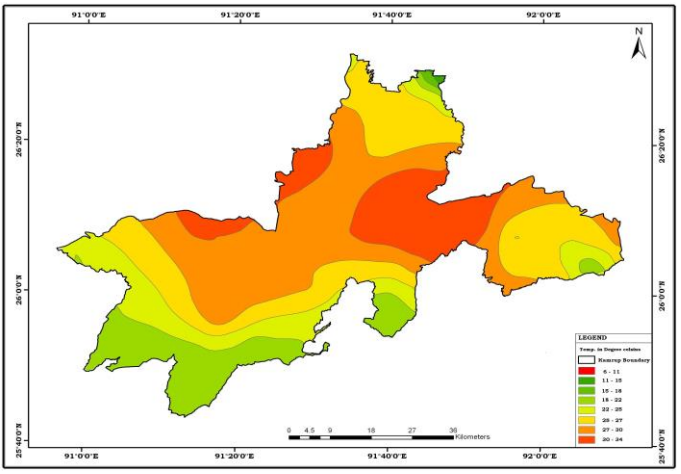


Figure - 4 Status of different Physical & Biophysical factors in Kamrup District

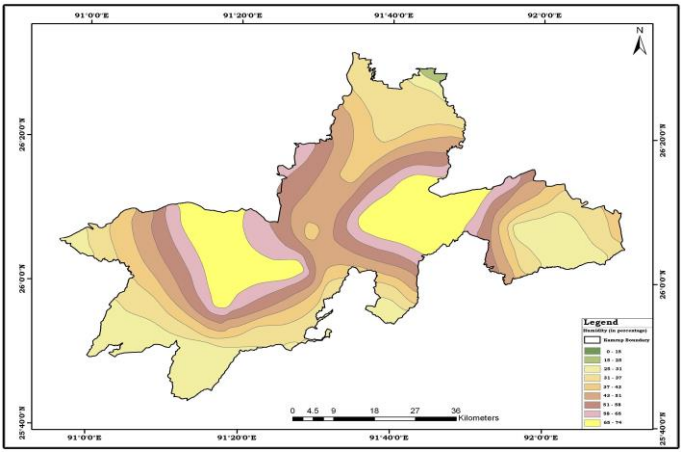


Figure 5- Temperature distribution pattern of Kamrup district

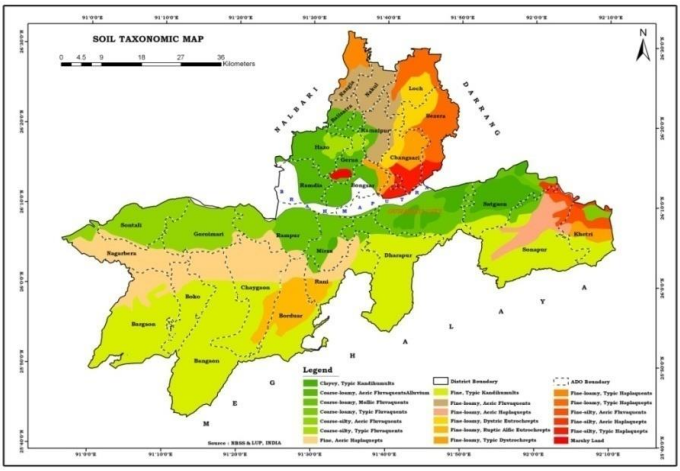


Figure 6- Soil Taxonomic map of Kamrup district

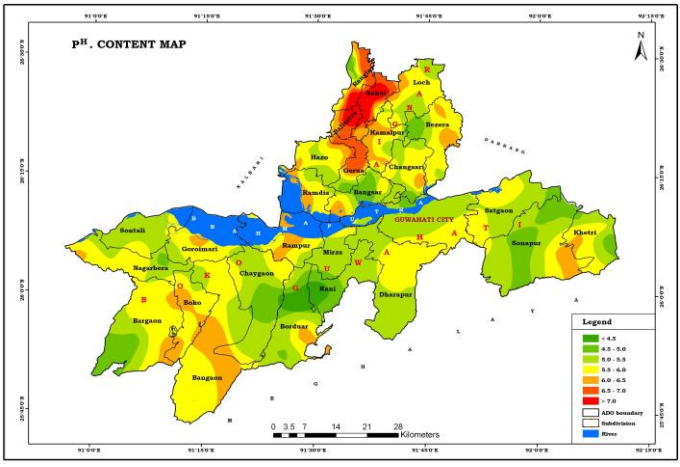


Figure 7- Soil p H distribution pattern map of Kamrup district

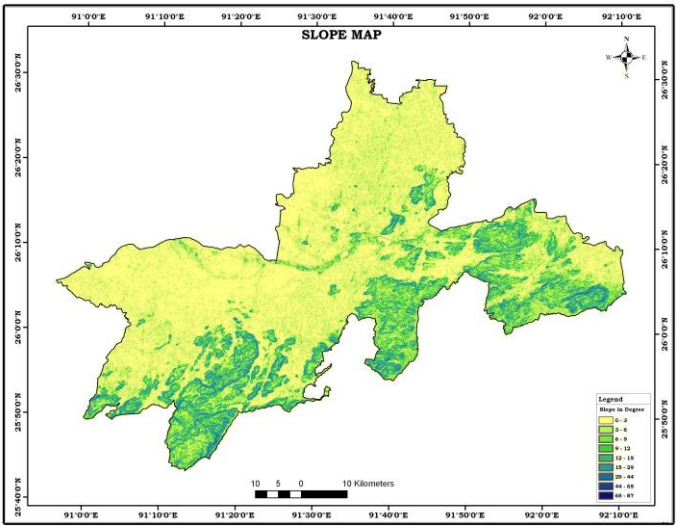


Figure 8 – Slope distribution pattern map of Kamrup district

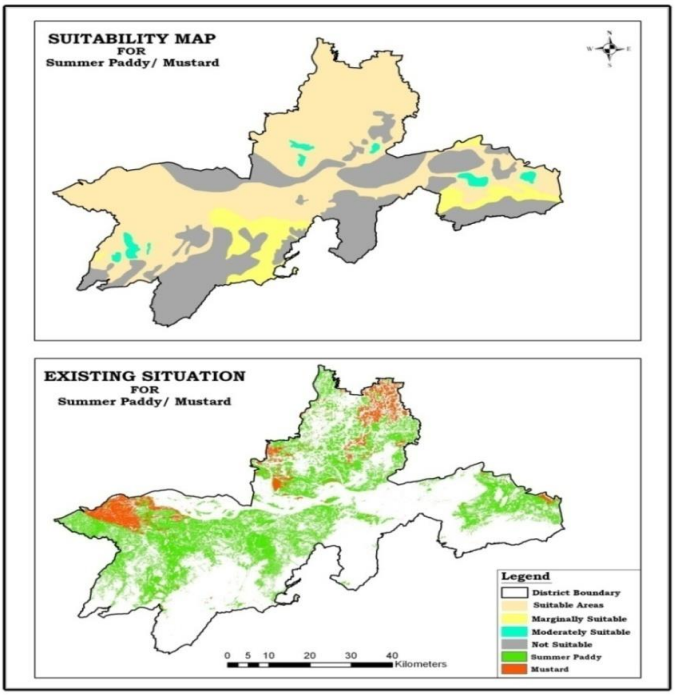
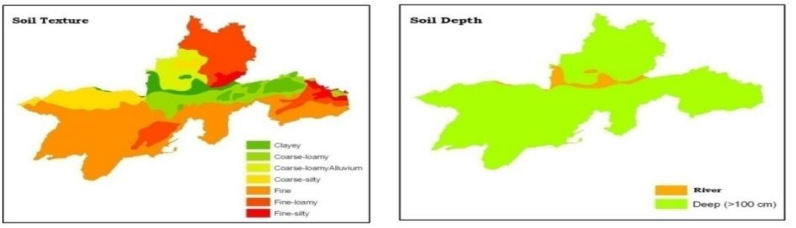


Figure-6. Land suitability zones for summer paddy cultivation, based on multi criteria decision making approach using slope and aspect of topographic pattern, soil parameters and climatic parameters

Figure.7 Suitability parameters map



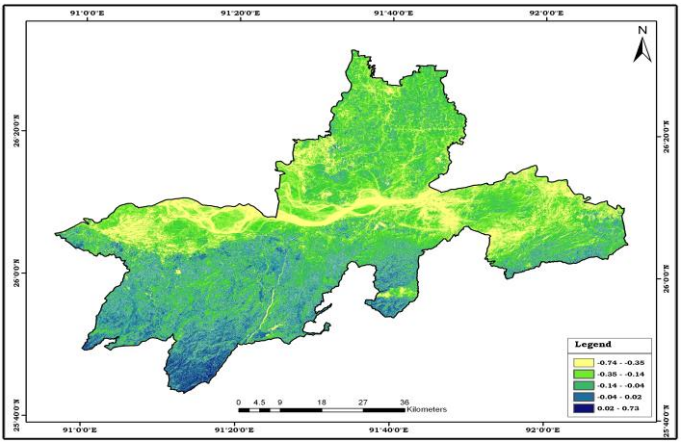


Figure. 8. NDVI map of Kamrup agricultural district

Summary and conclusion

Crop-land suitability analysis is an important component for the overall development of a region. In this particular study we have applied Remote sensing and GIS technique to identify suitable areas for summer paddy rice cultivation areas. The results obtained from this study indicate that the integration of

Remote sensing and GIS and application of multi-criteria evaluation technique could provide a superior database and guide map for decision makers considering crop substitutions in order to achieve better agricultural production. The study clearly brought out the spatial distribution of summer paddy cultivation areas derived from remote sensing data in conjunction with evaluation of biophysical variables of soil topographic and climatic databases in GIS context is helpful in crop management option for intensification and diversification of crops. This particular approach has been used in some other countries for the suitability analysis of several other crops. In the entire Indian subcontinent, countries like Bangladesh and Sri Lanka have the experience of following this approach for the identification of potential sites for summer paddy, jute and mustard crops. However, in North East India this kind of study doesn't have a very long historic base.

This particular study is a kind of base level research which is mostly based on biophysical database and that could be very much beneficial for a precise cropping management strategy at any level. Additionally, the results of this study could be beneficial for other investigators. This study has been done considering factors like prevailing landuse/land cover types, topographic and soil properties which have put its influence in land suitability classification of landuse types. For further study we propose to consider more number of factors like soil, climate, irrigation facilities and socio-economic factors which influence the sustainable use of land resources in near future.

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