Land Capability Classification of Bankura District, West Bengal

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Abstract

Land capability means productive potentials and ability of land to produce a particular crop. It refers to an expression of all environmental parameters as applied to the biological potential of a specific unit of land at a given time. The capability of land is clearly understood from its ultimate output. It not only depends on the geomorphic factors, soil fertility, irrigation facility and others but also technological inputs and management practices. On the basis of land capability, the production differences are found in all countries of the world. In the district of Bankura of West Bengal, there are significant differences in geomorphic conditions and technological inputs and management parameters. As a result production varies from one part to another of the district. All the positive and negative factors have been are included in the computation of Land Capability Index with varying weights. Finally, recommendations have been made for crops suitable for a particular type of land.

Introduction

Land capability is a parameter of land classification. The usefulness of land for agriculture, forest and tourism are assessed solely on the basis of physical environmental factors. In land capability classification, soil texture, soil structure, aspect of slope, terrain, temperature, rainfall, runoff and water availability are taken into consideration (Hussain, 2005). The western part of Bankura district has a rugged terrain, gravelly soil and higher slope and dry weather than the eastern part. All these affect the variety of crops produced as well as their production. The 'land capability index' may be used to classify the district into various types with characteristically suitable crops.

Study Area

The district Bankura is located between the 22°38′N to 23°38′N latitudes and 86°36′E to 87°46′E longitudes with an area of 6882 sq. km. It has 22 blocks, 3 municipalities, 23 police stations, 3830 mouzas, 190 gram panchayats and 1896 gram sangsads (Census, 2011). The district is surrounded by Paschim Medinipur in the south, Hooghly and Burdwan in the east and north, and Purulia in the west (Banerjee,1968; Fig.1).

Objectives

The major objectives of this study are:
1. To compute the land capability index of the C. D. Blocks and based on this classify them into suitable areas.
2. To recommend suitable landuse plans for optimization of production of particular crops

Database and Methodology

Both primary and secondary data have been used. The primary data related to the factors like rainfall, soil fertility, irrigation facility, ruggedness index, soil erosion, water logging, forest density, drought, higher degree of slope and flood have been either extracted from maps or collected through the field investigations and oral interview. The secondary data have been collected from unpublished thesis, books, census and remote sensing data. Computations have been done using Ms-Excel and Arc Gis 10.1 has been used for mapping and visualization.

Results and Discussion

Land capability classification is a field investigation of soil

properties, slopes, degrees of soil erosion and changing landuse patterns which form the basis for future planning of soil and water conservation (Sharma, 1972). Mandal (1990) has classified the land of Bihar (undivided) from various perspectives.

In the present case, for a rational basis two sets of variables have been identified: positive (that enhances production, viz., soil fertility, rainfall necessary for raising crops and irrigation facilities) and negative (which reduces the potentiality of land e.g. ruggedness, soil erosion, water logging, forest cover, drought, higher slope) (Mondal,1990). Each variable is represented as a determinant of land capability. Most of the variables have been subdivided according to their position and importance in determining the positive and negative side. A score (25,15,10,5) has been allotted to each sub-class of a variable separately on the basis of its importance for determining the positive and negative values of lamd raising crops. After properly weighing these variables on regional level, the land capability index have been prepared and then the capability classes have been determined to see the regional condition (Table -1 and 2). The formula used to compute the land capability index is:

$$ LCI = \frac{\frac{\sum (P_1 + P_2 + P_3)}{\sum PFV} x100}{\frac{\sum N_1 + N_2 + N_3 + N_4 + N_5 + N_6 + N_7}{\sum NFV} x100} $$

Where LCI=land capability index, PFV= positive factor values, NFV= negative factor values, P_1 = rainfall, P_2 = soil fertility, P_3 = irrigation facility, N_1 = Ruggedness, N_2 = soil erosion, N_3=waterlogging, N_4 = forest cover, N_5 = draught, N_6 = higher slope, and N_7=flood

The relationship between land capabilities index (y) and net sown area has been shown in Fig.2 (Table - 2).

A product moment coefficient of correlation has also been computed to be 0.28, that signifies a positive relationship between the two variables.

A linear regression analysis has been done assuming the model: y = f (x) and the equation has been solved as:

$$ Yc = 0.018x + 0.102 \ [R^2 = 0.08] $$

Thus, the proportion of the net sown area is found to be an indicator of the potentialities of land capability in a region.

A Lorenz curve has also been drawn to show the disparity / inequality of the distribution of 'land capability index' in the different blocks of Bankura district. It is moderately deviated from the 'line of equal distribution' (20 - 30%) (Table-3). There is certainly an inequality in the distribution of land capability with respect to area and it is of moderate degree. This can easily be attributed to the physical environmental factors as well as the prevailing socio-economic conditions.

Land Capability Regions

Based on Table -2, a map has been prepared on the ARC GIS 10.1 platform to show the categories of the 'land capability' regions of the Bankura district, West Bengal (Fig.4):

1. ***Region with very high LCI:*** It comprises the Blocks of Indas (2.80) and Kotulpur (2.80) where irrigation is facilitated by D.V.C. (Damodar Valley Corporation) and Kangasabati projects.

2. ***Region with moderately high LCI:*** It comprises the Patrasayer (1.94) Block only. Here, the positive factors are irrigation, rainfall and soils. the dominance of forest belt and other negative factors like soil erosion, slope retarded the block to include into the first categories.

3. ***Region with moderately low LCI:*** It comprises the Blocks of Jaypur (1.56), Onda (1.37), Barjora (1.37) Gangajalghati (1.31), Taldangra (1.30), Simlapal (1.30), Bishnupur (1.17) and Sonamukhi (1.11). In this region, all the negative factors like rugged terrain, soil erosion, higher slope, higher forest coverage are dominant.

4. ***Region with very low LCI***: It comprises the Blocks of Bankura-I (0.91), Bankura-II (0.86), Khatra (0.81), Mejia (0.73), Chhatna (0.47), Saltora (0.41), Hirbandh (0.41), Indpur (0.37), Ranibandh (0.37), Sarenga (0.73) and Raipur (0.61). Lack of irrigation facility, rugged terrain, presence of stony wastes, and high forest cover together limit the capability of land.

LCI for Certain Landuse

The cropping pattern and landuse of a particular region can be determined by the capability classes, e.g. clay loam soil comes under class - one and will naturally be suited to crops like rice, jute, sugarcane, potato, mustard etc, while the loams and silty loams are suitable for the rabi crops only. Under suitable conditions of water supply, sandy soils are also preferred for raising maize, sweet potato, root crops and vegetables. In the western and southwestern part of the district irrigation is poorly developed. Small monsoon rain with high variability often fails the crops, although the soil is suitable for raising different types of vegetables, and rabi crops.

Thus, the most important region covers the Blocks of Kotulpur, Indas, Patrasayer and Jaypur where different types of crops are grown and multicropping is common (Table 4). Major crops here are chillies, cauliflower, carrot, cucumber, cabbage, amaranth, apple gourd, ash gourd, bitter melon, bottle gourd, eggplant, elephant foot yam, French beans, Indian pea, jackfruit, lentil, mustard, tomato, spinach, rice, wheat, mustard, til, potato, and red lentil. The second important region comprises the Blocks of like Onda, Barjora, Gangajalghati, Bishnupur, Sonamukhi, Taldangra and Simlapal. Here, the possibility of 3-crop combination is quite high: rice - wheat - different types of vegetables like cauliflower, carrot, cucumber, cabbage, amaranth, apple gourd, ash gourd, bitter melon, bottle gourd, eggplant and elephant foot yam.

The major problems of this area are that the large areas are covered by forestry and some areas are semi arid with no irrigation facility. With good irrigation, this region has a great possibility to develop agriculturally. The third important area covers the Blocks of Mejia, Bankura-I, Bankura-II, Sarenga, Raipur and Khatra. Areas with irrigation facility produces paddy during monsoon and pulses, mustard and til and vegetables during the remaining part of the year. DVC canal provides irrigation water in some areas of Mejia while Kangsabati project supplies irrigation water in Sarenga. With more irrigation, it has a possibility of growing different types of vegetables also. The fourth area covers the Blocks of Chhatna, Saltora, Indpur, Hirbandh and Ranibandh blocks. It is a monocrop area and paddy is cultivated for subsistence during monsoon season.

Conclusion

Thus, land capability is the scientific evaluation of the physical factors in determining the amount of land put to net sown area of Bankura District in West Bengal. Rainfall, soil fertility and irrigation facility are the most important factors that exerts a positive impact on agricultural productivity. The blocks of Indas, Chhatna, Gangajalghati, Indpur, Joypur, Saltora, Mejia, Hirbandh, Taldangra, Simlapal, Sarenga, Kotulpur, Parasayer, Bankura - 1 and Bankura - 2 emerge as the most agriculturally resourceful. Net sown area has been found to be a good estimator of land capability. Land capability is also a factor of cropping intensity. The more the LCI, the more the intensity of cropping. The southeastern part of the district emerges as the most important region with higher LCI, higher cropping intensity (double to tripple cropping) and better in terms of agricultural infrastructure. It provides a way out for the planners to make effective strategies for suitable landuse planning, crop rotation, and crop diversification by improving the positive factors of LCI.

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Table – 1: Weighting and Evaluation of Land Capability

Variables	Weighing values			
	25	15	10	5
Rainfall	Above 150 cm	149-130 cm	129-119	Below 119 cm
Soil types	Younger alluvium	Older alluvium	sandy	Stony waste
Irrigation (Mukherjee,1998)	Canals, tube wells	wells	Tank/pond	Well & ditch
Slope	Above 3^0	2-3^0	1-2^0	Below 1^0
Flood	High flood	Partly flooded	Only in rainy season	No flood
Drought	Even water in scarce	Medium drought	Low drought	No drought
Forest density	Above 20 %	15-20%	5-15%	Below 5%
Ruggedness index * (Ghosh,1992)	Above 1.00	0.15-1.00	0.05-0.15	Below 0.05
Water logging	Whole year	6 months	3 months	No water logging
Soil erosion	High in plateau region	Medium in scarp region	Low in upland plain	Very low in plain l;and

Table -2: Land Capability Index in relation to Net Sown Area, Bankura District

Regions/blocks	Positive index	Negative index	Final percentage of	
			L.C. Index	NSA to Total area
Bankura 1	38.61	42.55	0.91	54.88
Bankura 2	38.61	44.91	0.86	54.86
Chhatna	22.06	47.27	0.47	69.72
Saltora	22.06	54.36	0.41	58.33
Mejia	27.58	37.82	0.73	55.36
G.Ghati	49.64	37.82	1.31	69.64
Barjora	55.15	40.18	1.37	49.47
Onda	55.15	40.18	1.37	46.51
Indpur	22.06	56.73	0.39	61.63
Khatra	44.12	54.36	0.81	47.38
Hirbandh	22.06	54.36	0.41	58.16
Ranibandh	22.06	59.09	0.37	36.24
Taldangra	55.15	42.55	1.3	53.28
Simlapal	55.15	42.55	1.3	54.38
Raipur	27.58	44.91	0.61	44.72
Sarenga	27.58	37.82	0.73	56.06
Bishnupur	49.64	42.55	1.17	41.2
Joypur	55.15	35.45	1.56	60.96
Kotulpur	66.18	23.64	2.8	55.76
Sonamukhi	49.64	44.91	1.11	78.8
Patrasayer	55.15	28.36	1.94	54.68
Indas	66.18	23.64	2.8	79.38

Table – 3: Cumulative Percentages of Land Capability and NSA, Bankura District

Regions/blocks	Cumulative Percentage of NSA (x)	Land Capability Index (%)	Cumulative Percentage of Land Capability Index
Bankura 1	4.42	3.68	3.68
Bankura 2	8.84	3.48	7.16
Chhatna	14.46	1.90	9.06
Saltora	19.16	1.66	10.72
Mejia	23.62	2.95	13.67
G.Ghati	29.23	5.30	18.97
Barjora	33.22	5.54	24.51
Onda	36.97	5.54	30.05
Indpur	41.93	1.58	31.63
Khatra	45.75	3.28	34.91
Hirbandh	50.44	1.66	36.57
Ranibandh	53.36	1.50	38.07
Taldangra	57.65	5.26	43.33
Simlapal	62.03	5.26	48.59
Raipur	65.63	2.47	51.06
Sarenga	70.15	2.95	54.01
Bishnupur	73.47	4.73	58.74
Joypur	78.38	6.31	65.05
Kotulpur	82.87	11.32	76.37
Sonamukhi	89.22	4.49	80.86
Patrasayer	93.62	7.84	88.70
Indas	100.00	11.32	100.00

Source: Compiled by the author.

Table -4: Land capability index requires for certain land use

Land capability requires	Land use	Crops mainly raised
Above 1.50	Multiple cropping	Chilies, plantain, turmeric, coriander, cauliflower, cabbage and other vegetables
1.00 to 1.49	Triple cropping	Sugarcane, wheat, rice, onion, etc.
0.50 to 1.00	Double cropping	Maize, millet, pulses, barley, jute, rice, groundnut, sweet potato, etc.
0.25 to 0.50	Single crop	Rice, kodo, china cotton, bajra, jower, etc.
Below 0.25	Mostly barren and pasture land or forest cover	Rice in valleys and on mountain terraces, tea gardens, rubber, cocoa and coffee plantations on plateau regions but only in rain fed conditions.

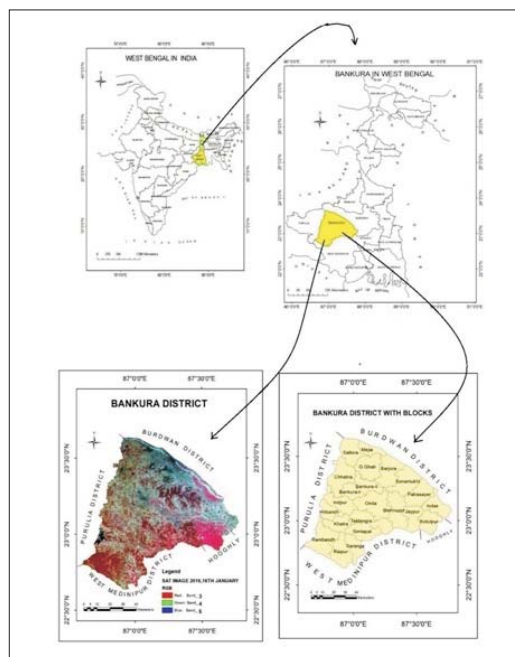*Source: Mondal, R.B. (pp-211) and compiled by author*
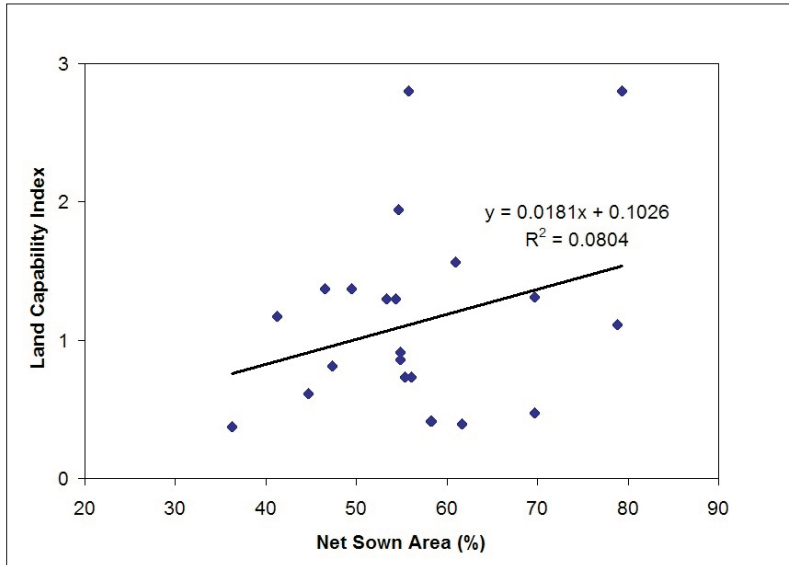

Fig. 1: Location of the Study Area

Fig. 2: Regression between NSA and LCI
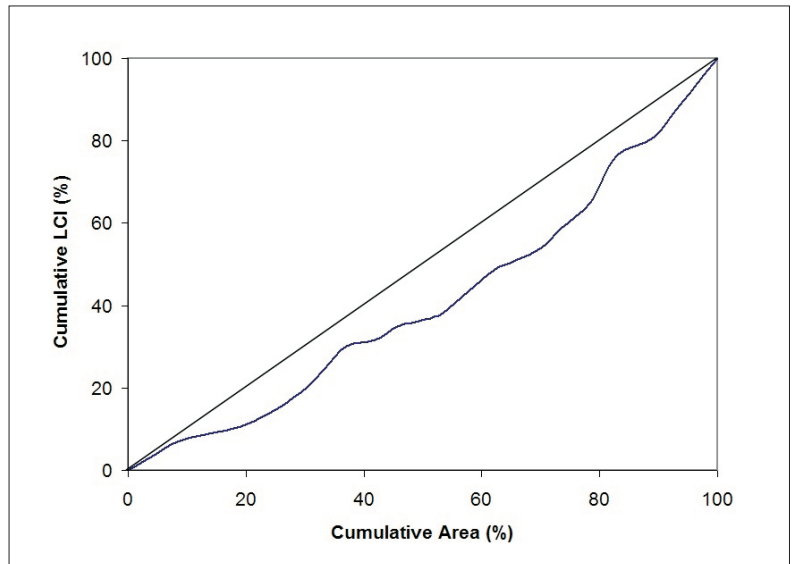
$y = 0.0181x + 0.1026$
$R^2 = 0.0804$

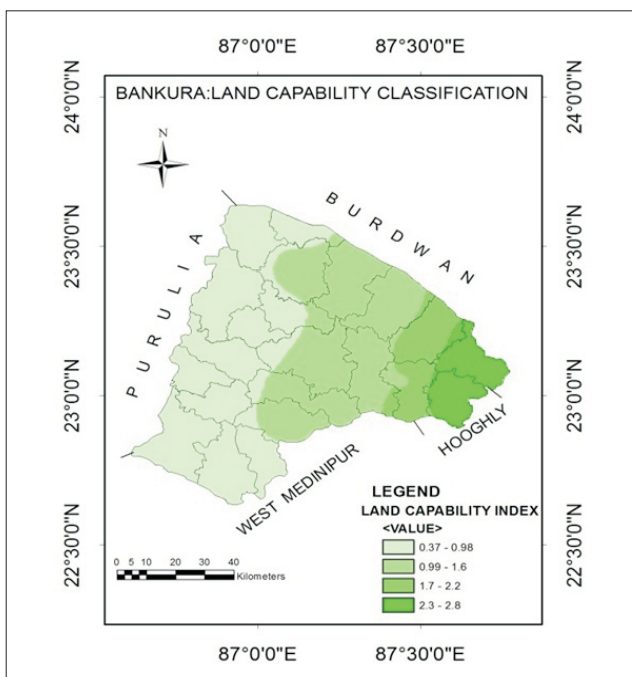Fig. 3: Lorenz Curve showing the Inequality of Distribution of LCI

Fig. 4: Spatial Pattern of Land Capabilty Index, Bankura

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