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Can Agricultural Production and Food Security be Imagined without Land? An Economic Assessment of Net Sown Area with Reference to Eastern India

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Abstract **Original Research Article**

Land is one of the important natural resources. Without land agriculture can't even be imagined. Many challenges are faced by agriculture due to land and water scarcity and pressure on natural resources. The cultivation of land is on a decreasing scale due to the high population growth. In the study attempt has been made to assess the dynamics of land use pattern in Eastern India. Secondary data related to land use pattern were used from 1990-91 to 2017-18. Growth rates, instability indices and location coefficients were computed to assess the status of net sown area (NSA) in the region. Further, regression model was applied to identify the factors influencing NSA in the region. Area under non-agricultural uses and total fallow land were found increasing consequently, the NSA registered a sharp decline from 44.54% in 1990 to 37.92% in 2018. Eastern India and all the constituent states except Assam registered significant and negative growth in NSA. Instability index for Eastern India was found comparatively high in period-II. In case of states, instability indices for all the periods under study was comparatively high in Jharkhand followed by Bihar. Assam registered comparatively low instability in all the periods under investigation. Location coefficients were computed to assess the spatial dynamics of net sown area over the last 28 years across different states of Eastern India and results revealed that during 2017-18, location coefficients were lower in all the states as compared to other periods of time. The factors responsible for declined NSA were ratio to urban population to total population, length of road Km^{-1} of geographical area, population density (Km^{-1}), land put to non-agricultural uses (lakh ha) and rainfall (mm). Factors taken into consideration had reducing and non-significant effect on NSA except rainfall. Adequate rainfall during season could enhance the NSA in the region.

Keywords: Net sown area (NSA), Natural resource, instability, location coefficient, Growth rates.

INTRODUCTION

The technological innovation in agricultural production plays a vital role in ensuring food security in the world. Many challenges are faced by agriculture due to land and water scarcity and pressure on natural resources. There is a misbalance between population growth and cultivatable land and this exerts a great challenge to the society as whole. The cultivation of land is on a decreasing scale due to the high population growth. Population growth and land loss are the main problems nowadays at global level. Due to globalization of the economic system, increasing population growth, urbanization and economic growth, demand for foodgrain has been increasing. However, land, water and natural resources are limited and they will be relatively scarce in future [1].

The increasing in food security has always been the top priority of national food development scheme. It is logically understood that when there is a lack in food it could result in some great consequences economically, politically and socially [2]. Land and water are the vital natural resources for any development activity. Like any other resource land also has two aspects like quality and quantity and both of these aspects are under serious threat due to the intensive and extensive use of land for agricultural and non-agricultural activities. Though the technological development in agricultural production and

intensification have extenuated the ever increasing demand for land for food production, the rapid population growth has boosted up the demand for land for non-agricultural uses like construction of dwelling houses and roads, installation of industries etc. consequently agricultural lands are converted for non-agricultural purposes and are posing serious challenges for planners, policy makers and researchers [3].

Agriculture, industry, energy production, urban development, grazing, logging, mining and other land uses relate to human activity or economic function associated with a specific piece of land. Generally land use is constrained by soil characteristics, topography, vegetation, climate, and other such environmental factors. But it also reflects the importance of land as a crucial and finite resource for most human activities. Land use is a product of interactions between cultural backgrounds, state and physical needs of the society with the natural potential of land [4].

The need for new housing, schools, industries, transportation and other civic amenities increases with increase in population. Earlier this was considered as a development, advancement or urbanization. However, urban dispersion processes in various parts of the country have led to patterns of uncontrolled suburbanization. Sprawl is defined as "the uncontrolled spreading out of a given city and its suburbs over more and more semi-rural land at the periphery of an urban area. The sprawling process of expansion is disordered, unplanned, leading often to inefficient and unsustainable urban expansion patterns [5].

Land use pattern at any given point of time is determined by several factors including size of human and livestock population, the demand pattern, the technology in use, the cultural traditions, the location and capability of land, institutional factors like ownership pattern and rights and state regulation. The land use pattern, besides having economic implications, has also important ecological dimensions, which if ignored can have disastrous consequences. Land utilization pattern refers to proportion of area under different activities such as area under forest, land put to non-agricultural uses, Culturable waste land, permanent pastures, land under trees and groves, fallow land other than current fallow, current fallow and net sown area etc. In other words, land utilization pattern is the distribution of area on which different activities are undertaken. Agricultural land is becoming a scarce commodity and shrinking land is a challenge for agricultural development [6]. Data pertaining to the land use pattern in eastern region showed that the net sown area is declining and areas under current fallow and land under non-agricultural uses have increased over the last 28 years.

The eastern region of India comprising the states of Assam, Bihar, Jharkhand, Odisha, and West Bengal is one of the most backward regions(consisting of 32.10% below poverty line population) and accounting for maximum number of economically most backward districts (69 out of 150 at national level) of the nation. This region occupies about 21.85% of geographical area and supports 34% of the population of the country. The population density is 1.91 fold higher in eastern states to national average. Agriculture is the mainstay of economy in this region.

It is said that Second Green Revolution has to come from Eastern India, because its potential has yet to be exploited. The Eastern states hold critical importance in generating second green revolution in the country. During the first green revolution period, the East was largely untouched. The eastern India (Assam, Bihar, Jharkhand, Odisha and West Bengal) with 14.79% of gross cropped area contributes to 19.17% of food grains production (2016-17). Fertility of land is high and there are abundant water resources. The Eastern states/areas account for 61per cent of total available groundwater in the country. Land is less intensively used in Eastern states. But still, productivity in various crops lags behind the national average. One major reason is for inconsistent production is that farming in this region is predominantly rain dependent. Irrigation potential has to be expanded in Bihar, Jharkhand and Orissa, where there is abundant surface water and underutilized groundwater.

In recent years, the government has made several initiatives to bring green revolution in Eastern region. A programme called 'Bringing Green Revolution to Eastern India (BGREI)', under RKVY in 2010-11 to promote "rice based cropping systems" in eastern India. Later, this programme is merged with Rashtriya Krishi Vikas Yojana. The programme is implemented in 121 identified districts which are not covered under National Food Security Mission Rice and Wheat. The main objectives are to harness the water potential, maximize yield through improving agronomical practices, optimal water utilization and addressing underlying constraints in the region.

The demands for land for non-agricultural uses like for construction of dwelling house due to increase in population, for economic growth like industrialization and urbanization are going up. In spite of this increasing pressure on land, there is tendency to keep the land idle due to factors like poor economic conditions of the farming community, reflecting that land management system is not in proper ways. An Investigation of how land is used and trends in land uses would help in framing better land management policy for the region.

METHODOLGY

In this investigation, time series data collected from different sources like Agriculture Statistics at Glance, Economic Survey of the states (various issues)

and websites of RBI were compiled and used from 1990-91 to 2017-18. The entire period is divided into two sub-periods: Period-1 from 1990-91 to 2003-04 and Period-II from 2004-05 to 2017-18.

Analysis of Data

Simple statistical and econometric models were used to study the dynamics of land use pattern in different states (Assam, Bihar, Jharkhand, Odisha and West Bengal) of Eastern India and to identify the factors affecting changes in area under net sown area (NSA) of the Eastern India.

Growth Rate Estimation

Compound growth rates of indices of area under net sown in Eastern India were calculated using log linear regression model. The net sown area of triennium ending 2003-04 was taken as base for estimation of indices for the whole period under investigation.

Analysis of instability in area under net sown

Instability index is simple statistical tool to know the fluctuation in time series data. It is estimated as follows:

(i). First the parameters of log linear trend line for the variable for which instability is to be estimated is worked out.

(ii). If the estimated parameter is statistically significant, then the instability index is worked as:

$$Instability\ Index = CV * \sqrt{1 - R^2}$$

Where, CV is the coefficient of variation for the time series data. It is calculated as follows:

$$CV = \frac{Standard\ DEviation\ of\ the\ variable}{Mean\ of\ the\ variable} \text{ X } 100$$

(iii). If the estimated parameter is not statistically significant, then CV itself is the instability index.

Location coefficient

Location coefficient (L) is used to assess the pattern of distribution of the certain categories of land across the region of the country. Location coefficient is expressed as given bellow:

$$L = \frac{L_{ij}/L_i}{L_j/L_c}$$

Where,

L_{ij} = area of j^{th} category of land in the i^{th} region of the country

L_i = area of all categories of land in the region

L_j = area of j^{th} category of land in the region

L_c = area of all categories of land in the country.

A higher value of location coefficient for a region indicates the higher concentration of that particular category of land in the region.

Factors affecting extent of net sown area

Econometric model was worked out using time series data at the region level to identify the factors affecting area under net sown in the eastern India.

RESULTS AND DISCUSSION

The changes in proportion of different categories of land presented in Table 1 reveal that there has been a decrease in forest land from 23.21% in 1990 to 20.46% in 2018 due to deforestation for construction of house and roads and installation of industries in the region. Area not available for cultivation has also been registered increase from 17.44% in 1990 to 21.64% in 2018. Similar trend was observed in case of total fallow land. Area under fallow land has doubled in 2018 that of 1990. The erratic rainfall, flood in Odisha and Assam could be the probable reasons for increasing fallow land and resulting in decrease in net sown area in the region. The net sown area was 44.54% in 1990 and has come down to 37.92% in 2018.

Table-1: Share of different categories of land in total reporting land use statistics in Eastern India

Particulars	1990	2000	2010	2018
Reporting area for land utilization statistics	100	100	100	100
Forests	23.21	23.86	23.58	20.46
Area under non-agri-cultural uses	10.46	11.74	13.61	13.88
Barren & unculturable land	6.54	6.73	6.97	7.77
Not available for cultivation	17.44	18.95	20.57	21.64
Permanent pastures & other grazing lands	2.10	1.49	1.62	1.61
Land under misc. tree crops & groves	2.90	2.15	1.63	2.21
Culturable waste land	2.33	1.79	2.03	2.63
Fallow lands other than current fallows	2.66	3.00	3.63	4.41
Current fallows	4.81	5.86	8.44	9.99
Total fallow lands	7.47	8.85	12.07	14.40
Net area Sown	44.54	43.00	40.18	37.92
Total Cropped Area	66.11	62.63	54.14	59.12
Area sown more than once	21.56	19.63	16.22	21.19

The higher the proportion of net sown area to the total geographical area, higher the agricultural production [7]. It is observed that the net sown area for the region as a whole has markedly reduced. Rise in the

area under non-agricultural uses as well as area under current fallow may also be the one of the reasons for decline in net sown area. The area put to non agricultural uses has recorded an increase in the period under study. The reason for sharp increase in area under this activity may probably be attributed to settlement of rising human population, construction of recreation grounds, development of infrastructural facilities for public, set up of factories/companies etc. Thus, it is also noticed that the total unculturable land has also gone up during the period under study. Further, it was observed that the land under current fallow has doubled during the study period. Swift rise in current fallow may probably be due to ongoing global climatic changes causing erratic rainfall, decline in water table, rising cost of production as well as leaving the soil fallow for maintaining soil fertility/health.

Status of Net Sown Area

To assess the status of net sown area in the region compound growth rates are computed for the period from 1990-91 to 2017-18 and is presented in the Table-2. The study period is divided into two sub-periods to assess the comparative growth rates. The table revealed that during overall period only Assam registered marginal increase in net sown area. In other states growth rates were negative and significant as well as for Eastern India growth rate was registered negative and significant. Declining trend in net sown area could be due to shift in land towards non-agricultural uses. In case of period-I the net sown area in Eastern India registered negative and significant decline at the rate of 0.132% per annum. State wise results depicted very less increase or almost stagnant net sown area in the states of Assam and Bihar during the first period and in rest of the states like Jharkhand, Odisha and West Bengal growth rates were found negative and significant. Similar trends were observed in period-II for the states and Eastern India as a whole. The result is conformity with the results of Sinha *et. al.,* (2016) who analyzed the net sown area in different agro-climatic zones of Bihar and found negative growth rates for net sown area i.e. reduction in net sown area in the state of Bihar. Shrinking net sown area is major challenge to agricultural production and consequently to food security of the region in particular and nation in general.

Table-2: Growth in net sown area (NSA) from 1991 to 2017-18

Periods	Assam	Bihar	Jharkhand	Odisha	West Bengal	Eastern India
Period-I	0.050 (0.0003)	0.004 (0.00061)	-0.488* (0.0013)	-0.359* (0.0004)	-0.003 (0.0003)	-0.132* (0.0002)
Period-II	0.070** (0.0002)	-0.231* (0.0006)	-1.279* (0.0033)	-0.349 (0.0033)	-0.062 (0.0005)	-0.235** (0.00096)
Overall period	0.055* (0.0005)	-0.128* (-0.0013)	-0.910* (0.0009)	-0.480* (0.0008)	-0.097* (0.0002)	-0.242* (0.0002)

Note: Growth rates are calculated for indices of NSA taking base triennium ending 2003-04
* & ** denote level of significance at 1% and 5% level of probability
Figures in parentheses are Standard errors
Period-I: 1990-91 to 2003-04
Period-II: 2004-05 to 2017-18

Extent of Variation in Net Sown Area

Instability index is a measure of extent of variability in time series data and hence the instability indices for net sown area in Eastern Indian states and region as whole were worked out for different periods under investigation and the results are presented in Table-3. Instability index for Eastern India was found comparatively high in period-II. In case of states, instability indices for all the periods under study was comparatively high in Jharkhand followed by Bihar. Assam registered comparatively low instability in all the periods under investigation. The variation in net sown area was found comparatively high in the period second in all the states and region as a whole. The reason could be year-to year fluctuation in rainfall since farming in the Eastern region mainly depends on rainfall. The other reason could be inadequate facility of irrigation and high cost on irrigation through diesel pump sets. The region is rich in natural resources but the farming community is resource poor and economically weak.

Table-3: Instability index for net sown area for different periods under study in Eastern India

States/region	Period-I(1990-91 to 2003-04)	Period-II: 2004-05 to 2017-18	Overall period (1990-91 to 2017-18)
Assam	0.08	0.06	0.06
Bihar	0.13	0.12	0.14
Jharkhand	0.30	0.80	0.65
Odisha	0.09	0.74	0.50
West Bengal	0.06	0.11	0.10
Eastern India	0.04	0.19	0.14

Spatial dynamics of net sown area in Eastern Indian states

Location coefficients were computed to assess the spatial dynamics of net sown area over the last 28 years across different states constituting Eastern India and are presented in Table 4. Results revealed that during 2017-18 location coefficients were computed to be lower in all the states as compared to other periods of time. Reduced location coefficients indicated that concentrations of net sown area have declined over the time across the different states of Eastern India. The reason could be increased in area under non-agricultural uses due to increased population pressure and resource poorness of the cultivators.

Table-4: Dynamics of spatial distribution of net sown area in Eastern India

States/region	Location coefficient of net sown area			
	1990-91	2000-01	2010-11	2017-18
Assam	0.78	0.82	0.83	0.84
Bihar	1.41	1.40	1.42	1.37
Jharkhand	0.52	0.51	0.45	0.44
Odisha	0.91	0.87	0.87	0.85
West Bengal	1.36	1.44	1.42	1.40
Eastern India	0.95	0.93	0.92	0.90

Factors Responsible For Decline in Net Sown Area

Several factors are responsible for decline in net sown area in the region. The factors included in the estimation of the regression model were ratio to urban population to total population, length of road Km^{-1} of geographical area, population density (Km^{-1}), land put to non-agricultural uses (lakh ha) and rainfall (mm). All the factors taken into consideration have reducing but non-significant effect on net sown area except rainfall. Adequate rainfall during farming season could significantly enhance the net sown area in the region. The other factors might be the labour scarcity in rural area and consequent hike in wage rate due to MGNREGA making rainfed farming less profitable and expansion in non-farm opportunities might result in a condition wherein even farm families leave agriculture due to non-profitability of agriculture. The value of R^2 indicates that model provides a good fit to the data. More than 87 percent of variation in dependent variable is explained by independent variables included in the model.

Table-5: Regression analysis of factors affecting net sown area in the Eastern India Dependent variable percentage of net sown area to geographical area

Variables	Coefficients	Standard Error	t-value	Level of significance
Intercept	47.007	8.683	5.414	0.000
Ratio to urban population to total population	-13.791	15.100	-0.913	0.371
Length of road Km^{-1} of geographical area	-0.904	1.955	-0.462	0.648
Population density (Km^{-1})	-0.006	0.017	-0.325	0.749
Land put to non-agricultural uses (lakh ha)	-0.046	0.115	-0.397	0.695
Rainfall (mm)	0.005	0.002	2.949	0.007
R^2- value	0.878			

CONCLUSION

From ongoing discussion it can be concluded that there has been a decrease in forest land from 23.21% in 1990 to 20.46% in 2018 due to deforestation for construction of houses and roads and installation of industries in the region. Area not available for cultivation, total fallow land have been found increasing consequently the net sown area registered a sharp decline from 44.54% in 1990 to 37.92% in 2018.

Rise in the area under non-agricultural uses as well as area under current fallow may also be the one of the reasons for decline in net sown area. The area put to non-agricultural uses has recorded an increase in the period under study. The reason for sharp increase in area under this activity may probably be attributed to settlement of rising human population, construction of recreation grounds, development of infrastructural facilities for public, set up of factories /companies etc. It was noticed that the total unculturable land had also gone up during the period under study. Further, it was observed that the land under current fallow has doubled during the study period. Swift rise in current fallow may probably be due to ongoing global climatic changes causing erratic rainfall, decline in water table, rising cost of production as well as leaving the soil fallow for maintaining soil fertility/health.

The growth rates of net sown area revealed that Eastern India registered negative and significant growth during period of study. In case of state wise analysis only Assam registered marginal increase in net sown area. Other states exhibited negative and significant growth rates. Shrinking net sown area is major challenge to agricultural production and

consequently to food security of the region in particular and nation in general.

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