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Growth and instability analysis of major crops in North East India

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ABSTRACT

The study investigates the growth and instability of major crops in North East India based on secondary data of area, production and productivity of major crops. Rice, the major crop in North East India, is growing overtime and become the most dominant crop of the kharif season. Area, production and productivity of rice have increased manifold overtime and it boosts the total productivity of cereal. Potato and oilseed are also making inroads in the late years. Pulses, fibre and sugarcane are seen as neglected crops in North East India. It can be inferred that there is a wide fluctuation in area, production and productivity. Overall area effect is more dominant factor for increasing the production of the crops.

Keywords: Cereal, growth rate, instability, North East India, productivity

The North East India comprises of eight states – Assam, Arunachal Pradesh, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim and Tripura with a total geographical area of 262230 km^2 which is about 8 per cent of the country's total area. Its population is approximately 45.6 million which is about 3.1 per cent of the total Indian population. More than 64 per cent (164.101 million hectares) of the total geographical area is covered by thick and deciduous forest (Barah, 2001).

Generally farmers practice jhum or shifting cultivation system with other sedentary agricultural practices. In valley land, mono cropping as well as mixed cropping is practiced by farmers. Terrace land cultivation system introduced by government has not get wide acceptability by farmers due to high cost of labours and fertilizers. The North East India area is rich in diversity of traditional varieties of cultivated crops and out of 355 reported from all over India, 132 are found in this region. This area is also considered as the native origin of more than 20 major agricultural and horticultural crops and native home of about 160 domesticated species of cultivated crops. The utilization of bio-resources by tribes and other communities based on indigenous and traditional knowledge helps in sustainable use and conservation of natural resources. The tribal farmers have been using hundred of locally adapted major and minor crops in their various agricultural systems that helped them to survive under risk and hard prone conditions. Therefore, appropriate strategies should be taken to boost the agricultural development. Before taking any strategies for development, one must identify the existing trends of area, production and productivity that stand in the way of development (Sharma, 2013). Hence an attempt has been made to study trends of area, production and productivity of major crops in the North East India.

MATERIALS AND METHODS

Data Base

Time series secondary data on the area, production and productivity of major crops in North East India and other relevant data are collected from various published sources. According to the availability of data, the study is made from 1990-91 to 2013-14 and in turn the entire period was divided into breakup of 12 years as phase I (1990-91 to 2001-02) and phase II (2002-03 to 2013-14).

Analytical framework

Growth rate analysis

Compound Annual Growth Rates (CAGR) of area, production and yield is computed by using the Cobb-Douglas type function of following form:

$Yt = abt,$

Or, $\log yt = \log a + t \log b$

Where, yt = area/production/yield of crop,

a = constant,

b = regression coefficient, and

t = time period in years

The CAGR (r) is worked out as, r = (antilog of 'b') – 1 x 100

Instability analysis

In order to measure the instability associated with the rate of increase in area, production and productivity of major crops, Adjusted Instability Index proposed by Cuddy-Della Valle (1978) is used.

where, $C.V = \frac{\text{Standard deviation}}{\text{Mean}} \times 100$ and R^2 = Coefficient of multiple determination.

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Table 1: Crop-wise compound growth rates and instability in area, production and productivity during phase I (1990-91 to 2001-02) and phase II (2002-03 to 2013-14).

Crops	Sub-Phases	Area		Production		Productivity	
		CGR	Instability	CGR	Instability	CGR	Instability
Rice	Phase I	0.38**	2.45	1.89*	5.82	1.50*	4.90
	Phase II	0.58***	3.63	3.01*	9.27	2.42*	5.95
Cereal	Phase I	0.36***	2.13	1.77*	4.75	1.41*	3.92
	Phase II	0.64***	3.43	2.95*	8.90	2.30*	5.70
Pulses	Phase I	1.71*	3.83	1.98*	4.90	0.27	2.87
	Phase II	-0.26	7.30	-1.72	12.59	-1.43**	7.00
Oilseed	Phase I	-0.47**	1.81	-0.63	5.50	-0.16	5.03
	Phase II	0.90***	5.66	2.41*	8.59	1.49*	4.17
Fibre	Phase I	-2.49*	7.43	-2.69**	11.12	-0.21	7.81
	Phase II	0.64	5.09	0.34	11.59	-0.29	10.71
Potato	Phase I	2.36*	3.05	4.01*	6.94	1.61**	6.33
	Phase II	1.88*	5.48	4.66*	15.03	2.74**	10.51
Sugarcane	Phase I	-2.67*	4.33	-3.00*	5.92	-0.34	3.52
	Phase II	1.57*	4.03	0.80***	4.31	-0.76*	2.85

Note: *, ** and *** indicate statistically significant at 1%, 5% and 10% respectively.

Decomposition analysis

The decomposition technique adopted in the present study to estimate the contribution of area and yield to enhancement in production of major crops is given as: $\Delta P = (Y_n - Y_o) A_o + (A_n - A_o)Y_o + \Delta A \Delta Y$

Where, ΔP = change in production, Ao and An are area in base and current year respectively, Yo and Yn denotes yield in base and current year and ΔA and ΔY presents change in area and yield respectively. The contributions of productivity, area and interaction of both are estimated by applying the formula $Ao\Delta Y/\Delta P$, $Yo\Delta A/\Delta P$ and $\Delta A\Delta Y/\Delta P$ respectively.

RESULTS AND DISCUSION

Growth rates and instability of area, production and productivity

Table-1 reveals that rice has registered a outstanding progress in terms of area, production and productivity growth both in phase I and II, but the rate is faster in phase II than phase I with high instability than phase I. The higher rise in cereal production might be attributed to spectacular response of rice to intensive use of inorganic sources of inputs coupled with introduction of HYVs and due to outstanding performance of rice (Bera *et al*., 2011). The performance of cereal in phase I and II shows the same behavioural pattern as in the case of rice. Cereal shows positive growth in area, production and productivity of 0.36, 1.77 and 1.41 per cent which are all significant but with low instability in phase I. But during phase II, it shows impressive growth in area, production and productivity of 0.64, 2.95 and 2.30 percent respectively which are again all significant, but associated with higher instability index than phase I. Singh (2001) has also reported similar results in their studied on production and productivity analysis of rice in North East India. In pulses, during phase I, there is positive growth in area, production and productivity of 1.71, 1.98 and 0.27 per cent respectively. But during phase II, it shows negative growth rate in area, production and productivity of -0.26, -1.72 and -1.43 per cent respectively. In oilseeds, during phase I, there is negative growth in area, production and productivity of -0.47, -0.63 and -0.16 per cent respectively. During phase II, it shows, impressive growth rate in area, production and productivity of 0.90, 2.41 and 1.49 per cent which are all significant. Growth in area, production and productivity of fibre crops is recorded to be negative in phase I with variations in instability indexes. During phase II, it shows little hope in area and production of 0.64 and 0.34 per cent respectively. Potato shows impressive growth in area, production and productivity both in phase I and II which are all significant, but with different instability values. Sugarcane follows similar pattern as that of potato in all fronts.

Table 2: Classification of crops based on compound growth rate and instability index of area, production and productivity during phase I (1990-91 to 2001-02) and phase II (2002-03 to 2013-14).

Area	Compound Growth Rate	Instability Index		
		< 5	5 – 10	> 10
Phase - I	< 1	Rice, cereal, oilseed, sugarcane	fibre	
	1 - 3	pulses, potato		
	> 3			
Phase – II	< 1	Rice, cereal,	pulses, oilseed, fibre	
	1 - 3	sugarcane	potato	
	> 3			
Production				
Phase - I	< 1	oilseed, sugarcane		fibre
	1 - 3	Rice, cereal, pulses,		
	> 3	potato		
Phase – II	< 1	sugarcane		pulses, fibre
	1 - 3		Cereal, oilseed	
	> 3		Rice	potato
Productivity				
Phase - I	< 1	pulses, sugarcane	oilseed, fibre	
	1 - 3	Rice, cereal	potato	
	> 3			
Phase - II	< 1	sugarcane	pulses	fibre
	1 - 3	oilseed	Rice, cereal	potato
	> 3			

Table 3: Sources of major crops growth in North East India during phase I and phase II.

Crops	Source	Phase I	Phase II
Rice	AE	31.65	6.24
	YE	64.03	92.29
	interaction	4.31	1.47
Cereal	AE	31.68	9.01
	YE	64.25	88.98
	interaction	4.07	2.01
Pulses	AE	69.72	219.69
	YE	24.97	-107.72
	interaction	5.31	-11.97
Oilseed	AE	101.78	29.42
	YE	-1.90	66.69
	interaction	0.12	3.89
Fibre	AE	118.54	-7.92
	YE	-24.89	106.94
	interaction	6.35	0.98
Potato	AE	66.03	48.56
	YE	26.27	40.62
	interaction	7.69	10.82
Sugarcane	AE	78.07	164.88
	YE	27.61	-56.29
	Interaction	-5.68	-8.59

Classification of crops based on growth rates and instability of area, production and productivity

Table 2 reveals that in area front, phase I and II are marked by lower growth rate with low instability in case of almost all the crops. Rice, cereal, oilseed and sugarcane have attained a low growth rate of less than 1 per cent with low variability (less than 5 %) followed by fibre with 5-10 per cent instability. Pulses and potato show positive sign during phase I with medium growth rate (1-3 per cent) and low instability (less than 5 %). In phase II, rice and cereal follow the same pattern as in phase I. Pulses, oilseed and fibre have witnessed a low growth rate of less than 1 per cent with low (less than 5 per cent) and followed by fibre with 5-10 per cent instability. Sugarcane and potato are marked by 1-3 per cent growth but with low and medium instability respectively. Not a single crop has attained high growth rate and high instability during phase I and II. In production front, during phase I fibre performed badly by registering growth of less than 1 per cent with high instability greater than 10 per cent followed by oilseed and sugarcane at less than 5 per cent instability. Rice, cereal and pulses at 1-3 per cent growth with less than 5 per cent instability in phase I. Potato production shows remarkable sign with greater than 3 per cent growth at low instability less than 5 per cent. In phase II, pulses and fibre performed badly by registering growth of less than 1 per cent with high instability greater than 10 per cent followed by sugarcane at less than 5 per cent instability. Cereal and oilseed performed at medium growth and instability. Rice and potato production grow at high rate (greater than 3 per cent) but at 5-10 per cent and greater than 10 per cent instability respectively. In productivity front, during phase I pulses and sugarcane performed badly by registering growth of less than 1 per cent with instability less than 5 per cent followed by oilseed and fibre at 5-10 per cent instability. Rice and cereal are marked by 1-3 per cent growth at low medium instability and potato with medium growth and instability in phase I. In phase II sugarcane, pulses and fibre attained low growth with variations in instability. Oilseed, rice, cereal and potato performed better in productivity growth but all attained different instability. Not a single crop has attained high growth rate and high instability during phase I and II.

Decomposition of output growth

A better understanding of different sources of growth and their magnitude would provide empirical support for the design of policies to improve the pace of agricultural growth (Joshi *et al*., 2004). So, estimating growth rates and decomposition analysis of agricultural growth are very important issue from the view point of policy makers. These sources of growth are very important for agricultural development programmes and for investment priorities (Ranede, 1980). Janal and Zaman (1992) also have concluded that to facilitate output project with alternative targets and policies, the breakdown of growth into various components such as area, yield and cropping pattern are important. Table 3 shows the decomposition of output of growth of crops in to area, yield and interaction effect. It reveals that the contribution of yield to the output rise in rice is large with 64.03 and 92.29 per cent in phase I and II respectively. Similarly, cereals also follow the same pattern as rice with 64.25 and 88.98 per cent in phase I and II respectively. In pulses, area is the dominant factor to the output in both the phases. But in phase II the area factor is as high as sufficient to nullify the yield and interaction effect. In oilseeds, area factor is dominant source of production increase in phase I. But in phase II, yield effect plays as the vital role in production augmentation. In case of fibre, area effect is the main source in phase I and yield effect is in phase II. In potato, both in phase I and II area effect is the dominant factor contributing the production. In sugarcane, area is the main contributing factor both in phase I and II. But in phase II the area factor is as high as sufficient to nullify the yield and interaction effect. The results are in collaboration with the studies conducted by Chand and Raju (2008), Bastine and Palanishami (1994) and for ginger crop by Gaikwad *et al*. (1998), Pradhi *et al*. (2015) for cotton and Singh *et al*. (2014) for rice.

Rice has maintained a steady growth with minimum year to year fluctuation over the study period. Potato is strengthening position by registering a growth over the time and oilseeds are also making inroads in the late years. Pulses, fibre and sugarcane are appeared to be neglected crops in North East India. It can be inferred that there exists wide fluctuation in area, production and productivity across the crops. The future development programmes should envisage on stabilization of yield for bringing stabilization in production of the crop through adoption of improved packages of practices. Lack of suitable HYVs, lack of improved crop management practices and standardization of production techniques, weak geographical links and poor infrastructure facilities, North East Indian states are slow in catching up agricultural development. In this circumstance, agricultural sector needs prioritization of development perspectives for enhancing the adoption of recommended technologies through extension programmes, input supply, support of financial institutions and marketing functionaries. More crucially, the research and development programmes must address the problem of generation of need-based location-specific technologies for the specific agro-ecological situations.

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