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RESEARCH ARTICLE

Agricultural Diversification in Assam under Trade Liberalization

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Abstract

Trade liberalization is the process whereby a country opens up its markets to international trade i.e. reduce the taxes and other limits. India initiated liberalization of the economy and trade reforms in June 1991. During reform period, many states in India have given a new thrust on diversification towards high value or remunerative crops. Assam has launched a massive crop diversification programme to support double cropping, facilitate shift in cropping pattern towards cash crops and support development of non-farm allied services. So, keeping in view, the background of trade liberalization and Assam Agriculture, the present study was designed to see the diversification of Assam Agriculture after trade liberalization with special reference to crop. The relevant data were collected from various sources. This study was undertaken to understand the movement and spread of crop diversification in Assam using time series disaggregate data for three periods i.e.; pre-reform, reform and post-reform periods. For estimation of crop diversification, Simpson's Index of Diversification was used. The study found that the Assam Agriculture is diversifying towards high valued horticultural crops and cash crops.

Keywords: Trade liberalization, diversification, Assam agriculture, remunerative crops, Simpson's index.

Introduction

Agricultural diversification has been a well-established traditional farming strategy adopted individually or collectively by Indian farmer or farming communities since time immemorial to minimize risk associated with specialized production system and to ensure household food security. However, with transformation of traditional agriculture, technological innovations (research, development and extension) in crop, animal husbandry and fisheries, forestry (collection of non-timber forests products for livelihood support under usufruct property rights regime in the state forest area), improvement in supporting infrastructural and service network and changes in consumption pattern lead to intensification or diversification of agriculture. In India, a series of reform, measures have been initiated in agricultural sector in the 1990s as a part of trade liberalization and globalization process under the new economic regime (Satyasai and Viswanathan, 1997). Agriculture diversification has been adopted as a major element in the reform strategies for accelerating agriculture growth, augmenting food security and reducing poverty. During reform period, many states in India have given a new thrust on diversification towards high value or remunerative crops considering agro-climatic conditions, natural resource base and domestic and international market demand and changing food consumption pattern. The state of Assam has launched a massive crop diversification programme to support double cropping, facilitate shift in cropping pattern towards cash crop and horticultural crops and support development of non-farm allied services.

Diversification of agriculture can help in accelerating agriculture growth, increasing income, generating employment opportunities, alleviating poverty and under nourishment, enhancing household food security, conserving natural resource base, and participating effectively in new trade regime (Haque, 1996). Assam with a total area of 78438 sq. km, two major rivers with a number of perennial tributaries, 2.24 crore people and varieties of natural resources is a sleeping giant whose energy is yet to be tapped. The state, which had one a promising economy, has today slided into poverty and backwardness. At the beginning of post-independence era, Assam was ranked among the prosperous states of the country. Assam, a northeastern state of India located south of the eastern Himalayas. It is divided into 23 districts and consist six agro-climatic zones viz. Upper Brahmaputra valley zone, Middle Brahmaputra valley zone, Lower Brahmaputra valley zone, North bank plain zone, Hill zone and Barak valley zone. Rice is staple food of Assam. Assam is surrounded by six of the other seven sister's states of the country, namely Arunachal Pradesh, Sikkim, Nagaland, Manipur, Mizoram, Tripura and Meghalaya. Assam also shares international borders with Bhutan and Bangladesh and cultures, peoples and climate with South-East Asia-important elements in India's look east policy. The flora, fauna, wildlife and rivers of Assam have great natural beauty to offer to tourists. It is also an important producer of natural gas and crude oil.

Assam became a part of India after the British occupied the region. It is known for Assam tea, large and old petroleum resources, Assam silk and for its rich biodiversity. Assam was also known for its Sal tree forests and forest products, much depleted now. A land of high rainfall, Assam is endowed with lush greenery and the mighty river Brahmaputra, whose tributaries and oxbow lakes provide the region with a unique hydro-geomorphic and aesthetic environment. Agricultural yield in Assam is lower than the all India figures and compared poorly with agriculturally progressive state. The low level of agricultural produce negatively affects the contribution of the agricultural sector to the state's economy. Farming techniques prevalent in the regions are outdated. Technology, best practices, better implements, etc. have yet to change the lives of the farmers in the state. The limited irrigation network with traditional field pattern of irrigating crops at critical growth stages in the state has made the farmer completely dependent on rainfall. The irrigation is basically of life saving nature and provided for paddy crop in *kharif* season. Ignorance of modern weather tracking techniques has left the farmers completely at the mercy of nature. Further, since most farmers currently follow a single crop pattern, total dependence on monsoons threatens their economic existence. The regular occurrence of flood is a serious concern for the state. The state also ranked backward in terms of major development indices (Radhakrishna and Reddy, 2004). Keeping the above facts in view, the present investigation was undertaken to understand the movement and spread of crop diversification in Assam using time series disaggregate data for three periods i.e. pre-reform, reform and post-reform periods.

Materials and methods

To understand the movement and spread of crop diversification in Assam using time series disaggregate data published from the Directorate of agriculture, Assam from the period of 1980 to 2009. A decadal analysis was carried out using the period 1985-95 as 1980s and 1996-2009 as 1990s. Further, 1985-95 and 1996-2009 were referred as pre-reform and post-reform period respectively. Triennium ending averages and percentage were estimated for 1980-81 to 1982-83, 1990-91 to 1992-93 and latest data published to examine the changes in crop diversification. For estimation of crop diversification, numerous methods are available which denotes specialization or diversification during a particular time period. These include index of maximum proportion, Herfindal index, Simpson's index, Ogive index, Entropy index, Modify entropy index and composite entropy index. Each method has limitation and/or comparative advantage over the others in terms of empirical parameters. A Simpson's diversity index has been used in the present research to study speed of crop diversification and its extent in Assam. It provides the index range from 0 to 1. If the value moves towards 0 or 1 it refers to specialization or diversification respectively. This index is easy for computation and explanation. It is computed as follows (Singh *et al*., 2006):

$$SID = 1 - \sum_{i=1}^{n} Wi^2$$

Where,

SID: Simpson's index of crop diversification

$$Wi = \frac{Xi}{\sum Xi}$$

Results and discussion

Pattern of diversification: Pattern of diversification and the changes have been workout for pre-reform, reform and post-reform periods. A brief discussion of changes in land use pattern, cropping pattern, cropping intensity, shift in crop area, inputs and productivity levels is presented in this section followed by crop diversification.

1. Land use pattern: The pattern of land use changes across the whole state was quite similar during pre-reform, reform and post-reform post reform period. The geographical area was increased during reform period, which was similar to the post reform period 7844 thousand ha (Table 1). The area under forest had increased during reform period while it slightly decreased in post-reform period. The area sown more than once was in the tune of 9.11, 15.01 and 15.09%, which was continuously increased. Barren and uncultivable land was declined in reform period from 19.62 to 18.35% due to various wasteland development programmes in the state. Land put to non-agricultural uses had declined during reform period while it had increased in post reform period. The permanent pasture and other grazing land declining in reform and post reform period. The fallow lands other than current fallow were declining at faster rate while current fallow lands were increasing continuously. The total cropped area was increasing during reform and post-reform period. Most of the degraded lands, pasture lands are used as common pool resources by a large number of population in the state and any further depletion of common lands may adversely affect livelihood of poor people (Marothia, 2004).

2. Cropping pattern: Rice is the most important crop in the cropping system of the state occupying 63.15% area (Table 2). It is largely grown during rainy (*kharif*) season. Other crops cover negligible area in the production system. Maize, wheat, rape and mustard, pulses, jute, mesta are commonly grown. After harvest of paddy, most of the land kept fallow during post rainy (*Rabi*) season. Although some crops like wheat, gram, rape and mustard, sesamum, linseed and *Rabi* vegetables are grown in the post rainy season but their area is not catching up.

Table 1. Land used pattern in Assam during pre-reform, reform and post-reform periods (Percent of geographical area).

	Triennium ending average		
Particulars	1980-81 to 1982-83	1990-91 to 1992-93	2002-03 to 2004-05
Geographical area (000'ha)	7852 (100)	7844(100)	7844(100)
Forest area	25.26	25.53	24.82
Barren and uncultivable land	19.62	18.35	19.46
Land put to non agricultural uses	11.63	13.02	13.71
Cultivable wasteland	1.34	1.14	0.98
Permanent pasture and other grazing land	2.34	2.04	2.04
Fallow land other than current fallow	1.08	0.89	0.80
Current fallow	1.13	1.19	1.60
Total cropped area	44.32	48.84	50.19
Area sown more than once	9.11	15.01	15.09

Table 2. Cropping pattern in Assam during pre-reform, reform and post-reform periods (Percent of total cropped area).

	Triennium ending average		
Particulars	1980-81 to 1982-83	1990-91 to 1992-93	2002-03 to 2004-05
Autumn rice	17.13	16.35	11.37
Winter rice	46.89	46.83	43.70
Summer rice	1.00	3.42	8.11
Total rice	64.99	66.56	63.21
Wheat	2.84	2.04	1.72
Maize	0.60	0.51	0.50
Other cereals and millets	0.45	0.26	0.20
Total cereals	68.90	69.35	66.98
Gram	0.10	0.08	0.05
Arahar	0.20	0.18	0.18
Black gram	-	0.84	0.98
Green gram	-	0.19	0.19
Lentil	-	0.47	0.53
Pea	-	0.91	0.59
Other *rabi* pulses	3.08	2.70	2.54
Total pulses	3.38	2.95	3.09
Total foodgrains	72.29	72.25	68.74
Rape/ Mustard	6.57	7.73	6.70
Sesamum	0.36	0.39	0.35
Linseed	0.17	0.21	0.25
Castor	0.06	0.05	0.03
Total oilseeds	7.16	8.38	7.86
Jute	3.15	2.53	1.61
Mesta	0.37	0.19	0.13
Cotton	0.11	0.05	0.03
Sugarcane	1.41	0.99	0.63
Tobacco	0.16	0.07	0.03
Arecanut	1.44	1.83	1.78
Banana	0.73	0.99	1.09
Chillies	0.30	0.33	0.37
Coconut	0.19	0.35	0.51
Onion	0.13	0.16	0.19
Potato	1.15	1.61	1.92
Sweet potato	0.27	0.24	0.21
Tapioca	0.05	0.06	0.07
Turmeric	0.23	0.21	0.31
Pineapple	-	0.32	0.35
Assam lemon	-	0.16	0.23
Orange	-	0.13	0.17

Table 3. Cropped area and cropping intensity in Assam during pre-reform, reform and post-reform periods (Area in 000'ha).

	Triennium ending average		
Particulars	1980-81 to 1982-83	1990-91 to 1992-93	2002-03 to 2004-05
Net cropped area	2682.33 (77.07)	2706 (70.63)	2753 (69.93)
Area sown more than once	715.5 (20.56)	1177.66 (30.74)	1184 (30.07)
Gross cropped area	3480.33 (100)	3831.33 (100)	3937 (100)
Cropping intensity (%)	129.75	141.59	143.01

Figures in parentheses denote the percentage of gross cropped area.

Table 4. Compound growth rates of area under different crops in Assam during pre-reform, reform and post-reform periods (In %).

Crops	1982-83 to 1990-91	1991-92 to 1999-2000	2000-01 to 2008-09
Autumn rice	-0.67	-3.33**	-11.70**
Winter rice	1.91**	-1.21*	-1.81
Summer rice	32.70**	23.41**	1.17
Total rice	1.98**	-0.07	-3.23**
Wheat	-6.50*	3.23*	-9.90**
Maize	0.51	1.81**	-4.21**
Other cereals and small millets	3.55	5.11**	-13.64**
Total cereals	1.61**	0.04	-
Gram	-6.18	-6.03*	-6.03*
Arahar	-14.50**	3.90	-7.25**
Black gram	-	9.59**	-1.06
Green gram	-	1.95	-2.34
Lentil	-	10.37**	1.45
Pea	-	-7.93**	-6.20**
Other *rabi* pulses	-3.99**	2.70*	-
Total pulses	-4.47**	5.76**	-3.01**
Total foodgrains	2.29	0.34	-3.43**
Rape and mustard	2.86*	-0.99	-6.00**
Sesamum	2.05	1.25**	-5.49**
Linseed	4.33	7.04**	-10.07**
Castor	-5.22**	-1.32	-21.29**
Total oilseeds	2.82*	2.21**	-7.89**
Jute	-5.51**	-4.85*	-5.33**
Mesta	-16.79**	-5.43**	0.58
Cotton	-17.14**	-5.84**	-
Sugarcane	-9.12**	-8.21**	0.94
Tobacco	-20.46**	-11.58**	-
Arecanut	9.34**	2.35**	-
Banana	7.89	1.90**	0.95
Chillies	7.93**	5.10**	3.59**
Coconut	12.67**	10.88**	-
Onion	13.08**	6.93**	-0.51
Potato	9.56**	6.96**	-1.43
Sweet potato	-2.15	0.80*	-7.44**
Tapioca	4.18*	9.69**	1.58**
Turmeric	-0.42	9.09**	3.73**

** Significant at 5% probability level; * Significant at 1% probability level.

The area under cereal crops are declining continuously which may be shifted towards fruits and vegetables in the state. The most predominant cropping pattern followed by the farmers of the state is rice + fallow, rice + wheat, rice + mustard; however, these sequences are comparatively less remunerative than rice + toria and rice + pea. These systems gained an additional return.

3. Cropping intensity: Cropping intensity index is a ratio of gross cropped area to the net cropped area. It measures the extent of land utilization by taking in to account the area planted more than once (twice or thrice depending on climatic situation). The change in cropping intensity reflects the sensitivity of agricultural activities to socio-economic, agro-biological condition and climatic aberration from time to time such as drought, floods etc. Table 3 presents the triennium ending average of the cropped area and the cropping intensity in Assam during pre-reform (1980-81 to 1982-83), reform (1990-91 to 1992-93) and post-reform (2001-03 to 2004-05) periods.

Cropping intensity across the state during pre-reform, reform and post-reform periods ranged between 129.75 to 143.01%. The net cropped area has increased to 2753 thousand ha in post reform period from 2682.33 thousand ha in pre-reform period. Similarly, the area sown more than once and the gross cropped area have also increased in the post reform period. The cropping intensity has increased to 143.01% from 129.75%.

4. Shift in crop area: The nature of shift in area of crops in pre reform (1982-83 to 1990-91), reform (1991-92 to 1999-2000) and post reform (2000-01 to 2008-09) periods has been estimated by computation of compound growth rate (CGR) for the state. Table 4 presents the compound growth rate of area under various crops of Assam during different time periods. The CGR of total rice had significantly increased by 1.98% per annum in the state during pre-reform period. However, in the post-reform period, the speed of increase in rice area was slowed down. The shift in area of rice towards right side was due to sacrifice of the area of wheat, maize, other cereal and small millet, gram, arahar, some *rabi* pulses, total pulses, linseed, castor, total oilseed, jute, mesta, cotton, sugarcane, tobacco and turmeric during pre reform period. The area of gram was negatively significant in three periods. Area of wheat has largely shifted to rice area in pre-reform and post-reform periods and it has shown negatively significant growth in the state at -6.50% and -9.90% per annum in these two periods. This analysis indicates that Assam agriculture has moved toward specialization. The possibility of cultivation of post rainy season crops has increased with creation of additional assured irrigation supply after the formation of state. Even though, few crops have been cultivated in assure irrigation condition by farmers such as paddy, jute, sugarcane, wheat, oilseeds, pulses, maize, vegetables etc. whereas, sesamum, linseed, sweet potato etc. were cultivated in rainfed condition by the farmers. It has been observed that negligible growth of area under jute and mesta during pre-reform period had shifted to positive growth in the reform period. Area under wheat, maize, small millet, arahar, total pulses, linseed, castor, sweet potato, tapioca and turmeric had increased significantly in reform period but in post-reform the reduction was in the tune of -9.90, -4.21, -13.64, -7.25, -3.01, -10.07, -21.29, -7.44, 1.58 and 3.73%. The growth of area under gram during post-reform period was constant i.e. -6.03%. Area under total foodgrain, sesamum, onion, sweet potato had significantly declined in both the periods. This has largely been due to poor marketing network and lower prices received by the farmers in local markets.

5. Input use pattern: Rice is the main crop grown under rainfed production system and most of the technological packages have been developed and transferred to increase paddy yield. The use of fertilizer and other chemical inputs was increasing during reform period while it declined in post-reform period (Table 5). The trend of fertilizer consumption in the state in terms of nutrient (NPK) per hectare is much lower than the national average consumption. It is important to note here that in several parts of Assam, farmers do not use even a single kg of fertilizer in cultivation of aromatic rice. The aromatic rice can be promoted for organic cultivation to take comparative advantage in new economic regime. However, it has to be at a larger scale increased significantly during post- reform period. The gross irrigated area across the stat during all the periods ranged between 104 thousand ha to 227 thousand ha. During post-reform period, it declined to 104 thousand ha from 227 thousand ha.

6. Productivity levels: The productivity levels of crops have not been achieved as it was expected during reform and post reform periods in the state as a whole. It was due to poor irrigation facilities and low level adoption of improved technologies at farm level. Rice is main crop in the state but its productivity level have not changed significantly during pre-reform, reform and post-reform periods (Table 6a). The productivity levels of cereal crops during all reform periods for the state (like wheat, maize, other cereals and small millet and total cereals) have been far below than other parts of the country. The productivity of maize had been at the levels of 603.67 kg/ha, 642 kg/ha and 748 kg/ha respectively during pre-reform, reform and post-reform period. During reform period, production of wheat and other cereal and small millet declined in post-reform period to 854.33 kg/ha and 514.67 kg/ha. The productivity level of total cereal have been increased in reform to 1269 kg/ha from 1081.33 kg/ha in pre-reform period. Growth in productivity of pulse group crops in the state has been comparatively low if compared with other parts of the country during pre-reform, reform and post-reform periods (Table 6b). The farmers in the state commonly grow sesamum, rape and mustard, linseed etc. The productivity level of sesamum, linseed and total oilseeds during pre-reform, reform and post-reform period has been continuously increasing (Table 6c). The productivity of cash crops such as jute, mesta and cotton in the state has been indicating increasing trends during all the periods (Table 6d). The productivity level horticultural crops like chilli, banana, and turmeric were showing an increasing trend during reform period, but it has been comparatively low as compared to the other parts of the country (Table 6c). Non-rice crops such as wheat, maize, pea, sugarcane, linseed, fruits and vegetable, sesame require special attention to develop the new strains according to local conditions and their adoptability at farmer's field so the state's goal of crop diversification can be achieved.

Table 5. Growth in irrigation, HYVs and fertilizer in Assam during pre-reform, reform and post-reform periods.

	Triennium ending average		
Particulars	1980-81 to 1982-83	1990-91 to 1992-93	2002-03 to 2004-05
Area under high yielding varieties (lakh ha)	17.79	11.54	13.97
NPK use (tonne)	11,202.33	33,217.33	21,2743.33
Gross irrigated area (000'ha)	142	227	104

Source: Statistical Handbook of Assam.

Table 6a. Growth in productivity levels of cereal crops in pre-reform, reform and post-reform periods (Yield: Kg/ha).

	Triennium ending average		
Particulars	1980-81 to 1982-83	1990-91 to 1992-93	2002-03 to 2004-05
Autumn rice	758.67	880	994
Winter rice	1209.67	1413.67	1458.33
Summer rice	1051.33	1628.33	2140
Total rice	1088	1291.33	1022
Wheat	1145.67	1256.33	854.33
Maize	603.67	642	748
Other cereals and small millet	490	533	514.67

Table 6b. Growth in productivity levels of pulse crops in pre-reform, reform and post-reform periods (Yield: Kg/ha).

	Triennium ending average		
Particulars	1980-81 to 1982-83	1990-91 to 1992-93	2002-03 to 2004-05
Gram	473.67	482.33	521.33
Arahar	714.33	678	719
Black gram	-	414.67	551.67
Green gram	-	463.67	482.33
Lentil	-	466	526.33
Pea	-	429.33	641.67
Other *rabi* pulses	404.67	437.67	-

Table 6c. Growth in productivity levels of oilseed crops in pre-reform, reform and post-reform periods (Yield: Kg/ha).

	Triennium ending average		
Particulars	1980-81 to 1982-83	1990-91 to 1992-93	2002-03 to 2004-05
Rape and mustard	480	532.33	529
Sesamum	492.33	493.33	568
Linseed	431.67	447.67	510.67
Castor	422.33	427.33	426.67
Nizer	-	-	509.33

Table 6d. Growth in productivity levels of cash crops in pre-reform, reform and post-reform periods (Yield: Kg/ha).

	Triennium ending average		
Particulars	1980-81 to 1982-83	1990-91 to 1992-93	2002-03 to 2004-05
Jute	1495.33	1726.67	1886.33
Mesta	739	834.67	914
Cotton	77	78.67	-
Sugarcane	40678	39913.67	38668

7. Speed of crop diversification: Crop diversification is a practice of cultivating more than one crop in a cropping year in the same piece of land. Crop diversification was measured using Simpson's diversification index (SID). Assam agriculture is dominated with mono crop system, as the values of SID are very less as compared to other parts of the country. The value of compound growth rates (CGR) further supported this empirical observation (Table 7).

This clearly indicates specialization nature of cropping pattern due to mono cropped area. Farmers grew a range of other crops in *Rabi* season, depending on irrigation availability. The poor irrigation facilities however, restrict the cultivation in *Rabi* season crops and leave little scope for crop diversification. As a result, even prime agricultural land has been kept fallow in *rabi* season.

Table 6e. Growth in productivity levels of horticultural crops in pre-reform, reform and post-reform periods (Yield: Kg/ha).

	Triennium ending average		
Particulars	1980-81 to 1982-83	1990-91 to 1992-93	2002-03 to 2004-05
Tobacco	683	560.33	-
Arecanut	161(no./plant)	133.67(no./plant)	-
Banana	13287.67	13185.33	24349
Chilli	571.33	618.67	1071.67
Coconut	60(no./plant)	61(no./plant)	-
Onion	2051.67	1961.67	4021.33
Potato	6307.67	7013	6668
Sweet potato	3281	3226.33	5923.67
Tapioca	4369.67	4285.33	7913.33
Turmeric	611.67	617.33	1217
Pineapple	-	1354.67	15547
Assam lemon	-	4498	6886
Orange	-	1009.67	11242

Table 7. Crop diversification index during pre-reform, reform and post-reform periods.

	Triennium ending average	
Year	Simpson's Index of Diversification (SID)	Compound growth rate
1980-81 to 1982-83	0.6383	1.63**
1990-91 to 1992-93	0.6502	0.79**
2006-07 to 2008-09	0.6529	-3.25**

** Significant at 5% probability level; * Significant at 1% probability level.

Complete dependence of agriculture on rainfall, which is also erratic in nature, inhibits the farmers to take chance for diversifying crop pattern. Rice is an essential component in the food basket of people in Assam and has been location and cultural compulsion to grow rice for the farmers. Also, open grazing is a serious problem in post rainy season (*Rabi* season) in most of the villages of Assam. Even if few farmers choose to grow *rabi* crops, it is difficult to save the crops from grazing. Free grazing is due to non existence of institutional mechanism to restrict free grazing.

Conclusion

Assam agriculture has been and its synonym of monocrop rainfed rice production system. The findings of the study clearly indicated that there is no evidence of crop diversification in the state after a massive place on agricultural diversification particularly after the formation of the state. However, micro-evidences indicate a gradual shift is observed from cereals to vegetables and fruit crops in the state. Poor infrastructural and support services network are major constraints in transforming monocrop rainfed rice system to diversification. To enhance the process of diversification the following strategies and policy initiative are suggested here in:

1. Introduce multiple land use planning.
2. Set up investment in agriculture.
3. SPS and bio safety issues for participation in global market particularly in aromatic rice and organic produce.
4. Ensuring sustainability for diversification policy irrespective of change in political system/pattern.
5. Reorient technology dissemination network.

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