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Structural Transformation in the North-Eastern Region of India: Charting out an agriculture-based development policy

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Structural Transformation in the North-Eastern Region of India: Charting out an agriculture-based development policy

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Abstract

Economic development is associated with a process of structural transformation that entails a falling share of agriculture both in terms of output and employment. However, at least in the initial phases, the share of agricultural GDP in total GDP tends to decline much faster than the share of agricultural employment in total employment. Consequently, the difference between these two shares, termed as the GAP in development literature, increases during the initial phase of economic development, whereby the agricultural sector continues to employ the majority of labour force but contributes less and less output to total GDP. This creates a structural imbalance in the economy, resulting in low agricultural productivity, high income inequality and consequent political instability. In this paper, we intend to study this process of structural transformation in the North Eastern States of India. Within the paradigm of agriculture led development, pioneered by John Mellor, our paper attempts to chart out a development path for the North Eastern region centred on agriculture and agricultural productivity. We derive specific policy parameters that would go a long way in correcting the structural imbalances and the resulting economic inequality and political instability by reducing the 'GAP' and by augmenting agricultural productivity.

Keywords: Structural transformation, agriculture-led-development, TFPG, North Eastern India

Structural Transformation in the North-Eastern Region of India: Charting out an agriculture-based development policy

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I. Introduction

India has been growing rapidly in the last decade and has emerged as the third largest economy (in PPP Gross Domestic Product terms) in the world after the USA and China. Unfortunately, the benefits arising out of this high growth have not percolated down to the entire country equally. There have been few pockets in the country that have remained backward – the eight states of the North Eastern (NE) Region belong to this backward segment. From the rankings of states and union territories of India with respect to Human Development Index in 1981 and 1991, it is evident that the North Eastern states along with the so called BIMAROU[1] states of mainland India are the worst performers. Most of the states in the North Eastern region have ranks ranging from 18 to 31 out of 32 states and union territories. Arunachal Pradesh and Assam are the worst of the lot with ranks 31 and 26 respectively in the year 1981. However, the only exceptions are the states of Manipur and Mizoram. They have performed surprisingly well, ranking fourth and eighth respectively. Even in 1991, the rankings did not change much with four of the eight states in the North Eastern region securing ranks 24 and above. With respect to the Human Poverty Index of 1981 and 1991, six out of eight North Eastern states had ranks higher than 20 (National Human Development Report, 2001). It is thus evident that the North Eastern (NE) Region has remained backward and underdeveloped relative to the advanced states of mainland India. This calls for a detailed analysis of the development experience of the North Eastern States. While there is now a considerable amount of economics/social-science literature on the North Eastern states, unfortunately there is very little by way of analytical research on the NE States within paradigms of economic development theory. Our paper attempts to fill this gap in the literature.

One aspect of economic development highlighted by the theoretical and empirical scholarship in development economics is the process of structural transformation that characterizes

[1] This term, coined by Ashish Bose, refers to following group of states: Bihar (and Jharkhand), Madhya Pradesh (and Chattisgarh), Rajasthan, Odhisha, Uttar Pradesh (and Uttarakhand). These are some of the most backward states of India in terms of development indicators.

economic development (Chenery and Syrquin, 1989). Streissler (1982) defined *Structural Change* as a "long term change in the composition of economic aggregates". Fisher (1939), Clark (1940), Chenery (1960) and Kuznets (1966) were the main advocates of the theory of structural change. They argued that structural transformation is necessary for economic growth. During the initial phase of the process of structural transformation, the share of agricultural in GDP and employment, while the corresponding shares of the non-agricultural sector increase. However, it has been contended that agriculture's share in GDP declines much faster than its share in employment. As a result, the difference between these two shares, termed as the GAP, increases during the initial phase of economic development. In this phase, the agricultural sector continues to employ majority of labour force but contributes less and less to GDP. This creates a structural imbalance resulting in low agricultural productivity, high income inequality and consequent political instability (Timmer, 2008).[2]A successful structural transformation requires a rapid reduction of the GAP, which is possible through a rapid growth in agricultural productivity. This would release agricultural labour for gainful employment in the non-agricultural sector and eventually tend to equalize productivity and wages among different sectors. It is at this stage where the developing economy begins to mimic the characteristics of a developed economy.

In this paper we attempt to explore the process of structural transformation in the North Eastern States of India, positing it in the paradigm of agriculture led development pioneered by Mellor (1961). We try to examine how far concerted policy effort to boost agricultural productivity in the region might reduce the size of the GAP and the resultant economic and social imbalances, thus providing a fillip to the region's development process.

The paper has six sections. After this introduction, section II examines the process of structural transformation of North East India juxtaposed against All India and BIMAROU states. Section III, attempts to identify factors affecting the GAP in the NE region. In section IV, we present a detailed profile of agricultural TFP growth in the north eastern states, using both Frontier (Stochastic Frontier Analysis) and Non-Frontier (Solow residual) methods of TFP estimation. Section V presents an analysis of the determinants of agricultural TFP growth in NE India. Finally, section VI presents a concluding summary.

[2] Young (2013) and Lagakos and Waugh (2012) confirmed that inequality is due to the "productivity draws" bestowed in the workers – those workers with higher productivity selects working in the non-agricultural activities while those with lower goes for agricultural sector.

II. Structural Transformation in the North East Indian States

The profile of structural transformation in the North Eastern states, juxtaposed against that of India (as a whole) and the BIMAROU states, presents an interesting case. Prima facie, it might appear from Table 1 that the sectoral composition of GDP has moved very similarly in the three regions (All India, BIMAROU states and the NE region), with the share of agriculture sharply declining between 1980-81 and 2010-11 in all regions, accompanied with a substantial rise in the share of the tertiary sector. It is with regard to the secondary sector that we find a contrast between the NE region and India. While All India and BIMAROU recorded some noticeable increase in the share of secondary sector in GDP, in the NE region this share increased only marginally over this period.

Table1: Sectoral Composition of GDP

States	**Sectors**	**1980/81**	**2010/11**
North Eastern States	Agr.& Allied*	44	22
	Secondary**	23	25
	Tertiary***	33	53
BIMAROU	Agr.& Allied*	47	20
	Secondary	23	30
	Tertiary	30	50
All India	Agr.& Allied*	41	17
	Secondary	24	30
	Tertiary	35	53

*agr. and allied includes agriculture, forestry and logging, fishing
**Secondary sector includes manufacturing (registered and unregistered), industries (construction; electricity, gas and water supply; mining and quarrying)
***Tertiary sector includes transport, storage and communication; trade, hotels and restaurants; banking and insurance; public administration; real estate owner ship and other services.

More interestingly, a closer look at the composition of the secondary sector itself in Table 2 reveals that the share of manufacturing in the NE region has actually declined, while the same has doubled in BIMAROU and marginally increased in All India. This is a cause for concern as “manufacturing sector provides a foundation for growth by providing various externalities and scale economies, and thereby promoting continuous growth potentialities, whereas a rise in the services sector at the initial phase would lead to overheating of the economy” (Barua and Bandyopadhyay, 2005).

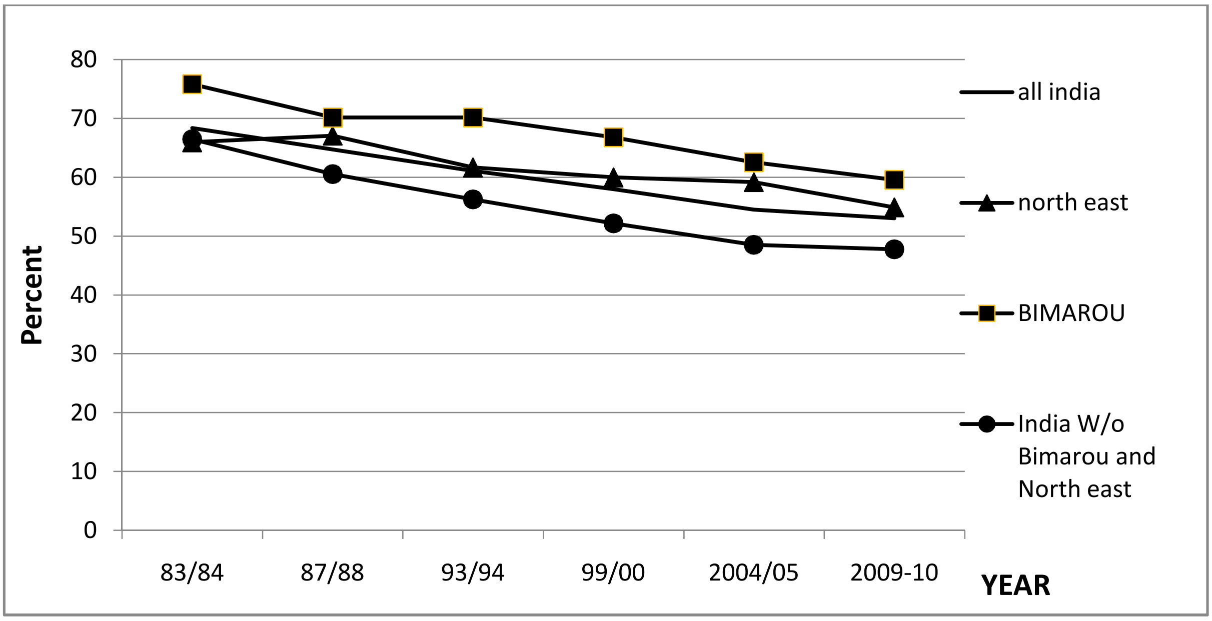
Table 2 Composition of the secondary sector

States	Sub Sectors	1980/81	2010/11
North Eastern States	Manu	6.5	3.6
	Const	12.7	14.1
	EPWS	2.0	5.5
	MQ	2.0	2.1
BIMAROU	Manu	10.2	14.1
	Const	5.5	8.7
	EPWS	3.4	1.7
	MQ	4.0	3.7
All India	Manu	13.5	16.4
	Const	7.3	8.5
	EPWS	1.0	2.5
	MQ	2.2	2.8

Manu= manufacturing, EPWS = electricity, power and water supply, Const= construction, MQ = mining and quarrying.

With respect to employment, we find a declining share of agriculture all three regions (All India, BIMAROU and NE – figure 1). However, the rest of India excluding BIMAROU and NE states shows a sharper decline in the employment share of agriculture, indicating that these two regions still have a larger share of the labour force engaged in agriculture.

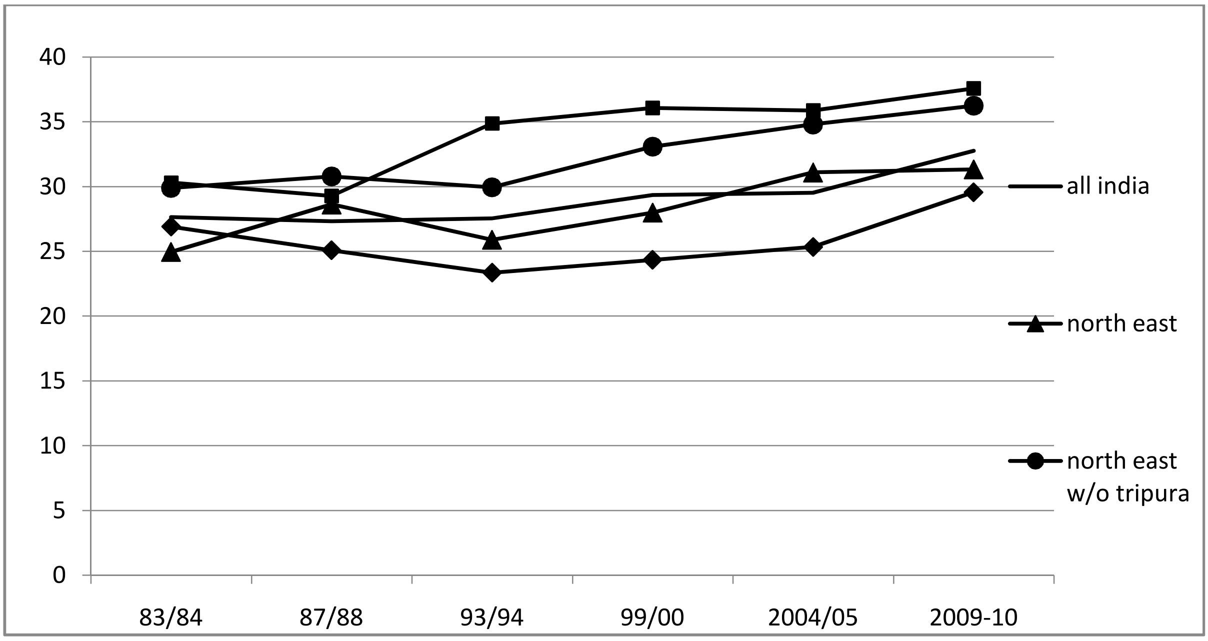
Figure 1 Agricultural and allied employment share in the total output in NE, BIMAROU and All India



Source: Authors calculation and CSO

The GAP, defined as the difference between agricultural employment share and agricultural output share, has been consistently increasing for all three regions (NE, BIMAROU and All India)from 1983/84 to 2009/10 (figure 2). The GAP profile in BIMAROU is clearly higher than that of All India and NE region. However, in the NE region, Tripura happens to be an outlier in terms of the GAP, as it has almost reached the point of convergence. Excluding Tripura, the trend line for NE region is very similar to that of BIMAROU and much higher than the rest of India (excluding BIMAROU and NE). In other words, in terms of structural transformation, especially with regards to the GAP, the NE region has been displaying the same characteristics as the backward BIMAROU states of India.

Figure 2: GAP



Source: Authors calculations and CSO, NSS and Census

Apart from this rising GAP, the NE region has witnessed rising income inequality. The entropy index[3]shows a steep rise post 2000 (see figure 3).[4] Calculating the decadal growth rates of the entropy measure in figure 4, the NE region shows a substantially higher increase in inequality than that of the All India average.

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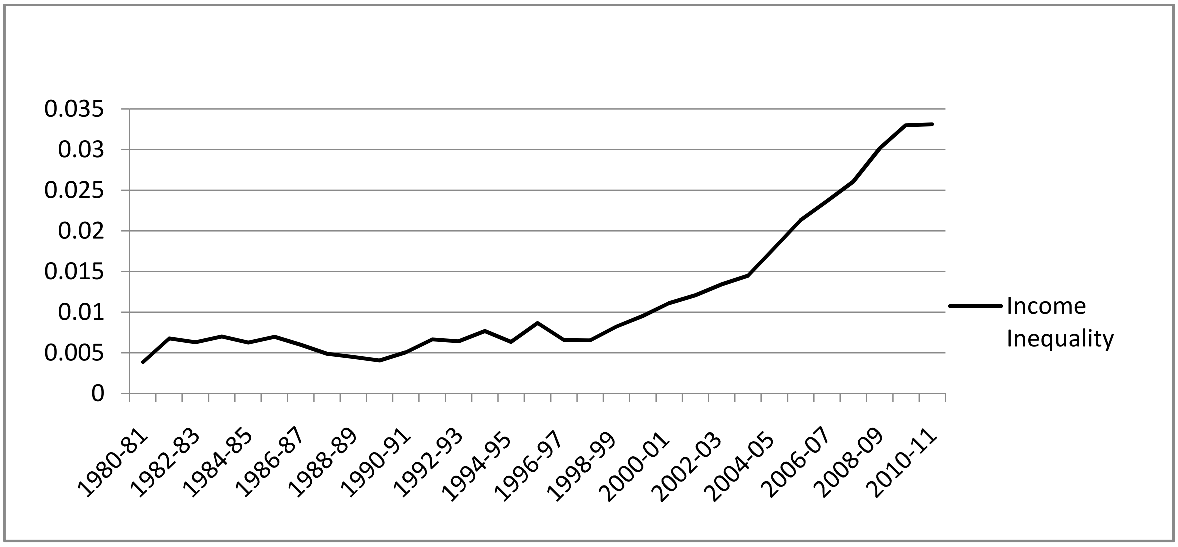
[3]Entropy Index, developed by Theil (1967, 1977), is defined as $E_y = \sum_{i=1}^{8} X_i \log(\frac{X_i}{P_i})$, where X_i is the proportion of gross domestic product at 2004-05 prices of the ith states in the North Eastern Region and P_i is the proportion of population in the ith state of the north eastern region. $\sum X_i = \sum P_i = 1$. E_y is equal to zero when there is no inequality suggesting that equal proportion of population earns the same share of State Domestic Product.

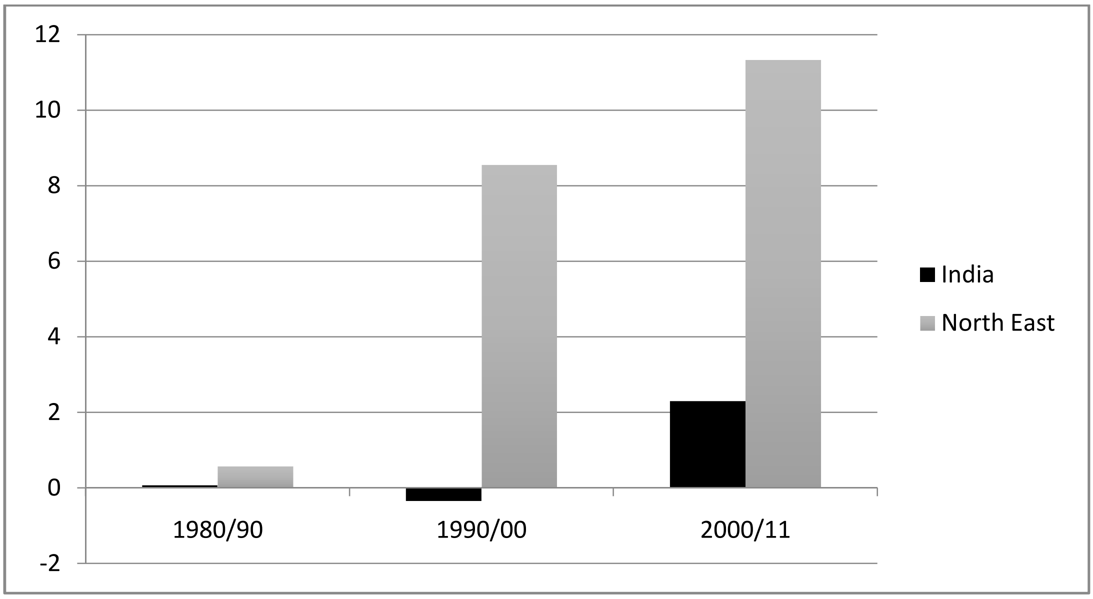
[4] It may be noted that NE region shows lower absolute values of the entropy measure when compared with all India average, perhaps due to a high degree of heterogeneity among Indian states.

Figure 3 Entropy Index for the Income Inequality of the NE region's economy



Source: Authors calculations and CSO

Figure 4 Decadal growth rate of Entropy Measure



Source: Authors calculations and CSO

Therefore, there is little doubt that the NE region has remained backward and underdeveloped relative to the advanced states of mainland India. The process of structural transformation of this region is similar to that of the most backward (BIMAROU) states of India, characterised by high and rising levels of the GAP that acts as a major deterrent to economic progress and prosperity. This calls for a deeper look at the GAP in the NE states in an attempt to analyse its determinants.

III. The Determinants of the GAP in NE India

GAP is a result of the mismatch between employment share and the output share of the agricultural sector. While output share falls considerably, there is not a commensurate fall in employment share as a result of which the sector becomes less productive. To identify the factors that could mitigate this mismatch, we consider variables like literacy, agricultural research and agricultural TFP – all of them are expected to have a dampening effect on the GAP. We expect literacy to reduce the GAP as literate farmers are expected to be more efficient and more skilful in performing agriculture task and thereby improving output and reducing the GAP. Likewise investment in agricultural research and higher agricultural TFP would also lead to rising agricultural productivity and output share and thereby lowering the GAP.

The data on percentage of literates in respective states were derived from Census of India (1981, 1991, 2001 and 2011). The inter-census years were interpolated using the exponential method. The plan and non-plan expenditure on agricultural research by respective state governments was obtained from the Handbook of Statistics on State Government Finances published by RBI, while the data on agricultural TFPG was computed using Stochastic Frontier Analysis for a period from 1980-11 for all North eastern states.[5] We thus obtain a panel for a period of thirty one years from 1980-2011 for all the eight states. We apply panel regression models for our estimation. We report the fixed effects model as indicated by the Hausman test:

$$GAP_{it} = 11.88 - (13.33) Agr.TFP_{it} + (0.482) literacy_{it} + (0.0367) Agr.research_{it} + \varepsilon_{it}$$

(3.57)   (-3.89) **   (13)*   (0.84)

Note: Standard Errors are given in parentheses. * indicates significant at 1 percent, ** indicates significant at 5 percent. 'i' represents the states: Assam, Tripura, Meghalaya, Manipur, Mizoram, Nagaland, Sikkim and Arunachal Pradesh and 't' represents the time period from 1980 to 2011.

The results show that TFP growth, as postulated, has a negative and significant impact on the GAP while agricultural research does not have any significant effect. Contrary to expectation, literacy seems to aggravate the GAP, instead of mitigating it. This is possible if the literate labour force shifts to non-agricultural occupations offering higher wages, leaving the illiterate

[5] We discuss the details of our TFPG calculations in the next section.

behind to attend to agriculture. This would lead to further decline in agricultural productivity and aggravate the GAP.

However, it is evident from our results how powerful the impact of TFPG can be on the GAP. A unit increase in TFP would reduce the GAP on an average by 13.33 percentage points. Indeed, a higher TFP growth is thus often considered to be a pre-condition for sustained long run pathway out of poverty. Therefore we now move on to a detailed analysis of agricultural TFP growth in the NE region.

IV. Agricultural TFP growth in NE India

There are two principal approaches to estimate TFP growth – Frontier and Non-Frontier Production Function Approaches. The former entails estimation of the maximum attainable outputs, given a set of input quantities and technology (Forsund et. al. 1980). The latter estimates the mean output for given inputs and technology. Data envelopment analysis and Stochastic Frontier Analysis (SFA) are the two most commonly used methods in Frontier Approach[6] while Growth Accounting Method and Thornqvist-Theil Index are popularly used methods in Non-Frontier Approach[7]. In this paper we use both SFA and the growth accounting method.

The advantage of SFA over the growth accounting approach is that SFA incorporates a "composed error structure with a two sided symmetric and a one sided component. The one sided component captures the effects of inefficiency relative to the stochastic frontier while the symmetric component permits random variation of frontier across firms and captures the effects of the measurement error or random shocks outside the firm's control. In growth accounting method, TFP is directly calculated as a "residual", while in SFA three components (scale efficiency, technological efficiency and technical efficiency) are calculated and combined to derive TFP growth (Keng and Li, 2010).

For the estimation of agricultural TFP we use the following data sources. For output we use aggregate gross value added (GVA) for the crop sector published by CSO (State level

[6]Aigner, Lovell and Schmidt (1977), Timmer (1971), Afriat (1972), Meeusen and Broeck (1977), Battese and Coelli (1992), Caves, Christensen and Diewert (1982), Yu and Linh, (2011)
[7]Rosegrant and Evenson (1995), Fuglie (2010), Hayami and Ruttan (1985)

Statistics). It is calculated by adding GVA for each crop at constant (2004-05) prices. The sub-aggregates include cereal, pulses, oilseeds, sugar, fibres, drugs and narcotics, condiments and spices, fruits and vegetables, other crops, by products, kitchen garden). We consider five important inputs: labour, animals, tractors, fertilizer and irrigation. For labour we have obtained and computed the number of agricultural labour from both NSS and Census data. The census of 1981, 1991 and 2001 were considered in absolute numbers while the NSS rounds of employment and unemployment surveys were considered for the proportions of the labour force in agriculture. The usual activity status (principal and subsidiary status) was considered for the proportions.[8] The reason for considering the NSS rounds of 38th, 43rd, 50th, 55th, 60th, and 66th was to fill the gap where no census data was available. This did not cause any data bias because only the proportion from the NSS rounds were used on the interpolated census numbers. The remaining gaps were then interpolated using the exponential method. The number of animals used (in thousands) was obtained from Livestock Census of 1982, 1987, 1992, 1997, 2003 and 2007. Interpolation using the exponential method was used for the non-census years. The data for tractors was obtained from CMIE. This data was rather scanty. The existing data was interpolated and extrapolated for the missing years. The data for fertilizers in thousand tonnes from 1980 to 2011 was obtained from Fertilizers Statistics (Fertilizer Association of India). This included the total sum of nitrogen, potash and permanganate. The data on the irrigated land in thousand hectares was obtained from Land Use Statistics (Ministry of Agriculture, Govt of India) from 1980 to 2011. The data on Net Sown Area was also obtained from Land Use Statistics (Ministry of Agriculture, Govt of India) from 1980 to 2011. All independent (output) and dependent (inputs) variables were normalized by Net Sown Area to control for the varying size effects.

To calculate the TFP growth, the Solow residual (Solow, 1957) was calculated using the OLS method for the following production function in log-log form:

$$\log(GVA/hectare)_{it} = \alpha + \varepsilon_1 \log(animal\ /hectare)_{it} + \varepsilon_2 \log(labour\ /hectare)_{it} + \varepsilon_3 \log(tractors\ /hectare)_{it} + \varepsilon_4 \log(fertilizer\ stonnes\ /hectare)_{it} + \varepsilon_5 \log(irrigateda\ rea/hectare)_{it} + \lambda t + U_{it} \text{..........} (1)$$

SFA also uses a linear form of Cobb Douglas function, but now with a one sided error term (U) added to it to represent the stochastic frontier:

[8] "The usual status relates to the activity status of a person during the reference period of 365 days preceding the date of survey." (NSS 66th round, 2009-10).

$$\log(GVA/hectare)_{it} = \varepsilon_1 \log(animal/hectare)_{it} + \varepsilon_2 \log(labour/hectare)_{it} + \varepsilon_3 \log(tractors/hectare)_{it} + \varepsilon_4 \log(fertilizerstonnes/hectare)_{it} + \varepsilon_5 \log(irrigatedarea/hectare)_{it} + \lambda t + V_{it} - U_{it} ....(2)$$

Where $U_{it} = \eta_{it} U_i = \{\exp[-\eta(t-T)]\} U_i$

U_{it} represents the technical inefficiency of the production which are to be independent and identically distributed non-negative truncations of the N (μ, σ^2) distribution while V_{it} represents the random shocks which might be positive like technological advancement or negative shocks such as shortages of inputs due to flood. This is assumed to be independent and identically distributed N (0, σ_v^2)

Before estimating the functions, we looked at the correlation matrix of the independent (input) variables. The pair wise correlation coefficients of fertilizers per hectare with animals per hectare and labour per hectare are over 0.5 and significant at 5 percent. To avoid problems of multi-collinearity, we dropped fertilizers per hectare.

Table 3 Estimation of the production function

	Solow (Model 1)	**SFA (Model 2)**
Animal per hectare	0.0498197	-0.0047
Labour per hectare	0.290980*	0.2344*
Tractors per hectare	0.118544*	0.095207*
Irrigation intensity	0.131769*	0.15127*
t	0.017007*	0.011268*
Constant	-0.732796	-0.10416*
γ		.6295976
$\sigma_s^2 = \sigma^2_v + \sigma^2$		.0934016
μ		.4823509
η		.0153049
Observation	248	248

* indicates significant at 5 percent level.

Table 3 indicates the elasticities of respective inputs. Labour appears with the highest elasticity in both models, suggesting that labour continues to play a major role in the agricultural sector. All inputs except the animals per hectare are statistically significant at 5% level. The elasticities (excluding that of the animals input) add up to 0.541 and 0.481 in Models 1 and 2 respectively, reflecting diminishing returns to scale in NE agriculture. The significant and positive time trend coefficient indicates a rise in total factor productivity in the North Eastern States through neutral technological progress.

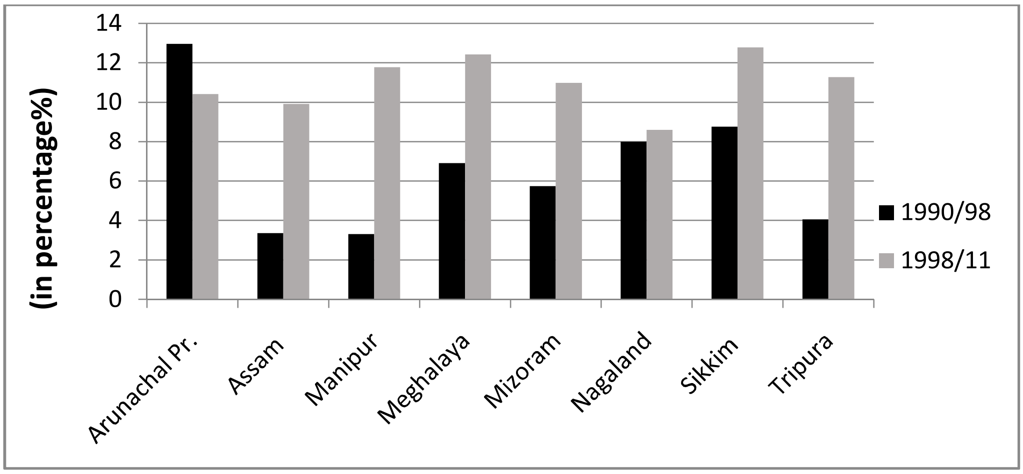
We decomposed TFP into three different components using the SFA method: technical change, efficiency change and scale component and reported the technical efficiency figure in table 4. It shows that technical efficiency of the North Eastern states have been increasing consistently from 1980 to 2011 which is also evident from the value μ which is 0.48 in the Table 3. Tripura records the highest technical efficiency while Nagaland has the lowest. Considering the average over the decades 1980-2000 and 2000-2011, a sharp improvement in technical efficiency is observed post 2000 in all states. But, except for Tripura, agriculture in the NE Region still suffers from high technical inefficiency.

Table 4: Level of Technical Efficiency of the North Eastern States from 1980-2011

Average of TE	Assam	Tripura	Manipur	Meghalaya	Nagaland	Arunachal Pradesh	Sikkim	Mizoram
1980-85	0.49	0.93	0.58	0.44	0.26	0.41	0.50	0.37
1985-90	0.52	0.94	0.60	0.47	0.28	0.43	0.52	0.40
1990-95	0.55	0.94	0.62	0.50	0.31	0.46	0.55	0.43
1995-00	0.57	0.95	0.65	0.53	0.34	0.49	0.57	0.46
2000-05	0.59	0.95	0.67	0.55	0.37	0.51	0.60	0.48
2005-09	0.61	0.95	0.68	0.57	0.39	0.54	0.62	0.50
2009-11	0.63	0.96	0.70	0.59	0.41	0.55	0.63	0.52
1980-00	0.53	0.94	0.61	0.49	0.30	0.45	0.54	0.41
2000-11	0.61	0.95	0.68	0.57	0.39	0.53	0.62	0.50

A structural break in the trend of TFPG was identified in 2000. This was done through the use of time dummy for each successive year. The sign of this dummy was negative and significant till 1995/96 and after a period of insignificance, it became positive and significant from 1999/00 onwards. The significant change in the trend of TFP occurring in 2000 might have been due to favourable changes in policies. On 8th May, 1998 the Prime Minister convened a meeting of the North Eastern States and agreed to create a Non-lapsable Central Pool of resources for the funding of specific projects. This was further emphasized by the Finance Minister during the Union budget speech of 1998/99. The Ministry of agriculture has implemented wide range of programmes post 1998. Few of them are Macro Management of Agriculture Scheme (2000-01), Technology Mission for Integrated Development of Horticulture (2003-04), National Project on Organic Farming (2004), Rashtriya Krishi Vikas Yojna (2007), National Project on Management of Soil Health and Fertility (2008-09). A special nodal department, DONER (Department of North Eastern Region), to deal with matters pertaining to socio-economic development of the NER and the North Eastern Development Finance Corporation was established in 1995 for financing projects related to agriculture and allied services, micro credit scheme for small local entrepreneurs. Figure 5 clearly shows that public investment in agriculture and allied activities increased manifold after 1998 in almost all NE states except Arunachal Pradesh. These may be some of the reasons which could explain the change in the trend of TFP post-1998.

Figure 5: Growth rate of Public Investments in Agriculture and Allied Activities in the North Eastern States pre and post 1998



Source: State government finances (RBI)

To compare the TFP experience of the NE region with that of the rest of India, we reviewed the existing empirical literature summarised in Table 5. Although the NE region seems to be lagging behind the rest of India, but it is not performing too badly either – it has nearly attained the TFP levels that the rest of India achieved post green revolution. During the period of 1980-1990 the NE states were performing poorly in TFPG, but it gathered momentum after 1990, with Assam, Tripura and Meghalaya achieving TFPG above 1 percent.

Table 5: TFPG estimates of the cropping sector in India and respective states

Avila and Evenson (2004)[9]	**Growth Accounting**	**1961/80**	**1981/01**	
	India	1.54	2.33	
Praduman Kumar, Anjani Kumar, Surabhi Mittal (2004)[10]	**Thornqvist Theil Index**	**1981/82 to 1990/91**	**1990/91 to 1996/97**	
	Punjab	1.24	1.2	
	Haryana	3.22	0.1	
	Uttar Pradesh	1.44	-0.54	
	Bihar	1.47	0.24	
	West Bengal	5.13	1.25	
OurStudy	**Stochastic Frontier Analysis (SFA)**	**1980/90**	**1990/00**	**2000/11**
	Assam	0.34	1.78	2.15
	Tripura	-1.50	1.19	1.13
	Manipur	-1.37	-0.79	4.94
	Meghalaya	0.70	1.31	2.73
	Nagaland	-0.20	-0.11	2.55
	Arunachal Pradesh	-1.82	0.27	1.84
	Sikkim	-3.16	-0.12	-1.40
	Mizoram	-5.07	0.72	2.64
	NE (Mean)	-1.51	0.53	2.07
Our Study	NE region	**1980/2011**		
	Solow	1.7		
	SFA	1.12		

V. Determinants of Agricultural TFP growth in NE India

In the previous section we saw that the NE region has been performing not too badly in terms of TFP growth vis-a-vis the rest of India. In this section we attempt to identify the factors driving agricultural TFP in the NE region. The factors which are likely to determine the TFP growth may be divided into (i) infrastructure variables (ii) technology variables and (iii) human resource variables. Infrastructural variables include construction of roads and number of villages electrified. Technology variables include investment by government in the agricultural research and cropping intensity, while human resource variable includes the

[9] Avila, A.FD. and R.E Evenson, (2004) "Total Factor Productivity Growth in Agriculture: The Role of technological Capital, Economic Growth Centre.

[10] Kumar, Praduman; Kurmar, Anjani and Surabhi Mittal, (2004) "Total Factor Productivity of Crop sector in the Indo Gangetic Plain of India: Sustainability issues revisited ", Indian Economic Review pp 169-201.

proportion of rural literates. We expect all the variables to have a positive effect of TFP (Rosegrant and Evenson, 1995).

For data related to electricity we considered the number of villages electrified over the years from 1980 to 2011 from the Statistical Abstracts of India and Central Electricity Authority while the data on the surface length of roads in India in Km were taken from the Basic Road Statistics of India, Ministry of Shipping, Road Transport and Highways. The data on cropping intensity was derived from Land Use Statistics and the data on expenditure on agricultural research was taken from the handbook of State government finances published by RBI respectively. The data on rural literacy was taken from Census.

The panel data for a period of thirty one years from 1980-2011 for all the eight states were considered for the TFP analysis[11].

The following panel regression was finally considered for estimation:

$$TFP_{it} = 0.38 + 0.0002(electricity)_{it} + 0.0039(ruralliteracy)_{it} + 0.0036(cropping\ intensity)_{it} + \varepsilon_{it}$$

(4.79)* (4.98)* (5.28)* (4.88)*

* Significant at 1 percent, numbers in the brackets are values of standard error.

Electricity, rural literacy and cropping intensity all have a positive and statistically significant effect on TFP. Availability of electricity is a pre-condition for the use of farm implements, storing perishable products such as fruits and vegetables, building warehouses. All these reduce wastage and raise efficiency.

As far as literacy is concerned, more literate the population, the quicker is the adoption process for new and improved technologies. Educated farmers are not only better aware of the new government schemes, subsidies, market prices, optimum application of the fertilizers, pesticides and HYV seeds etc, but they can also use this information more efficiently. Naturally, rural literacy has a positive impact on agricultural TFP.

Cropping intensity index, measured as a ratio of total cropped area over net sown area multiplied by 100, captures the number of times a piece of land is cultivated during an

[11] The pair wise correlations between agricultural research, electricity, road length are highly significant. Therefore to reduce the multi-collinearity, road length and agricultural research were dropped. The panel regression with random effects was considered since the null hypothesis for Hausman test was rejected.

agricultural year.[12] The North Eastern States, on an average, display lower cropping intensity compared to the national average. With the exception of Assam and Sikkim, all other NE states have cropping intensities lower than the national average (table 6). Manipur and Mizoram display mono-cropping with cropping intensity index of 100. Thus there is ample scope of raising cropping intensity in the NE and this will have a positive impact on TFP.

Table 6: Cropping Intensity

Cropping Intensity (%)	**2009/10**
Assam	145.82
Arunachal Pradesh	130.19
Meghalaya	118.73
Mizoram	100.00
Manipur	100.00
Nagaland	134.63
Sikkim	187.01
Tripura	110.36
All India	137.00

In the context of estimating agricultural TFP and its determinants in the NE region, one disclaimer is in order. Neoclassical production functions fail to capture fully the intricacies of agricultural practices prevalent in tribal societies and ethnic groups. Given such practices are common in the NE region of India, our analysis may not be capturing the subtle nuances of NE agriculture.

VI. Conclusion

Johnston and Mellor (1961) posited 50 years ago that agricultural led development leads to multiple benefits such as (a) increase in agricultural profits and labour income, (b) rise in rural non-farm profits and employment and labour income via linkages effects, (c) lowering of food prices mostly benefiting the poor, (d) increase in urban real wages (due to falling food prices) and (e) tightening of urban and rural labour market, raising unskilled wages in the wider economy. Therefore agriculture led development can lead to faster and more comprehensive economic development. And this growth becomes more inclusive if successful structural transformation takes place. Successful structural transformation rarely happens during initial stages of economic growth. During the early stages of economic development, the structural GAP widens due to the rapid urbanization resulting in the unequal accumulation of wealth. But the GAP shrinks as the economy diversifies and

[12] A value of 100 indicates a mono-cropping.

urbanization continues “leading to progressive convergence of rural and urban sectors into a fully integrated economy”. This is when the GAP tends to zero or becomes almost negligible (Losch, Freguin-Gresh and White, 2012).

In North Eastern India, the process of successful transformation has been prolonged with the persistence of an ever-widening GAP. Even though the GAP in the NE region as a whole is almost similar to that of the all India average, if we exclude one outlier (Tripura), the GAP in the NE region is magnified manifold and resembles that of the worst performing BIMAROU states. The calculation of the entropy index suggests that income inequality has also increased significantly in recent decades in the NE. This calls for an urgent need to address the issue of the rising increasing GAP in the NE region, as it could pose a threat to security and economic stability of the region.

This paper shows that agricultural TFP growth can play a major role in reducing the GAP. Rural literacy may act as a double edged sword – while it seems to magnify the GAP directly but at the same time it also appears to augment TFP (and thereby reduce the GAP in the long run). Our results also show that improvements in TFP may be brought about, not only through higher literacy, but also through expansion of rural electrification and by increasing cropping intensity. These are some of the concrete policy directions that could chart out an agriculture led development path for the NE region of India.

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