

# Development, Environment and Sustainable Livelihood



Development, Environment  
and Sustainable Livelihood

Edited by

Soumyendra Kishore Datta  
and  
Atanu Sengupta

**CAMBRIDGE  
SCHOLARS**

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P U B L I S H I N G

Development, Environment and Sustainable Livelihood,  
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and  
Atanu Sengupta

# INTRODUCTION

The achievement of higher economic growth is one of the principal objectives of the government policies. It is a great challenge for the developing countries and only vehicle which can bring these countries out of poverty. This also involves resource intensive development programmes with equitable access and distribution of output. Sustainable human development is conditioned by the equitable distribution of and access to such output and enhancement of human capabilities. Aspects of human development, have for a considerable period of time, been the central issue in the development debate for the world economies, especially the third world countries. The concern for making provision for better opportunities and advantages for a reasonably good standard of living for the majority of human beings, if not all, has been expressed in different quarters in different forms.

Apparently it seems that the countries with higher average income tend to enjoy higher average life expectancies, lower rates of infant and child mortality and higher literacy rates and hence a higher human development index. But inter-country comparisons in this field reveal that these income variations tend to explain less than half the variations in life expectancy, infant/child mortality and differences in adult literacy. The central focus of this statement is that in assessing human development the matter of concern should not be income alone but the use that this income is put to. A society can spend its income on arms without expending on education. An individual may buy narcotic drugs without consuming essential food.

Thus economic growth is very important but at the same time it is insufficient for human development. Hence enhancement of human capabilities rather than promotion of aggregate growth of gross national product alone should be the main concern.

Sometime back it was rife among well informed people that along with economic growth, through improved technology there will be availability of proper substitutes and there will be an efficient use of the existing natural resources.. But mere efficiency in the use of natural resources in the present generation does not guarantee its availability in future generations as well. There are certain ecosystem functions like air and soil quality, climate regulation, disturbance regulation, nutrient cycling, waste treatment etc which are quintessential for the existence of human race and

cannot be replaced. Thus in order to make economic development sustainable, natural and environmental resources must be used in such a way that there is enough for the present generation as well as the future generation.

Human development is also intimately related to access to the aforesaid type of resources and how these resources are distributed and utilized in shaping peoples' livelihood. India's development path is based on its unique resource endowments. As a welfare state the overriding priority lies in generating peoples' wellbeing with the multifarious programmes of eradicating poverty through providing means of earning income for a sustainable livelihood.

There is no counter to the fact that despite elapse of 60 years since independence the teeming millions in the Indian economy still reside in country side where fight against poverty for many still remain a regular phenomenon. Govt. has adopted a number of poverty alleviation strategies from time to time to provide sustainable earning opportunities to these people and raise their income and consumption level. While these are generally targeted to achieving the goals of eliminating rural poverty, the purpose of generating an all-round enhanced livelihood opportunity based on creation of an improved ambience is only partially served by such programmes. The recent focus, therefore, has been on the assets/processes/activity framework concerned with not only poverty reduction but also promoting sustainable livelihood enhancing strategies and access to assets like human capital, physical assets, social capital, financial capital and natural capital. In terms of the sustainable livelihood framework a livelihood comprises the activities, the assets, the capabilities and access that combine together for determining the living attainable by an individual. A livelihood is deemed to be sustainable when it can absorb unforeseen shocks and recover from the stresses and uncertainties while maintaining or enhancing the capability and asset base both at present and for future periods without distorting the natural resources and creating social unrest. There are seventeen papers in this book covering socio-developmental aspects as well livelihood issues intimately linked with the Farm and Non-farm Sector, natural resources as well as influenced by gender issues.

The paper by Arpita Banerjee and Pravat Kumar Kuri makes an attempt to examine the growth performances of agricultural production and productivity of major States of India and the level of disparity in the performances of agriculture since 1970-71. The paper also explores the nature of cropping pattern in India and its states over the study period. The growth performances have been analysed considering three distinct phases

of agricultural development in India viz the first phase of green revolution 1970-71 to 1979-80, second phase of green revolution 1980-81 to 1990-91, and the period after economic reform 1991-92 to 2007-08). The variability in agricultural output is observed to be responsible partly due to the variability in agro-climatic conditions across the states and partly due to the variations in agricultural infrastructure. Moreover, using cross section and time series analysis, this paper attempts to examine the trends of convergence/divergence of per capita value of agricultural output over the period 1970-71 to 2007-08. The results of tests of  $\sigma$  and absolute  $\beta$  convergence show a diverging tendency in agricultural growth in India. The unit root test result identifies the states that are responsible for divergence in agricultural growth in India.

The paper by Biswajit Ghosh and Namita Chakma used the notion of ecological footprint and biological capacity as indicators for measuring regional sustainable level of land use in West Bengal. They used the applied component method which was used by (Li et al, 2009) in assessing ecological footprint of land use in China, 2009. The content of the work is divided into two parts: the ecological supply (or bio-productive areas) and the demand on nature (or ecological footprint). They found that some of the districts like Darjiling, Malda, Purulia, Bankura, Haora and South 24 Parganas were endowed with less cultivable land and low cropland bio-capacity (less than 1000000 ha), while districts like Dakshin Dinajpur, Murshidabad, Nadia and Paschim Medinipur had large amount of cultivable land high cropland bio-capacity. Ecological surplus were enjoyed by districts having more bio-capacity of cropland than footprint while the reverse happened to be the case with ecological deficit, districts suffering from more footprint of cropland than bio-capacity. They concluded the paper with the findings that 14 districts were experiencing ecological deficit while nine districts amongst them were having a very crucial condition. There include Malda, Murshidabad, Nadia, North 24 Parganas, Haora, Hugli, Barddhaman, PurbaMedinipur and Kolkata which were afflicted with a high density of population.

Nirmalendu Sarkar, Santosh Kumar Dutta and Swapan Kumar Biswas, in their paper ventured to assess the remunerative crop or combination of crops in an agricultural year of any cropping system suitable to a specific agricultural region, by considering both production costs and annual net returns. . The study undertaken in the context of some selected villages in the district of Budwan, West Bengal had been based on the fact that improving the productivity of agricultural land largely depends on the comparative advantage of agriculture of any cropping system selected by the respondent farmers. It is observed by them that operation and

interaction of a variety of factors like production cost in terms of seed and fertilizer requirements, expenses on modern implements, size of land holding and usability of machine, electricity used for agricultural purpose, marketing infrastructure and transport facilities, are usually crucial in influencing the productivity and profitability in agricultural scenario.

Arup Majumdar in this paper, has tried to present the results of an anthropological field based study among a group of peasant families in the villages under Kharagpur- I Block in Paschim Medinipur district of West Bengal. He specifically put focus on the comparative conditions of the women of landloser and non- landloser families subsequent to the acquisition of agricultural land for the establishment of a heavy industry. He showed that after the acquisition, livelihood pattern have changed among the female members of landloser families.

The paper, "Microfinance Access And Women Empowerment In India: An Inter-State Analysis" written jointly by Arindam Laha and Pravat Kumar Kuri deals with the problem of microfinance outreach in enhancing the economic opportunities among the women. The paper delineates two aspects: the microfinance outreach and women empowerment. Both these aspects are collated into two separate indices that are a combination of several dimensional indicators. The authors then look at the relation between these two indices. Interestingly a positive association is established between microfinance outreach and women empowerment. The states having higher level of microfinance outreach are also the states with a relatively high level of women empowerment. It is, thus, predicted that an all-inclusive microfinance system would strengthen the process of financial inclusion in India and thereby would promote women's empowerment.

Soumyendra Kishore Datta and Tanushree De focus on the relative discrimination and deprivation of females compared to male counterparts in the sphere of diversification in job market and find that the differential in livelihood diversification is well correlated gender differential in capability. They also ascribe this female discrimination to observed differences in asset ownership and mobility status across gender. They report that in the developing regions, they still have far less access to material resources, education and training, health related benefits and economic and employment opportunities. Particularly they remain deprived in terms of provision of health and education services for women. There operate several constraining factors that continue to keep their capabilities at a subdued level compared to males and in the process females usually do not get opportunities to pursue a broader diversified form of livelihood unlike their male counterparts. This often stands in the

way of their continuous source of earning and affects financial independence and social dignity. Sometimes the gender differential in socio-economic attainments is so acute that women face severe problems in earning from a diversified access to work opportunities.

Soumitra Sarkar has considered the problem of women empowerment when they seek support through multiple borrowing from micro finance institutions. He undertook a case study in the Rajganj block of Jalpaiguri district. It focuses on the fact that often when it comes to reporting during project evaluation stages, figures show that repayment is meeting recovery targets. But beyond the recovery factor there exist some chains of financial transaction which govern the efficacy of functioning of SGSY scheme and have bearing on women empowerment. Citing some case study examples he shows how some women members of certain SHGs fell into debt trap while trying to repay the interest and principal of one loan by taking recourse to a second and sometimes even a third loan from various different private financial institutions. Data collected from field survey revealed that beneficiaries often undertook debt swapping which had indeed been a serious phenomenon that proliferated subsequent to emergence of microfinance systems in the area under the study. Excess debt intake often results due to absence of adequate knowledge of the debt schemes i.e., term of debt, conditions of debt, rates of interest etc. According to him unless the phenomenon multiple lending/ multiple borrowing be stopped the beneficiaries would not be able to reap the full benefit of the microfinance system and the aspect of women empowerment would be continue to be eluded.

Utpal Kumar De has tried to focus attention on relative efficacy of the look east policy undertaken by the Govt. of India in the event of globalization for more regional and sub-regional cooperation and understanding for the promotion of trade, especially export in the eastern and south-east Asian countries. Attempts have been made in this paper to show how far India has been able to integrate with other Asian countries in terms of various globalisation indices and expand foreign trade with these nations and finally took advantage of open policies to accelerate the growth of GDP and HDI. The study came out with the conclusion that despite the emergence of a notable crisis in the fast growing Asian countries after 1997 and their subsequent recovery, India's effort to catch up the eastern markets has not been highly successful. In terms of growth in exports India could not fare well commensurate with those of other countries and the trade deficit with major ASEAN countries still continues.

Atanu Sengupta and Debjyoty Mukherjee in their paper investigated whether performance of individual physicians within the same “Service-State” differs and if yes how? They define service-state as a compound of different dimensions that includes stock of infrastructure, consumables, quality of support staff and number and attitude of patients. They record self-reported performance of physicians within a given service-state considering knowledge asymmetry of licensed physicians has a downward rigidity. Mainstream economists developed a measure of objective efficiency—the standard stochastic, DEA and other such methods. In trying to look at mathematical precision, economists lose much simple truth that lie underneath such complex analysis. This paper goes beyond the gamut of traditional efficiency measures and brings the conception of measures through subjective efficiency.

Debasish Batabyal analysed the prospect of Tourism development in Sikkim which has new dimensions in many respects. According to him, the growth and development potentials of tourism in Sikkim, is usually measured only with arrival statistics over the years with no available information about the origin of tourists inside and outside the country. He deems it important to reconsider the development potential of Sikkim with the emergence of problems like over-crowded routes and resulting negative socio-cultural and environmental consequences. This can be possible with sector specific focus on the tourism industry e.g. accommodations, attraction features, transportation etc. The present study is a sector specific analysis of performances of tourism elements in Sikkim with the help of WES tourism index with relevant weights. This WES tourism index has covered two aspects of tourism industry viz. data collection for each and every sub-sector in tourism and measurement of performance (Bruges and hinterland area, West-Flanders region in Belgium; 1962). He found that there had been variations in tourism index over the years under consideration. Finally he concludes that the types of tourism, types of tourists, spending pattern, alternative routes and channelization of tourist traffic are found to be the core areas of development and management in Sikkim tourism with its regional disparity in tourist arrival and varied development of supply components.

Anish Kumar Mukhopadhyay stresses that since its introduction, the choice of variables and the methodology of construction of Human Development Index, has given rise to great controversy. The UNDP made some drastic changes in the Human Development Report- 2010 by addressing certain issues pertaining to the index in order to engineer quite substantial redressal of the previous shortcomings. He mentions that changes have taken place in the field of gender bias with the advent of new

indices in place of the earlier ones. However these new indices are also not without criticism. Arguments are pertinent and calls for improvements especially in the question of inequality both for Human Development and Gender. This paper investigates the actual scenario with some greater details both in terms of theoretical construction as well as from empirical point of view in a cross-national framework.

Soumya Sahin and Ambar Nath Ghosh constructed a simple overlapping generations model in which parents are assumed to derive utility from their children's education. They also used this framework to understand and analyze the implications of trade policies on skilled vis-à-vis unskilled wage and also on the relative sectoral sizes. The production sector is divided into two parts: an export sector and an import competing sector. The former produces only for the export market, while the latter caters only to the domestic market and its output competes with imports. Labour is considered as the only factor of production. While only adult unskilled labour and child labour are assumed to be employed by the export sector, the import competing sector uses both skilled and unskilled labour. Further on assumption of competitiveness the export industry is viewed as earning only zero-profit. The country under consideration is assumed to be a small open economy and therefore faces a fairly elastic demand. Then, a rise in the tariff rate will raise skilled wage, and thereby increase inequality. Also the increase in tariff rate leads to expansion of the import competing sector and contraction of the export sector. The incidence of child labour depends solely on the international price of the home country exportable.

Tonmoy Chatterjee and Kausik Gupta in their paper attempt to develop an integrated framework covering aspects of international fragmentation, trade liberalization and health sector. In order to attain this they considered two different models based on Heckscher-Ohlin-Samuelson general equilibrium structure, with special stress on the health sector. The first model is devoted in considering four sectors and it was assumed that the production process of the health sector could be fragmented. In this structure an analysis was made about the impact of movement from no fragmentation regime to a regime of fragmentation on the output levels of health sector. They observed an expansionary effect on the health sector through shifting to a fragmented regime. In the second model they considered three sectors and assumed the production process of the health sector as fragmented. In this framework they elicited the result that trade liberalization would lead to an enhanced output level of the health sector.

Ruma Kundu in her paper seeks to analyse the prospect of organic farming in providing sustainable livelihood in Sikkim and its potential in

empowering rural women. She undertook field survey in two different parts of East Sikkim. While the growers in Samdur operate on an individual basis, those in Sajung consist primarily of woman cultivators working and sharing profits on a group based system. The group cultivation system has demonstrated a remarkable degree of success in this newer method of cultivation. This paper uses the regression methodology for analysing both cases. She has also thrown some light on the customers' willingness to pay a premium for organic products and the possible determinant factors by using logistic regression. Apart from this, she has also examined the possible environmental benefits from the use of organic products by employing the Contingent Valuation Method.

The paper by Pradip Kumar Parida and Notan Bhusan Kar deals with an important dilemma in the development programs in India. The arena of their analysis is Chhattisgarh formed as a separate state to safeguard the interests of the inhabitants in that land. However vigorous development policies carried out in the state have produced large scale evacuation and relocation. The protest of these development refugees are then treated as anti-developmental and detrimental to the interests of the state. The state is coming forward to create another movement to stop the genuine movement and declare it as a conflict zone. What about the 'life' and 'livelihood' of a citizen from the point of view of 'human security' in a conflict zone. It tries to examine the approach to development strategy as well as the voice of people in that context. It also tries to find out where does the 'subalterns' stands today in the Indian state whose constitution categorically mentions about establishing the so called 'Socialistic Pattern of Society'. What about ecology of the society and the involvement of the community in terms of maintaining their livelihood vs. the economic development of the state and the security of the individuals, i.e. - life & liberty.

Banani Ghosh and Swapna Ghorai in their paper focus on the importance of sustainable forest management practices which has the capacity to influence the socio-economic conditions related to livelihood of the forest fringe communities. According to them, sustainable livelihood through forest management ensures more income, increased well being, reduced vulnerability, improved food security and more sustainable use of natural forest resource base that continues to provide similar benefits and productivity in the future as well. They have tried to analyse the intensity of forest based sustainable livelihood in the context of forest fringe communities of Jhargram Block situated in the western part of Paschim Medinipur district of West Bengal. An attempt has been made to develop strategies for both sustainable livelihood using forest

resources and also the conservation & management of forest resource. The aspect of forest degradation and land use map has also been provided with the help of RS & GIS.

Suchismita Mondal Sarkar focused on the issue of livelihood diversification in the context of selected villages in the Burdwan District of West Bengal. Only primary data were collected and analysed for arriving at results and conclusions. She found varying degree of diversification across the villages depending on socio-economic differences of rural people as well as their attitude towards diversification. However she also noted several constraints faced by the rural households in the study area. Most of them are socio-economic in nature and can be overcome if proper govt. steps are taken. Though Government of India is running many wage employment programmes, the performance these schemes are not encouraging. Many of these programmes have not much relevance to local resources, needs and priorities. She pinpointed the most important hurdles in the implementation of such programmes, embedded in illiteracy and indifference of the rural people towards the development schemes, lack of resources, wrong selection of beneficiaries, local dominant culture, factionalism, lack of identification of felt needs of local people, etc



**SECTION A:**  
**FARM SECTORS AND LIVELIHOOD ISSUES**

# CHAPTER ONE

## AGRICULTURAL GROWTH AND CHANGES IN CROPPING PATTERNS IN INDIA: AN INTERSTATE ANALYSIS

ARPITA BANERJEE AND PRAVAT KUMAR KURI

### 1. Introduction

The Agriculture sector in India has been the predominant sector as it provides the livelihood of nearly 60% of the workforce in India. In spite of the slowing down of its contribution, agriculture still contributes around 14.2% of GDP in the country, and its role is essential in promoting inclusive growth, enhancing rural income and sustaining food security. Undoubtedly, agriculture has growth linkages with other sectors of the economy. Empirical studies show that a unit increase in agricultural output would have a positive effect on both industrial production and national income and thus, have significant implications to widespread inequality in per capita income in India. In India there exists a wide regional variation in terms of agro-climatic conditions, persistence of rainfall, resource base, irrigation facility and infrastructural development, and accordingly there is wide regional variation in the performances of agriculture. In fact, there is a plethora of literature about the growth, instability, cropping patterns and interstate differences in agriculture in India. Several studies such as Rao (1975), Mehra (1981), and Desai & Hazell (1982) have pointed out that the new strategy of agricultural production based on HYV seed fertilizer technology has contributed to the growth in production and productivity in India. In an in-depth study, Bhalla & Singh (2009) showed that there had been a marked acceleration in both the output and yield growth rate in agriculture during 1980–83 to 1992–95. This result was supported by many authors like Sawant & Achuthan (1995), who claimed that the yield rate of both food grain and non-foodgrain crops accelerated significantly along with output growth during the 1980s. However, these studies also observed marked deceleration in the level and trend growth rate of output

and yield during the 1990s. Several attempts have been made in the literature to identify the factors causing deceleration trends in agricultural growth in India. Regarding the convergence/ divergence of agricultural growth across Indian states, the study by Kalirajan et al. (1998) found a long-term divergence and cyclical pattern in agricultural growth. Ghosh (2006) also found absolute divergence and conditional convergence in agricultural growth in India. Under this backdrop, this study analyses the trend and disparity in the rate of growth of value of output and yield in agriculture in India since the 1970s with explicit focus on the phases of green revolution and new economic reform. The study also focuses on the nature of cropping patterns in India and its major states. Finally, a convergence/divergence test has been done with respect to the per capita value of agricultural output to find the nature of convergence/divergence in India and to identify the states responsible for causing convergence/divergence in agricultural growth in India. For convenience, the chapter is divided into four sections. Section 2 deals with data sources and methodology used in this study. Section 3 discusses the results obtained in this study in respect of growth rates, cropping patterns, construction of agricultural indices and the convergence tests. Section 4 presents the concluding remarks.

## **2. Data Sources and Methodology**

### **2.1 Data sources**

The period of the study covers thirty-eight years from 1970–71 to 2007–08. Twenty major states have been studied for interstate comparisons. The study uses secondary data exclusively. The state wise and crop wise values of output for the period 1970–71 to 2005–06 have been taken from different issues of CSO, a Govt. of India publication. The figures for the value of the agricultural output of Indian states have been converted at a constant price, using 1999–2000 as the base year. Eight major crops have been selected for this study: rice, wheat, jute, cotton, sugarcane, rapeseed, mustard and potato. The state wise data on inputs and operated areas for different years are collected from different issues of Indian Agriculture in Brief, Directorate of Economics and statistics, Ministry of Agriculture and Centre for Monitoring Indian Economy, Agriculture etc. The data for area, yield and production of some selected crop for India and the states are collected from different issues of the Centre for Monitoring Indian Economy and Agriculture.

## 2.2 Methodology

The statistical and econometric methodologies followed in this study can be summarized under three headings relating to the estimation of growth, construction of agriculture infrastructure index and convergence analysis. For the computation of growth rates of the value of agricultural output and productivity, the trend or exponential and kinked growth rates have been computed. Changes in cropping patterns overtime have been measured in terms of relative change in area under crops to the changes in GCA. For measuring the disparity among the states in respect of different agricultural infrastructural indicators, the Composite Index of Agricultural Infrastructure is computed by using principal component analysis. The composite indices are computed using the deprivation method. To construct this index, eight agricultural development indicators are selected: Cropping intensity (CI), Percentage irrigated area to GCA (IAGC), Fertilizer consumption per hectare of GCA (fcgc), Credit to agriculture (CTA), Number of tractors and pumpsets used per 1,000 hectares (TAP), Average yield of agricultural land (AY), Road length per 100 sq km (RL), and Percentage share to total consumption of electricity in agriculture (CELA). The steps taken for computation of the index are: in the first place the component indices are constructed by using the formula  $I_{ij} = (X_{ij} - \min X_{ij}) / (\max X_{ij} - \min X_{ij})$ , where  $I_{ij}$  = component index for the  $j$ th state with respect to the  $i$ th variable,  $X_{ij}$  = actual value of the  $j$ th state in the  $i$ th variable, and  $\min X_{ij}$  and  $\max X_{ij}$  are the minimum and maximum values of the  $i$ th variable. Subsequently, using the Principal Component Method, weights are determined for different indicators used, and finally the respective index is computed by using the formula

$$I_j = \frac{\sum_{i=1}^n W_i I_{ij}}{\sum_{i=1}^n W_i},$$

where  $w_i$  = weight attached to  $i$ th indicator, and  $I_j$  = the index of the  $j$ th state. For convergence analysis,  $\sigma$  convergence and absolute  $\beta$  convergence have been tested in the cross sectional framework and a time series analysis (unit root test) has been made to identify which states are responsible for the convergence/ divergence of agricultural growth in India.

### 3. Results and Discussion

#### 3.1 Growth performance of agriculture in Indian states

The growth performance of the states has been analyzed considering three distinct phases of agricultural development in India: the first phase of the green revolution (1970–71 to 1979–80), the second phase of the green revolution (1980–81 to 1990–91), and the period after economic reforms (1991–92 to 2007–08). The exponential growth<sup>1</sup> rates of value of output and productivity for the country during the whole period (1970–71 to 2005–06) reveal that all Indian agricultural output and yield grew at the rate of 2.6% and 1.43% respectively. The states like Haryana (3.46%), Madhya Pradesh (3.38), Rajasthan (3.36%), Goa (3.3%) and West Bengal (3.24%) achieved higher growths in the level of output, whereas the states like Madhya Pradesh (2.81%), Rajasthan (2.5%), Haryana (2.5%), Punjab (2.12%) and Uttar Pradesh (2.04%) registered higher growth in productivity during the entire period. The performance of the state Jammu and Kashmir remained poor in both respects during the whole period. The study revealed that the performance of the nation during the first phase of the green revolution (1970–71 to 1979–80) was not outstanding, but moderate. All Indian growth for the agricultural output and yield during this period was recorded as 1.88% and 1.48% per annum, respectively. However, during this period few states achieved outstanding growth in the level of output and yield rate. In case of the level of output, the states like Manipur (6.46%), Arunachal Pradesh (5.9%), Maharashtra (5.78%), Punjab (5.43%) and Haryana (3.36%) performed significantly, while in case of yield the states Punjab, Maharashtra and Manipur achieved significant growth. In fact, during this period the effect of green revolution did not spread all over the country, which is visible from the observed lower growth rate of other states like Andhra Pradesh, Madhya Pradesh, Kerala, Rajasthan, Orissa, Bihar, Karnataka and Jammu and Kashmir in both output and yield. The effect of the green revolution was visible from the second phase of green revolution, i.e. the period 1980–81 to 1990–91. It has been observed from the kinked exponential growth rate (see Tables 1.1 and 1.2 below) that all Indian agricultural performance registered an unprecedented improvement in both output and yield growth during the second phase of the green revolution. The kinked exponential growth rate

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<sup>1</sup>  $\ln Y_t = a + b_1 t + u_t$  (Semi logarithmic equation is estimated to derive the exponential growth rate).

**Table 1.1. Trend Growth Rate of Value of Output of Agriculture of Indian States 1970–71 to 2005–06**

Growth rate	Exponential Growth rate		Kinked exponential growth rate	
	Whole period	1st sub-period	2nd sub-period	3rd sub-period
	(1970–71 to 2005–06)	1970–71 to 1979–80	1980–81 to 1990–91	1990–91 to 2005–06
			b1	b2
<b>Andhra Pradesh</b>	2.406	1.93	3.16	1.46
<b>Arunachal Pradesh</b>	1.065	5.9	3.87	2.32
<b>Assam</b>	2.098	1.67	2.63	1.45
<b>Bihar</b>	2.549	0.61	2.26	1.98
<b>Goa</b>	3.3	3.01	1.46	3.12
<b>Gujarat</b>	2.082	2.76	-0.37	3.29
<b>Haryana</b>	3.463	3.36	4.78	2.34
<b>Himachal Pradesh</b>	2.797	1.4	2.63	1.08
<b>Jammu &amp; Kashmir</b>	-0.263	1.79	1.75	-0.03
<b>Karnataka</b>	2.251	2.1	3.94	2.07
<b>Kerala</b>	1.189	-0.8	2.76	2.57
<b>Madhya Pradesh</b>	2.76	-0.93	4.61	1.84
<b>Maharashtra</b>	3.38	5.78	2.2	3.94
<b>Manipur</b>	2.8	6.46	0.45	2.16
<b>Orissa</b>	1.57	0.44	1.66	0.17
<b>Punjab</b>	2.88	5.43	4.9	1.47
<b>Rajasthan</b>	3.36	0.83	5.5	2.58
<b>Tamil Nadu</b>	1.896	1.77	5.46	0.15
<b>Uttar Pradesh</b>	1.918	1.09	3.14	1.58
<b>West Bengal</b>	3.24	2.26	5.25	2.09
<b>Delhi</b>	2.054	1.59	-1.9	1.23
<b>India</b>	2.6	1.88	3.34	2

Source: CSO, different issues, Govt of India Publication.

Note: The estimates are based on author's own calculation.

**Table 1.2. Trend growth rate of yield from agriculture of Indian states 1970–71 to 2005–06**

States	Exponential Growth Rate		Kinked Exponential Growth Rate	
	Whole period	1st sub-period	2nd sub-period	3rd sub-period
	1970–2006	1970–80	1980–91	1991–92 to 2008–09
<b>Andhra Pradesh</b>	1.87	2.56	2.64	1.56
<b>Assam</b>	0.4	-0.37	2.98	0.021
<b>Bihar</b>	1.91	-0.0005	3.86	1.24
<b>Gujarat</b>	1.35	2.26	-0.34	2.93
<b>Haryana</b>	2.5	2.5	6.25	0.19
<b>Himachal Pradesh</b>	0.27	1.053	4.46	-0.34
<b>Jammu &amp; Kashmir</b>	-2.79	0.69	2.08	-1.22
<b>Karnataka</b>	0.82	2.5	2.73	2.06
<b>Kerala</b>	0.7	-0.62	3.42	1.58
<b>Madhya Pradesh</b>	2.81	-1.21	6.1	1.95
<b>Maharashtra</b>	1.92	4.54	2.32	3.02
<b>Manipur</b>	1.64	3.23	3.21	-0.41
<b>Orissa</b>	-0.64	-0.19	2.22	-0.28
<b>Punjab</b>	2.12	3.9	6.38	-1.07
<b>Rajasthan</b>	2.52	0.56	4.76	1.79
<b>Tamil Nadu</b>	1.96	3.15	4.33	1.53
<b>Uttar Pradesh</b>	2.04	0.73	4.71	0.19
<b>West Bengal</b>	0.78	1.25	5.48	-0.29
<b>India</b>	1.43	1.48	3.38	1.16

Source: CSO, different issues, Govt. of India Publication.

Note: The estimates are based on author's own calculation.

of value of output and yield for India were 3.34% and 3.38% per annum, respectively, during this period. Most of the states grew at an accelerated rate in both output and yield during this period, and Tamil Nadu (5.46%), West Bengal<sup>3</sup> (5.25%), Rajasthan (5.5%), Punjab (4.9%), Haryana (4.78%) and Madhya Pradesh (4.62%) achieved outstanding growth in agricultural output, and Punjab (6.38), Haryana (6.29), Madhya Pradesh (6.11) and West Bengal (5.48) achieved remarkable growth in yield rate.

<sup>3</sup> See Ghosh (2010a and 2010b).

Moreover, during this period the states of different regions i.e. West Bengal of the eastern region, Rajasthan of the central region, and Tamil Nadu of the southern region contributed to the higher growth rate in India. All the other states registered higher growth during this phase compared to the previous period, barring a few exceptions.

However, it has been observed from this study that the phase of outstanding growth could not be sustained until the reform period, and the agricultural output and yield growth of the country experienced a severe slowdown during the post reform period. All Indian growth in output and yield rates declined to 2% and 1.16% per annum during this period, compared to 3.34% and 3.38% in the previous period. Aside from Maharashtra, Gujarat and Goa, all other states experienced a significant deceleration in both output and yield growth in the reform period. Some states also registered negative growth during this period. In fact, according to many researchers the most important factor for this agricultural downturn may be traced in the slowdown of food grain production in the post-reform period in India. Since foodgrain comprises nearly 60% of the total crop output in India and the majority of states are dependent on its production, the slackening growth of value of crop output reflects the deceleration in food grain production. Thus, the results establish that there was a significant acceleration in growth rate in the value of output and yield during the second phase of the green revolution, but the post liberalization period has marked a sign of depression both in agricultural output and its yield rate in India. Our findings are in conformity with the previous empirical studies by Bhalla & Singh, and others. In a comprehensive study about the growth and regional disparity of Indian states in respect of agricultural output, yield and area, Bhalla & Singh (2009) argued that increase in regional disparity during the first phase of the green revolution (1971–81) was followed by decline during the second phase due to the effect of HYV technology. However, the post liberalization period (since 1991) witnessed the continuous decline in growth rates in Indian agriculture. This result was supported by authors like Mathur et al. (2006), Mahendradev (1987), Janaiah et al.(2005) and Chand et al. (2007), according to whom factors like the slowdown in growth of fertilizer use, declining irrigation intensity, reduction of energy use and lack of adoption of modern techniques were considered to be attributable to the deceleration in the trends of agricultural growth in India during the 1990s.

**Table 1.3. Change in percentage of area under foodgrain and non-foodgrain crops of Indian states**

States	FOODGRAIN			NON-FOODGRAIN		
	1970–71	1990–91	2007–08	1970–71	1990–91	2007–08
<b>Andhra Pradesh</b>	71.07	56.33	54.45	3.3	7.15	10.18
<b>Assam</b>	75.44	71.24	65.59	11.6	13.07	10.32
<b>Bihar</b>	89.86	80.24	88.86	4.4	6.46	6.05
<b>Gujarat</b>	50.78	37.10	36.66	16.5	15.81	24.33
<b>Haryana</b>	77.58	64.36	69.31	9.7	25.11	19.21
<b>Himachal Pradesh</b>	90.15	87.42	83.67	2.7	2.56	2.58
<b>Jammu &amp; Kashmir</b>	89.41	83.76	81.01	3.1	5.55	5.01
<b>Karnataka</b>	66.00	58.01	61.05	10.2	7.26	6.00
<b>Kerala</b>	31.58	19.01	8.80	0.5	0.55	0.12
<b>Madhya Pradesh</b>	81.96	66.12	55.29	4.7	6.83	6.52
<b>Maharashtra</b>	66.93	63.83	64.69	15.8	15.78	21.13
<b>Orissa</b>	68.50	73.90	60.88	1.8	2.76	1.11
<b>Punjab</b>	69.16	75.10	80.09	11.4	12.10	10.43
<b>Rajasthan</b>	76.96	62.39	61.27	3.1	16.03	13.00
<b>Tamil Nadu</b>	70.36	57.43	53.27	6.2	7.18	9.61
<b>Uttar Pradesh</b>	84.59	78.71	76.56	16.1	12.58	14.24
<b>West Bengal</b>	86.22	73.80	65.17	8.7	14.40	14.77
<b>India</b>	74.26	66.87	63.35	8.8	10.96	11.57

Source: Data for foodgrain and non-foodgrain crops are compiled from different issues of CMIE, Agriculture. Foodgrain crops: rice and wheat, Non-foodgrain crops: jute, cotton, sugarcane, rapeseed, mustard and potato.

Note: Estimates are based on Author's own calculations.

### 3.2 Cropping pattern in India

Cropping pattern is defined by the proportion of area under different crops at a point of time. It is a mix of agricultural crops grown in a particular geographical area. Changes in cropping pattern can be seen as a

change in the proportion of area or value of production under different crops to total agricultural area over time. The cropping pattern is governed by the law of comparative advantage in relation to agro climatic conditions, and technical and institutional factors (Vaidyanathan 1994). In India, since the 1980s the process of change in the cropping pattern hastened and was prominent in favour of non-foodgrain crops, reflected in the ratio of area in foodgrain crop to GCA. During the period 1970–71 to 1980–81 the proportion of area under foodgrain experienced a small decline from 74.3% in 1970–71 to 72.6% in 1980–81 (see Table 1.3). Since the 1980s onwards, the share of area under foodgrain to total GCA declined persistently to 66.9% in 1991–92, 64.6% in 2000–01 and 63.4% in 2007–08, respectively. Taking all selected non-foodgrain crops together, the area allocation reveals an upward trend at the all-Indian level over the period 1970–71 (8.8%) to 2007–08 (11.6%).

### 3.3 State wise changes in cropping patterns

State wise patterns of changes in area of crops overtime in India are wide and varied. It is worth mentioning that foodgrain occupies the most important place in area composition in almost all states still now. India is mostly a foodgrain-producing country. In recent years, especially in the post-reform period, a marginal shift in cropping patterns favouring non-food crops is observable. However, there are substantial inter-state variations to this result. In the case of foodgrain, the proportion of area declined at a high rate in states like Andhra Pradesh, Gujarat, Rajasthan, Tamil Nadu, Madhya Pradesh and West Bengal. Haryana, Himachal Pradesh, Jammu & Kashmir and Uttar Pradesh also experienced deceleration in the composition of area under foodgrain, but at a moderate rate. In Bihar around 90% of GCA was under foodgrain crop in 1970–71. In 1980–81 this decreased to 66.55%. Again, the same proportion registered a sharp increase from 66.55% to 80.2% in 1991–92, 90.7% in 2000–01 and 88.9% in 2007–08, respectively. Further, the state of Punjab experienced an increase in the proportion of area under foodgrain from 69.2% in 1970–71 to 80.1% in 2007–08. Excepting Punjab and Bihar, almost all the states showed a diversification of cropping pattern in favour of non-food crops.

Andhra Pradesh, Gujarat, Haryana, Jammu & Kashmir, Madhya Pradesh, Maharashtra, Rajasthan, Tamil Nadu and West Bengal experienced an increase in the area allocated to major non-food crops over the study period. Among the 17 states considered here, more than 9 faced a deceleration in the share of non-foodgrain crops after the year 1991–92.

Among the remaining states, Andhra Pradesh, Maharashtra and Tamil Nadu managed to maintain a steady upward trend in terms of area allocation towards selected non-foodgrain crops. Gujarat, Madhya Pradesh, Punjab and Rajasthan experienced an increase in the area allocated to non-food crops, especially in the post-reform period. The crop as well as state-wise scenario is presented in appendix Tables A1 to A7.

### **3.4 Regional disparity in agricultural infrastructure in India: an interstate analysis**

India is characterized by wide regional variation in agro-climatic condition. Agricultural output in different regions varies due to different agro-climatic factors, physical resource endowment and level of investment in rural infrastructure and technological innovation.<sup>4</sup> The regional variation in agricultural infrastructure and the use of agricultural inputs in India is quite high.

To provide a vivid picture<sup>5</sup> a composite index of agricultural infrastructure, constructed through the Deprivation Method, explores the disparity in agricultural infrastructure across the states of India. The detailed methodology of constructing the index is explained in the methodology section. The result of the index and the subsequent rank of the states according to the index are presented in Table 1.4. From the table it is clear that there is a widespread disparity among states in respect of the distribution of agricultural inputs in India. The advanced states consistently enjoyed the benefit of better agricultural infrastructure throughout the period under study. For example, states like Punjab, Haryana, Uttar Pradesh, Tamil Nadu and Andhra Pradesh occupied the top positions according to the rank of the index, whereas Assam, Himachal Pradesh and Orissa lagged behind throughout the period. Assam and Orissa remained at the bottom throughout the study period. Kerala, Karnataka, Gujarat, Maharashtra, Rajasthan and West Bengal occupied middle positions during the periods under study. The status of Jammu and Kashmir declined

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<sup>4</sup> Apart from these physical factors, agrarian relations and tenurial contracts play an important role in enhancing agricultural productivity and efficiency. For details see Laha & Kuri (2012).

<sup>5</sup> To construct this index eight agricultural development indicators are selected: Cropping intensity (CI), Percentage irrigated area to GCA (IAGC), Fertilizer consumption per hectare of GCA (fcgc), Credit to agriculture (CTA), Number of tractors and pumpsets used per 1,000 hectares (TAP), Average yield of agricultural land (AY), Road length per 100 sq km (RL), Percentage share to total consumption of electricity in agriculture (CELA).

**Table 1.4. Composite index of agriculture infrastructure of Indian states 1980–81 to 2007–08 (CIAI)**

STATES	INDEX				RANK			
	1980 –81	1990 –91	2000 –01	2007 –08	1980 –81	1990 –91	2000 –01	2007 –08
Andhra Pradesh	0.33	0.52	0.57	0.58	5	4	4.5	4
Assam	0.10	0.10	0.10	0.08	16.5	17	17	16
Bihar	0.21	0.29	0.39	0.39	11	8.5	8	8
Gujarat	0.28	0.31	0.32	0.45	7	7	10	6
Haryana	0.60	0.72	0.73	0.76	2	2	2	2
Himachal Pradesh	0.17	0.17	0.16	0.16	13.5	15	15	15
Jammu & Kashmir	0.22	0.22	0.20	0.23	9	12.5	14	14
Karnataka	0.17	0.33	0.41	0.37	13.5	6	7	9
Kerala	0.31	0.28	0.33	0.27	6	10	9	13
Madhya Pradesh	0.10	0.21	0.22	0.31	16.5	14	13	12
Maharashtra	0.21	0.26	0.28	0.32	11	11	11	11
Orissa	0.12	0.13	0.12	0.07	15	16	16	17
Punjab	0.90	0.94	0.85	0.85	1	1	1	1
Rajasthan	0.24	0.22	0.27	0.34	8	12.5	12	10
Tamil Nadu	0.51	0.50	0.57	0.54	4	5	4.5	5
Uttar Pradesh	0.53	0.61	0.61	0.63	3	3	3	3
West Bengal	0.21	0.29	0.42	0.41	11	8.5	6	7

Source: Data for inputs are taken from various issues of Indian Agriculture in brief and CMIE, Agriculture.

Notes: Estimates are based on the author's calculations.

to a large extent as its position slipped from ninth in 1980–81 to fourteenth in 2007–08 during the period of study. The reverse happened for Madhya Pradesh as its position improved from 16.5 in 1980–81 to 12 in 2007–08. Thus, from the result of composite index it can be said that a wide disparity remained in the distribution of agricultural infrastructure across the states in India during the study period.

### 3.5 Agricultural growth in India: a convergence analysis

Several attempts have been made in India to explain the nature of convergence in agricultural growth. Kalirajan et al. (1998) found regional