POPULATION PRESSURE AND AGRICULTURAL CHANGE UNDER POOR PUBLIC INVESTMENT IN INFRASTRUCTURE
THE CASE OF ASSAM

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Dissertation submitted in partial fulfilment of the requirements for the Degree of Master of Philosophy in Applied Economics of the Jawaharlal Nehru University

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June, 2011

*I hereby affirm that the work for this thesis, "**Population Pressure and Agricultural Change under Poor Public Investment in Infrastructure: The Case of Assam**" being submitted as part of the requirements for award of the degree of Master of Philosophy in Applied Economics of the Jawaharlal Nehru University, was carried out entirely by myself. I also affirm that it was not part of any other programme of study and has not been submitted to any other university for the award of any degree.*

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June, 2011 **Ashapurna Baruah**

Certified that this study is the bona fide work of **Ashapurna Baruah**, carried out under our supervision at the Centre for Development Studies.

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Needless to mention all errors and omissions are mine.

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ABSTRACT OF THE DISSERTATION

POPULATION PRESSURE AND AGRICULTURAL CHANGE UNDER POOR PUBLIC INVESTMENT IN INFRASTRUCTURE: THE CASE OF ASSAM

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It is well known that all regions in the country have not benefitted to the same extent from the green revolution technology owing largely to the differential public investment in agriculture and infrastructure across the regions. The north western region has been the forerunner whereas the eastern region has continued to show low productivity and low agricultural net state domestic product. Moreover, these agriculturally backward states have high rates of population growth and majority of their population is dependent on agriculture. Assam is one of these states where population growth is high and agriculture is characterised by low growth, poor yield and little diversification. Increasing population pressure and a poorly performing agriculture raises serious concerns as it has to provide for and support a growing rural population. It has been argued that increasing population is an important determinant of agricultural change but is largely conditioned by government's role in facilitating it. Against this background, the study examines agricultural change in the state in the context of increasing population pressure and poor governmental efforts to develop agriculture.

Taking a period of four decades (mid 1960s to late 2000s), the present study examines the agricultural changes in terms of extensification, labour intensification, crop intensification, shifts in cropping pattern and improvements in technology that have taken place in response to population pressure across the districts of the state. To examine the role of the government, plan strategies, investment and the outcome in Assam agriculture have been analysed. The study finds that extensification has taken place in the state as an initial response to population pressure. So far as the intensive system of cultivation is concerned, labour intensification has notably taken place in the state. There have also been some changes in cropping intensity, cropping pattern and technology adoption. However, change beyond a threshold has not taken place due to the poor infrastructural development in terms of irrigation and flood control, rural electrification, agricultural credit and road connectivity. Given that agricultural changes beyond a certain threshold are conditional on infrastructural development, it can be said that Assam's low agricultural development has largely been due to lack of government initiatives.

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CHAPTER I

INTRODUCTION

1.1 Introduction

Indian agriculture was placed in a higher growth trajectory after the advent of the Green Revolution in the mid 1970s. Higher growth manifested from the deliberate government policies and the massive public investment that followed to boost agriculture. It is recognized that in the post-independence period, the government undertook a conscious and proactive policy for promoting agricultural development owing to the growing demand for food by the growing population. Such huge public investment since 1950 culminated in the introduction of the new agricultural technology in the mid 1960s. The main elements of it were massive public investments in canal systems and rural electrification which resulted in near trebling of irrigated area in the past five decades together with investment to boost research, credit and banking institutions (Vaidyanathan, 2002). However, such public investment did not take place in all the states of the country uniformly; Punjab, Haryana and Uttar Pradesh were the forerunners and this indeed reflected in the higher agricultural growth attained by their economies. The eastern states namely Bihar, Orissa, and Assam, hill regions and eastern Uttar Pradesh failed to benefit from green revolution and showed poor performance in terms of low productivity and low agricultural net state domestic product (Chand, 1999). Moreover, these states had higher rates of population growth and majority of their population was dependent on agriculture. An increasing population, it is argued provides stimulus to agricultural growth but in the absence of government initiative or public investment, higher agricultural growth cannot be realised. The eastern states fall into this category.

The present study attempts to examine the agricultural changes in the state of Assam during the mid-1960s to late 2000s in the context of increasing population pressure. The state is characterised by low public investment and poor efforts *in*

agricultural development by the government resulting in low agricultural growth. The chapter is divided into six sections. The second section presents the significance of the study and the statement of the problem. The objectives of the study are elaborated in the third section. The fourth and fifth sections give the data used and the methodology adopted in the study respectively. The final section is the chapter outline of the study.

1.2 Statement of the Problem

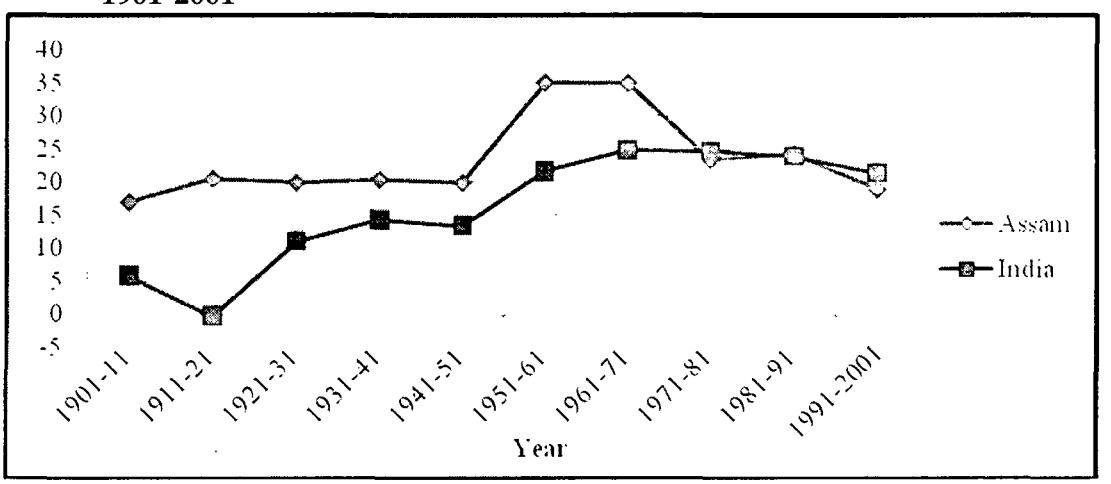
Assam is primarily an agrarian economy and agriculture is the dominant sector of its economy. The contribution of agriculture to the Gross State Domestic Product (GSDP) was 26 percent in 2006-07. The importance of agriculture in Assam's economy transcends its economic contribution. The share of agriculture in the GSDP understates its importance in the economy of Assam for it is the main source of livelihood of a majority of the rural population. The rural population constitutes 87 percent of the total population in Assam compared to 72 percent in India. Compared to 58 percent of the workforce engaged in agricultural activities for the country as a whole in Assam about 53 percent of the total work force was engaged in agricultural activities in 2001[1].

Assam has shown lacklustre performance in agriculture and has been lagging behind most of the states in the country. The growth in NSDP in agriculture had decelerated over the years, falling from 2 percent in 1970-80 to 1.3 percent in 2000-10, and had been lower than the all-India average in all the decades (Appendix Table 1). Lower agricultural growth, it has been argued is due to the lack of public investment to develop agriculture in the state (Bhattacharya, 1998). Poor public investment has been a perennial concern for the state; the per capita outlay/expenditure in the state has remained much lower than the national average over the years despite planned efforts initiated by the state government

[1] The proportion of the workforce dependent on agriculture in Assam is lower than the national average because the Population Census does not include the plantation workers among agricultural workers and in Assam a sizeable proportion of the workforce is in plantation agriculture. In 2001, the plantation workers constituted 12.2 percent of the total workforce in Assam. Thus, the total workforce in agriculture might come to about 65 percent in Assam.

since 1950-51. Besides, little had changed even with the Green Revolution. During the Third Five Year Plan (1961-66), the ratio of state per capita plan outlay to that of the nation was 56.9 percent i.e., the plan outlay for Assam was 43 percent lower than that of the nation; the ratio in the period 2002-07 (Tenth Five Year Plan) was 40 percent indicating that the plan outlay for Assam was 60 percent lower than the national average.

Figure 1.1: Decadal percentage variation in population in Assam and India, 1901-2001



Source: Census of India, various years.

The low public investment becomes a primary concern when one observes the unprecedented growth in population in Assam. The population in Assam has been growing rapidly both in the pre-independence and the post-independence periods; the decadal variation in growth had been higher than the national average in all the decades, except 1991-2001 (Figure1.1). The consequence of high population growth is the increasing pressure on land. The growing population pressure on land and scanty expenditure to improve agriculture in the state is indeed a case of worry since it bears adverse ramifications on future growth of the economy.

There are numerous studies on agricultural development in Assam. These have largely dealt with agricultural performance in terms of output growth, productivity, technology adoption, diversification, and cropping pattern. Agricultural development in relation to population has not attracted as much attention. The few studies that have examined the relationship between

population growth and agricultural development in Assam have focused on population in relation to cropping intensity and production. Das's (1984) study of selected sub-divisions in Assam taking rural density of 1971 finds a significant positive correlation between population pressure and intensity of cropping. The study uses cross sectional regression analysis and finds that 48 percent of the variation in the area sown more than once is explained by the density of rural population. This study looks into only a single aspect that is of cropping intensity and does not take into account the other agrarian changes like extension of cultivation, labour intensification, shifts in cropping pattern and technology improvements that contribute to higher agricultural growth both in terms of production and productivity. Another study by Barah (2003) for the district of Jorhat establishes a positive association between agricultural productivity and population pressure. Similar findings were also drawn by Bhagabati (2000) in his study of lower Brahmaputra valley. The studies by Barah (2003) and Bhagabati (2000) establish the association between population pressure and agricultural productivity without bringing out how higher productivity has been achieved – whether it is the outcome of higher cropping intensity, labour intensification, technology improvements or shifts in cropping pattern or all of these factors taken together. Moreover all these studies pertain to only a few regions or districts in the state.

Given the limitations of the existing studies there is need for a fresh look at Assam agriculture from a broader perspective of population pressure and agricultural change, which is the point of departure of the present study. Increasing population is an important determinant of agricultural change. Population pressure on land leads to many changes in the system of cultivation such as increasing the frequency of cultivation, shifts in the cropping pattern, labour intensification and improvements in technology. With higher population pressure, changes along these lines take place to improve agricultural production and productivity. However, government intervention in terms of infrastructure development becomes a necessity to effect these agricultural changes. An

intensified agriculture follows from greater government intervention and policy initiatives.

1.3 Objectives of the Study

The present study examines how agriculture has changed over time in the context of increasing population. In particular, it seeks to analyse agricultural change in Assam in terms of extensification, intensity of cropping, shifts in the cropping pattern, labour intensification and improvements in technology. The study further looks into the development efforts undertaken to improve agriculture in Assam during the different plans periods. Thus, the specific objectives of the study are:

1. To examine agricultural change under increasing population pressure in Assam.
2. To examine the role of the government in the development of agriculture in the state.

1.4 Data

The study is based on secondary sources of information. District-wise data pertaining to land use and area in this study had been collected from the Department of Economics and Statistics (Government of Assam) and from its publications namely Statistical Abstract of Assam, Statistical Hand Book, Assam and Economic Survey of Assam for various years. The Assam Five Year Plan Documents released by the Planning and Development Department, Government of Assam had also been used. Information on growth, density, rural-urban composition, and occupational structure of population had been taken from the different series of Census Reports for various years. Further the NSS 59th round has been used for the data on operational land holdings for the state as a whole. The Agricultural census had been used for the data on operational holdings across the districts. The data on infrastructure released by Centre for Monitoring Indian Economy (CMIE) had also been used.

1.5 Methodology

Assam has an area of 78,523 sq km and is the 16th largest state in India with wide agro-climatic and topographical variations. The hill region covers an area of 15,222 sq km which constitutes about 20 per cent of the total area of the state. The major area is covered by the Brahmaputra and the Barak valleys. The population growth has also varied across these diverse regions. So the issue of agricultural development in relation to population calls for a disaggregated analysis. The study is done taking district as the unit of analysis.

The period of study extends from 1965-66 to 2006-07. As the latest data on land use statistics available is for the year 2006-07, the analysis has been confined to this period. However, for a few indicators the year 2007-08 has been included as per availability of information. The present day Assam was formed in the 1970s with 8 districts. According to the Census 2001, there are 23 districts in Assam and as of now 4 more districts have been added raising the number to 27. But for a district-wise analysis since the 1960s, the original 8 districts have to be taken; this requires the clubbing of the present day districts into the original 8. The clubbing of the districts is shown in Table 1.1. In the study growth rates, simple proportions, coefficient of variation and indexes are computed to fulfil the stated objectives.

Table 1.1: The original districts in terms of the present districts.

District Unit in 1971	Comparable Unit in 2006-07
1. Cachar	Cachar + Hailakandi + Karimkanj
2. Darrang	Darrang + Sonitpur
3. Goalpara	Goalpara+ Dhubri+Kokrajhar+Bongaigaon
4. Sibsagar	Sibsagar + Jorhat + Golaghat
5. Kamrup	Kamrup + Nalbari + Barpeta
6. Karbi-Anglong & N.C. Hills	Karbi-Anglong + N.C. Hills
7. Lakhimpur	Lakhimpur + Dhemaji+ Dibrugarh+ Tinsukia
8. Nagaon	Nagaon + Morigaon

1.6 Chapter Outline

Chapter one is the introduction to the study. It includes the statement of problem, context of the study and the data and methodology used in the study. The second chapter deals with the relevant review of literature and gives a theoretical backdrop to the following chapters. The third chapter brings out the agricultural changes in the state in the context of increasing population pressure. The fourth chapter captures the development efforts undertaken by the government to effect agricultural changes and hence promote agricultural growth in the state. The final chapter concludes the study, draws the policy implications of the study and also hints at issues that can be taken up for further research.

Appendix A

Table 1A: Trend Growth Rate in Agricultural NSDP in Assam and India

Period	Assam (in percent)	All-India (in percent)
1970-1980	2.0	1.8
1980-1990	2.2	3.1
1990-2000	1.1	3.2
2000-2010	1.3	2.9
1970-2010	1.8	2.9

Source: Computed from EPWRF, 2006-07 and Central Statistical Organization

CHAPTER II

REVIEW OF LITERATURE AND THEORETICAL BACKDROP

2.1 Introduction

The present chapter makes an attempt to review the existing literature on the population-agriculture relationship. It develops the arguments by taking a critical look at the studies which hold that increasing population provides stimulus to agricultural growth. The various scenarios of changes that take place in agriculture as response to increasing population pressure have also been discussed in this chapter.

The present chapter is divided into seven sections. The next section is on the relationship between population and agricultural development. The following four sections review the various responses to population pressure. The third section discusses extensification that takes place as the earliest response to population pressure. The fourth section elaborates the development of an intensive system of cultivation. The fifth section discusses how agricultural change fails to take place even with population pressure on land. The change in occupation and migration as a response to population pressure is reviewed in the sixth section. The concluding section brings out the critical issues that lead to the development of an analytical frame for the study.

2.2 Population and Agricultural Development

The relationships between agriculture, population, and land-use had in fact been long studied and discussed. Broadly, two theoretical traditions can be found which yield opposing expectations of the relationship between population and agricultural development. The pessimistic view is associated with Malthus while the optimistic perspective originates in the works of Boserup. Malthus' line of argument is that unchecked population growth coupled with diminishing returns to land results in a lower food production per capita and hence lower per capita consumption. He holds that food production unable to keep pace with the

increasing population will push people to subsistence living. Subsistence living conditions will decrease birth rates and increase death rates; thus food production will establish limits to population growth (Malthus, 1989; Weir, 1988). There are two strands of the Malthusian Theory. These two strands are first, if food supply increases in the economy at any point of time then there will be increase in population until the excess food supply is wiped out so that equilibrium is restored between food supply and population; and second, any population increase beyond the means of subsistence will be brought down by the positive and preventive checks until the said equilibrium is restored.

Boserup (1965) probing into the causes of agricultural development argues that agricultural development is induced by exogenous force. It is population pressure that brings about or causes the developments in agriculture. The development of the techniques of cultivation and also that of the agrarian structure is influenced by population growth. Boserup refutes Malthusian Theory on both the strands- she argues that population growth takes place not because of improvement in food conditions but because of medical intervention and other factors[1]. She further maintains that population pressure does not cause a reduction in population instead it results in technical and institutional change that boosts agricultural growth and leads to an increase in food supply. Agricultural development, according to her will happen in stages; population pressure will result in employing more labour per unit of land so as to raise the production levels and thereby sustain the growing population. Eventually techniques of production will also change and so will technology; a technological change, Boserup argues, is not autonomous to population.

Following Boserup, Grigg (1980), studying the changes in the peasant community in pre-industrial Europe, found that population growth itself prompts production and demographic responses. The threat of overpopulation stimulates a variety of responses in order to put off a fall in output per head. When most of the cultivable lands are brought under the plough, the peasants act against population pressure by intensifying land-use besides adopting birth control

[1] See Boserup (1965).

measures and emigration. Grigg (1980) holds that with population pressure, the less fertile land is brought under cultivation and the existing arable land is intensively used by increased intensity of cropping, application of more labour inputs per hectare of land per crop per season and changes in the crop mix and crop rotations.

Turner and Ali (1996) suggest that Malthus and Boserup may be more complementary than opposing. "They share various assumptions about the relationships among population, technology, and resource use but differ primarily in their views of the origins of technology. Malthus implies that technology is exogenous in the sense that its development is not necessarily linked into the population- resource condition. Boserup, in contrast, grounds this development directly into that condition; technological change is endogenous to it" (Turner and Ali, 1996: 14990).

Keys and Connell (2005) argues that since population growth is the common trait across the regions that experience agricultural change, explanations point to population as the primary cause of agricultural change and pass over other important causes such as affluence and technology, culture, market etc. The study holds that although agricultural intensification may take place in different forms from intensive cultivation of land to changes in the types of crops cultivated; what matters are the factors that enable those changes. The study identifies market dynamics, government policies, and social relationships as the major factors operating in favour of or against agricultural intensification. Cuffaro (1997) holds research institutions as crucial for changes in agriculture to take place. Further, the study argues that adjustments in terms of agricultural intensification as response to population pressure may not take place in those regions which have very fast growing populations and already high densities. This is because in such a case population growth will be associated with increasing landlessness, income inequality and unemployment. With increasing population, large groups will be exposed to hunger or starvation and the incentive to intensify will be lacking due to slow growth of effective demand.

The agricultural responses (intensification, shifts in cropping pattern, labour intensification, and technological improvements) to population pressure are, "not automatic and likely depend to a substantial extent upon the initial institutional framework, cultural norms, and government policies. The government has a critical role to play in facilitating the process of market development, technological, and institutional innovation" (Pender, 1998: 109). Keys *et* al. (2005: 328) also hold similar views: "... population size, growth and density virtually never work in isolation; rather, other social and economic factors mediate between population attributes and agricultural systems." The institutional factors considered by them included, market demand, market access, property regime, government/NGO policy, income affecting program, standard of living, off farm employment, education and religion/ethnicity.

Penders (1999) tested the Boserupian prediction that population pressure induces agricultural change (in the form of adopting of labour-intensive land improvements, collective action to manage natural resources, and organizational development) taking central Honduras. He found that the impact of population pressure on agricultural change was relatively small. Other factors of infrastructure development and technical assistance programs had stronger impacts on agricultural change and natural resource management.

Boyce's (1987) study of the Bengal delta (Bangladesh and West Bengal) holds that increasing population has brought about positive growth in agriculture though at a rate lower than that of the population. Bengal's agriculture has not yet achieved its potential despite intense demographic pressure, largely due to the absence of systems for water control. Water control is a public good which cannot be undertaken by individual cultivators alone; it calls for institutional mechanisms for collective action. "The technological complementarity between water control and other inputs (fertilizers and high yielding varieties) thus raises the possibility of an institutional complementarity between collective and private action: once the public good problems of irrigation, drainage, and flood control are resolved, other agricultural operations can be carried out either privately or jointly" (Boyce, 1987: 252).

Class relations based on unequal distribution of land, small average size and extreme fragmentation inhibit collective action. To remove the barriers to collective action, Boyce (1987:255) prescribes a redistribution of property rights in land. Thus, both technological and institutional change (through collective action of individuals) is pertinent to achieve higher agricultural growth.

In the Indian context, Krishnaji's (1994) study found that amongst the changes - cropping intensity, cropping pattern and labour intensification which he considered to have taken place in response to population pressure, labour intensification was the only clearly identified adjustment in both the pre-independence (1891-1931) and the post-independence (1961-1981) periods. His district wise analysis showed that while labour intensification as the process of adjustment led to reduction of spatial inequalities in the former period; in the latter period inequalities have widened. This inequality has been attributed to the deliberate government policies to increase the growth in agricultural productivity in the well-endowed parts of the country. Thus, only the well-irrigated regions of the country benefitted from government policies.

Boserup (1965) had also presented arguments concerning accompanying changes in institutions, particularly land tenure, and investment in the course of agricultural development. For the changes in the agricultural land use to happen owing to population pressure, it has been found that the conditioning factors play an important role. Better infrastructure whether in terms of irrigation, transport etc. are pertinent to agricultural development and precisely for more intensive use of land. In least developed rural areas, dearth of economic infrastructure is a constraint to agricultural production. "Often, the population in such areas can produce the food needed for subsistence with a relatively small input of labour, but they have insufficient incentive to produce a surplus beyond subsistence needs because the lack of infrastructure results in high costs of transport and distribution both for locally produced agricultural products and for products imported into the area from outside" (Boserup, 1975: 260). Boserup argues that infrastructure development will take place with increase in population because the costs of infrastructure such as roads, irrigation systems

and electricity are largely fixed costs or lump sum costs, so that cost per capita declines as population grows. "Infrastructure development is crucial as it promotes agricultural growth and productivity and ensures higher rural income by making easy accessibility to inputs, increasing farm level prices of outputs, enabling high valued agriculture, improving education and technical assistance, increasing specialization and trade and increasing off farm employment" (Penders, 1999: 40). Along with growing markets and developed infrastructure another factor that affects agricultural sector is that of the lending institutions. In economies like India where there is the dominance of small and marginal farmers cheap and development oriented credit, supplied in adequate quantity can play the role of an accelerator in agricultural development (Narayanamoorthy, 2007).

Individual responses to population pressure on land are in the form of expanding the area under cultivation, intensification of cultivation, and changes in occupation or migration. When expansion of area under cultivation is limited, an intensified system is adopted by raising the cropping intensity, through multiple cropping, labour intensification, and by changing the techniques of cultivation. Migration to urban areas in search of non-farm employment may take place when the process of intensification is impeded by technological and institutional constraints. The conditioning factors of infrastructure, policies, and institutions play a defining role in the adoption of an intensive system of cultivation, which many studies have pointed to. However, mere increase in population will not lead to the development of infrastructure or institutions and the government has a significant role to play.

More of government intervention becomes necessary with increasing population pressure to transform agriculture (Boserup, 1981). The government's role is crucial to crowd in private investment, especially in those economies where there is dominance of marginal and small farm holders. For instance, unless the government builds an irrigation system, there will be no incentive on the part of the farmers to invest in the use of more fertilizer or high yielding variety seeds. When the institutional arrangements are not in place, agriculture suffers from the constraints such as uneconomic size of holdings, unequal tenurial arrangements,

indebtedness, and lack of access to credit and agricultural inputs. To overcome such institutional constraints, implementing land reforms and creation of lending institutions to cater to the needs of the small farmers becomes necessary (Roy, 1999). Institutional changes of this kind can only be brought about by governments, in particular, in developing countries like India. Therefore, the kind of adjustments which Boserup has predicted may not take place due to the failure of government as a catalyst or facilitator.

As a response to population pressure on land a host of strategies are adopted. Expansion of area under cultivation takes place as the earliest response to population pressure. When the area under cultivation can no longer be expanded, an intensive form of cultivation is adopted by increasing the cropping frequency, intensifying the use of labour, changing the cropping pattern and by improvements in technology. The following pages discuss at length the strategies that are adopted as a response to population pressure.

2.3 Extensification

Extensification of cultivation in agriculture takes place as the initial response to increase in population pressure. Extensification occurs with traditional methods of shifting cultivation, when population growth takes place in regions having low population densities (Boserup, 1965). The process of expansion holds when land is available in abundance. However, availability will not ensure expansion if land is not accessible. "The land available for cultivation should be accessible because there are situations (most common in Latin America) where the small holders are unable to expand cultivation because the most suitable and accessible land is owned and protected by large farmers or ranchers. Also the land should be suitable for cultivation; certain factors such as the problems of pests and disease (common in the humid tropics of Africa) inhibit agricultural expansion" (Pender, 1999: 10).

Normally extensification takes place when land is abundant; more labour inputs will be employed to bring the newly extended area under cultivation. Under this situation the return from increased labour inputs will be higher from the new

land relative to the land that is already under cultivation. As extensification continues, land frontier will be reached and marginal land will also be brought under cultivation. Then, the returns to inputs from extension of area falls and the consequence is a shift to an intensive system (Smith et al., 1994).

2.4 Intensification

Agricultural intensification takes place as the next response to population pressure. Agricultural intensification is the frequency with which a unit of land is cultivated. It is induced by the increased demand for cultivable land. The demand for cultivable land may be due to a rise in population, increased market demand for agricultural products or reduced transportation costs (Pingali et al., 1987). In a subsistence economy, intensification is driven by population growth while in a market oriented economy the driving force is market demand and the related aspects such as better transportation facilities. The regions with better access to markets and/or located near the urban centres will be more intensively cultivated (mainly, high valued crops like fruits). Urban demand and low transportation cost induce intensive cultivation (Pingali, Bigot and Binswanger, 1987; Rao, Birthal and Joshi, 2006).

In a subsistence economy whatever is produced is consumed so that the equivalence between per capita food production and per capita consumption levels is maintained. In these economies agricultural intensification is driven by population pressure. Boserup's (1965) theory asserts that farmers are responsive primarily to the subsistence needs of the immediate population that they must feed (Turner et al., 1993). As population-land ratio increases, farmers are forced to employ more labour and technical inputs to achieve greater production. This raises the output per unit of land but not necessarily the per capita production. Technological change becomes necessary for improving per capita production. In the early stages, when there is movement from shifting cultivation to permanent cultivation, traditional land improvement techniques such as irrigation and drainage are employed whereas in the latter stages, improvements in land takes place through adoption of biological technology such as high yielding varieties. The technological changes take place gradually and according to demand; certain

threshold of demand has to be reached for changes to take place. The continuous pressure on the new agricultural systems results in diminishing returns until a new threshold is reached, leading to a new technological change (Turner et al., 1993; Cuffaro, 1997). This is an elaboration of how Boserup perceived developments in agriculture as induced by households' needs and wants.

"In a subsistence economy, there arises no need to produce beyond the needs of the households (surplus production) because it confers no gains. Storage facilities are virtually non-existent and "redundancy of production" blocks the progress of trade and exchange. However, to ensure that the basic consumption needs are met, farmers take into account losses due to production constraints (such as droughts and pests). Production may exceed the expected level when these constraints are low" (Turner and Ali, 1996: 14985). Boserup talks about the appearance of markets to exchange such surplus production for non-agricultural commodities, but surplus production is only accidental (see Boserup, 1965; chap 8).

The existence of markets reduces redundant production and increases the aspiration levels of the farmers; the higher aspiration levels in turn induces them to respond to market signals and intensify cultivation accordingly (Scott, 1976). The equivalence between per capita consumption and per capita production no longer holds in the economies with non-agricultural sector, differing resource bases and international trade (Cuffaro, 1997). Agricultural intensification in the market oriented economies will be driven more by factors other than population pressure.

In the present day economies with the presence of markets, it may be that the intensification process is driven both by population pressure and market forces. But in economies where the growth of markets is low with lower levels of urbanization, it can be expected that agricultural intensification has taken place more in response to the growth in population or population pressure. Turner and Ali (1996) in their study of the small holder agrarian economy in Bangladesh found that though majority of the farmers grew basically for their own

subsistence, many of them were also engaged in market cultivation responding to price signals for various crops.[2]

Thus what can be gathered from the above is that agricultural intensification may be induced by population pressure or market-demand or both. In a non-subsistence economy, agricultural intensification is stimulated by market demand, which in turn depends on factors such as urbanisation and development of transportation.

2.4.1 Frequency of Cropping

In the initial stages of intensification, the farmers simply shorten the length of the fallow (Boserup, 1965). Adoption of multiple cropping calls for better irrigation facilities to ensure timely and adequate supply of water, use of fertilizers to replenish soil nutrients, cultivation of short duration crop varieties that will release the land early for cultivation of the next round. Without improvement in the technique of cultivation, faster increase in cropping intensity cannot take place in spite of heavy population pressure (Bezbaruah, 1994; Roy, 1999).

Even with the increase in population pressure/population density, this process of intensification may be slow if there exist opportunities for non-farm employment locally or through migration. We would deal with migration and non-farm employment as response to population pressure later on.

Environmental factors also influence the frequency of cropping. The environmental factors were held constant by Boserup so as to make the relationship between population pressure and agricultural intensity more apparent (Turner et al., 1977). But environment has a role to play in the process of agricultural intensification. Favourable land in terms of better water facility, say having a well drained river and higher fertility, will be more intensively cultivated. Environmental extremes, prime or poor lands, it has been argued, can accelerate the intensification process beyond the corresponding level of demand.

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[2] The study is an assessment of agricultural change and induced intensification in Bangladesh between 1956 and 1980. The study has been carried out for 265 households in six villages.

The prime lands have good yields and intensive cultivation will result in higher land productivity. Poor lands or marginal lands, on the other hand, will demand notably large investment for permanent cultivation to take place, and this will be focused especially on small areas, which then become intensively cultivated parcels (Levi, 1976; Turner et al., 1977).

2.4.2 Labour intensification

The use of labour input per unit of land indeed is the most pertinent response to population pressure on land. With increasing population exerting pressure on land, the increase in both cropping intensity and labour intensity can be expected to take place simultaneously. With paucity of mechanization, increase in cropping frequency under conditions of growing population pressure is achieved by increased application of labour inputs (Netting et al., 1993). This is true in regions which cannot adopt mechanization due to financial constraints; or in regions which have difficult terrain, for instance, in the hilly regions the use of tractors will be meagre.

According to Boserup, "extensive systems of agriculture maximize labour efficiency when population density is low" (Turner et al., 1977: 384). She holds that growing pressure of population on land will imply higher use of labour that is subjected to diminishing returns. Thus, as population pressure increases more labour per unit of land will be employed and eventually labour efficiencies decline (Boserup, 1965). This happens because of declining soil fertility. In other words, labour efficiencies (output per man hour) are poorer at more intensive systems of cultivation. Boserup, however, mentions that labour efficiency can be prevented from falling if new and superior techniques are introduced; the techniques evolve in response to population pressure implying that her focus is on transmission of technology and not invention. Brookfield (1972), on the other hand, talks of a hierarchy of systems rather than a continuum as done by Boserup and mentions that increasing labour inputs are employed as a response to growing population pressure "but there are often resistances to transition to a more intensive level because of specific environmental conditions, a lack of

suitable technology, investment requirements in the new system, or investments made in the old" (Vasey, 1979:270). In an agrarian economy, population pressure will result in increase in the number of labour per unit of land but such increasing number may cause a fall in the efficiency of labour unless improved techniques of production are introduced.

2.4.3 Cropping pattern

As a response to population pressure on land, there might be changes in cropping pattern or a shift from low valued agriculture to high valued agriculture. As a response to population pressure, there may be shift to crops which are relatively more labour absorbing. In her study Boserup (1965) found that in East Asia with growing population densities there was a shift from upland crops to wet rice which was more labour intensive. Labour intensity varies with crops; for cereal crops like rice, labour used per unit of land will be higher relative to the root crops like yam and sweet potato (Turner et al., 1977). So shift to labour intensive crops is plausible with increasing population pressure.

2.4.4 Adoption of Technology: Biological and Mechanical

The use of more labour per unit of land as a response to increasing population pressure is the traditional way of adaptation, which is supplemented now by the use of industrial and scientific inputs in agriculture. These factors, such as chemical fertilizers, pesticides, high yielding seeds and modern equipments facilitate greater agricultural intensification and enhance the scope of obtaining higher yields; eliminating fallow and waste land; introducing multi-cropping; and cultivating infertile, dry and hilly land (Boserup, 1975; Schultz,1964). As the fallow period gradually declines and the system of cultivation moves from annual to multi cropping, the techniques of production too evolve from traditional to modern. While in the initial stages, techniques like hoeing, ploughing and animal traction are employed, in the latter stages of intensive cultivation, mechanization techniques like tractorisation are adopted (Pingali et al., 1987).

The techniques of production adopted are influenced by the factor endowments in an economy. In labour abundant economies or economies with high population pressure, the constraints imposed on agricultural growth are overcome not by mechanization but by adoption of biological technologies supported by heavy investment in irrigation along with intensive manuring techniques. In economies where supply of labour is inelastic, the constraint of limited labour supply will be offset by advances in mechanical technologies (Hayami and Ruttan, 1985). This does not mean that mechanical technologies will not be adopted in land scarce economies with higher population densities. Mechanisation can be seen but it will be selective with greater emphasis on power intensive mechanization[3] (see Pingali et al., 1987).

The adoption of technology whether biological or mechanical is conditioned by a number of factors such as soil fertility, market access and the extent of commercialization and credit access and availability (Pingali et al., 1987). Farmers' access to credit and/or income determines whether and how much they are able to purchase inputs. Low purchasing power and limited access to credit will not allow farmers to go for improved technology due to financial constraint and risk aversion. Government policies (e.g. input subsidies) play an important role in making the farm inputs accessible to the farmers.

Another important factor that governs the adoption of technology especially the biological technology is that of water control. Because of its complementarities with (HYV) seeds and fertilizers, water is the leading input in agriculture and its control is of utmost importance to ensure higher growth and productivity (Boyce, 1987). In drought prone areas, use of chemical fertilizers can be risky if soil moisture cannot be retained with effective irrigation and a system of water management. In flood prone areas also a system of water resource management is necessary to avoid crop damage and unprecedented losses. In those areas, as a risk aversion strategy farmers may choose not to go for improved seed varieties

[3] Agricultural operations can be grouped into power intensive or control intensive operation depending on human judgment. Land preparation, transport, milling, grinding and threshing are power intensive while weeding, sifting, winnowing and fruit harvesting are control intensive. The first set of operations requires lot of power and little of human judgment so are adopted by labour-abundant economies with lower wages.

and fertilizers and instead stick to the traditional low yielding varieties (Bhowmick, 2005) even when they confront no financial constraints.

Another conditioning factor that can be identified is farm size. Population pressure leads to a decline in the average size of operational holding. The smaller size farms can be expected to intensify cultivation by adopting more of biological technology since adoption of mechanical technology is constrained by the smallness of the farm.

2.5 Adjustment Failures

It has been found that population pressure triggers adjustments in terms of agricultural intensification, labour intensification, and changes in cropping pattern and diversification. However, such adjustments may fail to occur when there exist certain impediments in the economy. In regions which are poor, densely populated and which already have a reasonably high level of agricultural intensity, further agricultural intensification cannot take place without supplementary technological improvements. Moreover, growth of effective demand in those economies will be too slow to provide incentives for higher intensification (Lipton, 1990).

Another aspect that has to be taken count of is the factor of environmental degradation. Increase in population will induce the kind of responses which Boserup and others have predicted but at the expense of the environment which will adversely affect the productivity of land and hence growth in agriculture. Owing to population pressure, there may be rural-rural migration which will have adverse consequences especially when farmers settle in fragile environments and these farmers have technological knowhow that does not suit the new location. Although farming communities may try to adapt to the existing economic conditions but the process of adaptation in the face of various constraints will cause the land productivity to fall in the long run. To restore the fertility of land the use of chemical fertilizers will become necessary but this is constrained by the farmers' lack of capital and sometimes their risk averse strategies in the context of weather uncertainty (Cuffaro, 1997).

2.6 Changes in Occupation and Migration

Increasing population pressure on land and decline in land availability may cause the people to migrate to urban centres in search of alternative sources of income. "In peasant economies that is typically characterised by continuing population pressure on land, small and fragmented holdings, high iniquitous land distribution structures, increasing application of labour-saving farm technologies etc., agriculture alone cannot provide for the ultimate answer for rural unemployment and underemployment" (Chadha, 1993:296). In Boserup's model (1965), rural to urban migration takes place before agricultural intensification happens because instead of adopting an intensive system people go for the less arduous work in non-agricultural occupations. However, in present times even with agricultural intensification taking place, migration to urban areas occurs when such intensification does not ensure higher production or productivity from land and thereby fetch lower incomes. The agrarian economy may even consider combining farm and non-farm income to supplement the lower farm earnings. Employment in the non-farm sector becomes an important option when increased pressure on land limits the scope for increasing employment in agriculture (Jha, 2006). Or it may so happen that with the development of infrastructure and markets, agricultural intensification by itself creates non-farm employment opportunities which will employ people previously engaged in farming or cultivation (Mellor, 1976).

The change of occupation and migration are conditioned by a number of key factors such as "education, training and opportunities, labour mobility, land tenure security, development of infrastructure, housing and land markets, the pace of investment and growth in the industrial sector in the economy, the presence of social services in the urban sector and poverty" (Pender, 1999: 33). If population pressure on the land pushes those dependent on land into deprivation then they will migrate to urban areas in search of better living conditions. Unemployment may be greater in the urban areas but urban biased policies, better social services or/and higher wages will lure migrants (Harris and Todaro, 1970). Even if employment opportunities are available in the urban

areas, migration will not take place when labour mobility is constrained by land tenure insecurity or absence of housing in the urban areas. Moreover, if employment opportunities available in the urban areas demand skill and education then unskilled people cannot afford to migrate even in the face of increasing population pressure.

2.7 Towards an Analytical Frame

Agrarian economy responds to increasing population pressure by adopting various changes in the system of cultivation. Availability of abundant land will lead to expansion of area under cultivation. When little scope for extensification remains, an intensive system of cultivation is adopted; with increase in cropping intensity, shifts in cropping pattern, and increase in the number labour employed per unit of land. However, the increases in cropping intensity or the shift in cropping pattern are conditioned by a number of factors. These conditioning factors have to be favourable for cropping intensity to increase and cropping pattern to change beyond a certain extent. The conditioning factors relate mainly to institutions and infrastructure that influence agricultural growth. To increase frequency of cropping or adopt multiple cropping, there has to be a system of controlled water supply; only a proper water control system can ensure cultivation throughout the year and in various seasons. Other factors of infrastructure such as roads and markets and also of institutions such as credit and research is crucial to achieve higher cropping intensity and adoption of a multiple cropping system. But these conditioning factors are not endogenous. In bringing about infrastructure development and facilitating institutional change, the government has a critical role to play. Since infrastructure is a public good and involves lumpy investment, private efforts to develop the same will not be forthcoming. Thus, unless the government works as a facilitator, agricultural intensification beyond a certain extent will not take place. Therefore, in analysing the agricultural change taking place under increasing population pressure, one needs to examine the initiatives that had been undertaken by the government to facilitate various institutional changes and infrastructural development.

CHAPTER III

POPULATION PRESSURE AND AGRICULTURAL CHANGE IN ASSAM

3.1 Introduction

The present chapter makes an attempt at analysing the agricultural changes which the peasants of Assam have adopted in the face of sustained growth in population. The hypothesis is that population growth provides a positive stimulus to agricultural change. These agricultural changes are extensification, labour intensification, crop intensification, shifts in cropping pattern and changes in technology. A study of the effect of population growth on agricultural change needs necessarily to be preceded by a discussion of the growth and composition of the population. The varying population growth across the districts will result in differing agricultural changes. So the analysis needs necessarily be disaggregated at the district level. As the period of analysis is over four decades and many new districts have been formed during this period, they have been combined into the original eight districts of the mid 1960s.

The chapter is divided into nine sections. The next section discusses the trends in population and the occupational structure in Assam; the third section examines the growth of population and the population pressure on land. The fourth section is on the extensification of cultivation. The cropping intensity, cropping pattern, labour intensification and adoption of technology in Assam are analysed in the fifth, sixth, seventh and the eight sections respectively. The final section concludes the present chapter.

3.2 Trends in Population Growth and Occupational Structure

The present population of Assam is 31,169,272 that constitutes 2.6 percent of the country's total population (Census of India, 2011). Kamrup (includes the present day Kamrup, Barpeta and Nalbari) is the largest district accounting for about one fifth the population of Assam followed by Goalpara and Lakhimpur. Karbi-Anglong and N.C Hills had the lowest population.

During the last five decades, the state witnessed unprecedented growth in population. The decadal variation in population has been remarkable especially in the two decades of 1951-61 and 1961-71; precisely 34.98 percent and 34.95 percent in 1951-61 and 1961-71 respectively whereas the population in India as a whole grew at 21.64 percent and 24.80 percent in the respective decades. The period 1971-2001 shows growth in population more or less (see Figure 1.1) in line with the country's average. The variation in population growth across the districts of Assam that was relatively higher in the earlier decades has come down in recent decades (Table 3.1).

The density of population across the districts of Assam varies from 65 to 560 persons per sq. km. Karbi-Anglong and N.C Hills is the most sparsely populated with only 65 persons per sq. km. and the most densely populated district is Nagaon (Table 3.1). The overall density of the state has been pulled down by the low density of Karbi-Anglong and N.C Hills.

Table 3.1: Population growth across districts in Assam

Density/Period	Population, 2001		Compound Annual Growth Rate (in percent)			
	Total ('000)	Density per sq. km	1951 -61	1961 -71	1971 -91	1991 -01
Cachar	2995.77	433	2.11	2.17	3.74	1.84
Darrang	3185.83	362	3.44	2.97	4.50	1.57
Goalpara	4269.98	414	3.32	3.65	4.84	1.68
Kamrup	5318.35	540	3.25	3.25	4.33	1.89
Lakhimpur	3796.09	299	3.72	3.06	4.21	1.60
Nagaon	3090.86	560	3.11	3.28	4.10	1.99
Sibsagar	2997.24	332	2.19	1.97	3.50	1.39
Karbi-Anglong and N.C Hills	1001.39	65	5.25	4.87	5.80	2.08
Assam	26655.53	340	3.07	3.00	4.27	1.73
C.V (%)	37.00	41.52	29.63	28.44	16.24	13.34

Source: *Computed from Census of India, various years.*

So far as the growth in population is concerned, there has been a sustained increase over the decades in all the districts. There had been a deceleration in growth for a few districts in the decade of 1961-71 but growth accelerated in the next period with an annual increase of over 4 percent for most of the districts. In the decade of 1991-2001 however, there has been a deceleration in growth in general and for all the districts. During this decade, the state recorded an annual

population growth of 1.73 percent. Cachar, Kamrup, Nagaon, and Karbi-Anglong and N.C. Hills registered growth above the state's average. Sibsagar showed the lowest growth among the districts with a growth of 1.39 percent annually.

As far as the rural-urban composition of the population is concerned, Assam is pre-dominantly rural. It is imperative to look into the rural-urban composition of population because it has important implications for the agricultural sector. A larger share of urban population will mean more demand for agricultural produce; higher demand raises the prices and enhances the profits of the cultivators. When there is a decrease in rural population the agricultural population decreases whereby the gains of agricultural profits are distributed among a small number of peasants who are thus encouraged to bring changes to agriculture (Das, 1984). The percentage of rural population in the state is 87 percent in 2001 which is only a drop of about 9 percent in five decades (Table 3.2).

In 1951, the rural-urban composition of population shows almost no variation across the districts (Table 3.2). The percentage of rural population was 96 percent; the lowest rural population was in Cachar (94.5 percent) and the highest in Darrang (98.72 percent). Between 1951 and 1961, the share of the rural population declined by 3 percent points to 93 percent for the state as a whole. For all the districts the share of the urban population has gone up. The hill district however showed the least improvement having only 1.17 percent as urban population. Kamrup and Lakhimpur showed a significant fall in the share of rural population from the previous decade. The share of urban population in Kamrup and Lakhimpur had gone up from 5 percent and 1.24 percent to 10.65 percent and 9.68 percent respectively. Thus, in 1961, the most urbanized district is Kamrup and the least urbanised is Karbi-Anglong and Darrang.

In 1971, the rural population constituted 91 percent of the total for the state as a whole. Like the previous decade, it is Kamrup and Lakhimpur where the share of

Table 3.2: Percentage of rural (R) and urban (U) population in the total population across districts

Districts	1951		1961		1971		1991		2001	
	R	U	R	U	R	U	R	U	R	U
Cachar	94.50	5.50	92.98	7.02	92.08	7.92	91.42	8.58	89.34	10.66
Darrang	98.82	1.18	96.35	3.65	94.30	5.70	93.83	6.17	92.13	7.87
Goalpara	96.47	3.53	93.52	6.48	92.38	7.62	90.62	9.38	89.86	10.14
Kamrup	95.00	5.00	89.35	10.65	88.35	11.65	82.37	17.63	80.02	19.98
Lakhimpur	98.76	1.24	90.32	9.68	88.09	11.91	87.63	12.37	85.34	14.66
Nagaon	95.00	5.00	93.13	6.87	92.58	7.42	90.58	9.42	89.77	10.23
Sibsagar	96.60	3.40	94.70	5.30	91.32	8.68	90.51	9.49	88.33	11.67
Karbi-Anglong and N.C. Hills	98.69	1.31	98.83	1.17	96.62	3.38	87.10	12.90	84.88	15.12
Assam	96.40	3.60	92.79	7.21	91.18	8.82	88.90	11.10	87.10	12.90

Source: *Census of India, 2001. General Population Tables Assam.*

urban population was the highest and it was the lowest in the hill district. However, by 1991 in the hill district there had been a leap in the share of urban population. It increased from 3.28 percent in 1971 to 12.9 percent in 1991 which was higher than the state's average (11.1 percent). Kamrup continued to be the most urbanised district with 17 percent urban population. The rural population was found the highest in Darrang (93.83 percent).

In 2001, the share of rural population (87 percent) shows a fall for all the districts from the previous decade. Cachar, Goalpara, Darrang, Nagaon and Sibsagar are less urbanized with the urban population below the state's average. Darrang has the lowest share of urban population (7.87 percent) and Kamrup with 20 percent urban population is the most urbanized district in the state.

Urbanization has been taking place at a slow pace in the state and except Kamrup all other districts have rural population equal or above 85 percent. Slow urbanization in Assam leaves hardly any avenue for the workers in the rural areas to migrate to the urban areas even with increasing population pressure.

Table 3.3: Percentage of agricultural workers*, household industry workers and other workers in the total workers, 1971 and 2001

District/Year	Cultivators+ Agricultural Labourers		Household Industry Workers		Other Workers	
	1971	2001	1971	2001	1971	2001
Cachar	66.66	40.05	1.61	3.61	31.74	56.34
Darrang	64.59	53.06	0.84	3.11	34.57	43.83
Goalpara	78.06	59.98	1.42	3.74	20.52	36.29
Kamrup	69.84	44.46	2.14	5.53	28.01	50.02
Lakhimpur	49.33	54.59	0.95	2.26	49.72	43.15
Nagaon	77.38	61.99	1.25	3.34	21.37	34.67
Sibsagar	51.09	47.62	1.45	3.37	47.46	49.00
K.A. and N.C Hills	81.25	69.16	0.59	3.49	18.16	27.35
Assam	65.77	52.36	1.39	3.62	32.84	44.03
C.V (%)	17.87	17.99	38.28	25.75	38.19	22.14

Source: *Census of India 1971 and 2001.*
Note: *consists of cultivators and agricultural labourers.

Thus, it is not unusual to expect a major section of the population to be engaged in agricultural activities. The work force structure of the population is shown in Table 3.3. The proportion of workers engaged in agricultural activities shows a declining trend from 1971 but its share is still high constituting over half the

work force in 2001. The decline in share is supplemented by the increase in the proportion of other workers. Across districts the share in agricultural workers shows some variation. Darrang, Goalpara, Lakhimpur, Nagaon and Karbi-Anglong and N.C Hills are the districts with the share of agricultural workers above the state's average in 2001.

Contrary to the rest of the districts, Lakhimpur has registered a 5 percent increase in the proportion of agricultural workers between 1971 and 2001. In Kamrup and Cachar, the share shows sharp fall between 1971 and 2001. The growth of urbanization in Kamrup creating non-farm employment opportunities might have absorbed the major proportion of the workers. The falling shares of agricultural workers, though still high (70 percent), is significant in Karbi-Anglong and N.C Hills which also happened to be among the fast urbanizing districts. On the other hand, even with urbanization in Lakhimpur, more workers have been drawn into agriculture; growing market facilities and better transport might have made agriculture considerably more remunerative luring more workers to engage in agricultural activities.

3.3 Population Pressure on Land

A major chunk of the population being dependent on agriculture coupled with a sustained increase in rural population (Table 3.4) has exerted an increasing pressure on land. The growth in rural population has been phenomenal during the period 1971-91 with an annual increase of 4 percent for the state as a whole. The period 1991-2001 saw a deceleration in growth but continues to be over 1.5 percent for most of the districts. Among all the districts, Darrang, Lakhimpur, and Sibsagar have experienced lower growth in rural population during 1991-2001. Nagaon showed the fastest growth in the latest period and is also the most densely populated (511 persons per sq. km.). Karbi-Anglong and N.C Hills though show much lower rural density records a rapid growth in rural population over the years.

Table 3.4: Net sown area (in ha.) per rural population (NSAP), rural density per sq.km and growth in rural population across districts

Districts / Periods	NSAP (ha.)			Rural Density per sq. km			Compound Annual Growth Rate in Rural Population			
	1965-66	1974-75	2001-02	1961	1971	2001	1961-71	1971-91	1991-2001	1961-2001
Cachar	0.16	0.17	0.09	187	230	390	2.08	3.67	1.61	1.84
Darrang	0.24	0.27	0.13	142	187	336	2.76	4.45	1.39	2.15
Goalpara	0.21	0.23	0.10	141	201	376	3.53	4.64	1.60	2.44
Kamrup	0.23	0.26	0.12	193	264	446	3.14	3.63	1.60	2.09
Lakhimpur	0.19	0.20	0.12	113	149	258	2.80	4.16	1.34	2.08
Nagaon	0.23	0.23	0.12	208	286	511	3.22	3.88	1.90	2.25
Sibsagar	0.22	0.23	0.14	161	189	298	1.61	3.41	1.15	1.54
Karbi-Anglong and N.C. Hills	0.20	0.33	0.18	18	29	56	4.65	4.77	1.82	2.81
Assam	0.21	0.23	0.12	130	172	300	2.82	4.02	1.53	2.09
C.V (%)	13.43	20.04	21.80	41	41	41	30.98	12.41	16.05	16.58

Source: *Computed from Census Reports, 1961, 1971 and 2001;*
Statistical Abstract of Assam, 1978; and
Directorate of Economics and Statistics, Government of India.

Note: *agricultural workers include cultivators and agricultural labourers.

In an agrarian rural economy, a falling ratio of net sown area to rural population can be an indicator of population pressure on land.[1] "The term 'population pressure' is used in circumstances where pressure to raise agricultural output is wholly or pre-dominantly due to food demands of the increasing populace" (Levi, 1976: 66). It is reasonable to use the term population pressure in the context of Assam because production is mainly for subsistence and very little goes out to the market (Table 3.5). Rice is the principal crop produced in Assam but it is seen that only 25 percent of the total production goes to the market which is much lower compared to the other rice producing states.

Table 3.5: Marketed surplus- output ratio of rice

State/Period	1999-2000	2006-07	2007-08
Assam	25.0	34.55	25.96
Punjab	94.7	98.66	98.06
West Bengal	40.9	48.51	64.45
All India[2]	60.1	71.25	72.64

Source: *Directorate of Economics and Statistics, Government of India, 2001 and 2010.*

A sustained rise in population over the decades is associated with a falling net sown area per person since the 1970s (Table 3.4). However, the net sown area per person (NSAP) showed an increase for the state as a whole in the period 1965-66 to 1974-75 which is an indication of the expansion of the area under cultivation. The NSAP showed a sharp fall from 0.23 hectare to 0.12 hectare indicating the increasing pressure of population on land. The process of expanding net sown area (NSA) if it has taken place was unable to match the higher growth in population in the state.

Invariably in all the districts the NSAP had fallen between 1974-75 and 2001-02. Cachar had the smallest NSAP- 0.09 hectare followed by Goalpara (0.10). The sharpest fall is in the district of Goalpara followed by Kamrup and Darrang; the net sown area per person had fallen by more than 50 percent in these districts (Table 3.4).

[1] See Krishnaji (1994)

[2] Average of the states that produce rice; includes Andhra Pradesh, Assam, Bihar, Haryana, Karnataka, Kerala, Madhya Pradesh, Orissa, Punjab, Tamil Nadu, Uttar Pradesh and West Bengal.

It can be inferred from the analysis so far that Darrang, Goalpara, Kamrup, Nagaon and Karbi-Anglong and N.C Hills are the districts with higher growth in rural population and lower NSAP. The remaining districts namely Cachar, Lakhimpur, and Sibsagar are the districts experiencing relatively low population pressure. Now, it can be expected that the districts where population pressure is high, land will be intensively used. But before examining the system of intensive cultivation, we first look into the process of extensification which is the initial response to population pressure.

The agricultural changes namely extensification of area under cultivation, crop intensification, changes in cropping pattern, labour intensification and technology adoption in Assam are analysed at length in this section. We begin with extensification.

3.4 Extensification of Area under Cultivation

With land available an increase in population will result in an expansion of the area under cultivation. Extension of the area under cultivation takes place as the initial response to increasing population pressure. In the case of Assam, the extension of area, as indicated by the increase in net sown area, has taken place during 1965-66 to 1981-82 (Table 3.6). The net sown area as a proportion of the geographical area has increased by 7.2 percentage points during this period. The expansion has been attained mainly by transforming barren and uncultivable land into cultivable land; its contribution being 3.5 percentage points. The other contributors were fallow (1.4 percent points), forest land (1.3 percent points), culturable land (1.1 percent points) and permanent pasture (0.7 percent points). However, it must be mentioned that this period has also seen a sizeable increase (1.8 percent points) in land put to non-agricultural use.

Table 3.6: Distribution (in Percent) by land- use categories, 1965-66 to 2006-07

Category of use	1965 -66	1969 -70	1973 -74	1981 -82	1992 -93	1999 -00	2006 -07
1	2	3	4	5	6	7	8
1. Forest	26.7	26.7	26.9	25.3	25.3	24.6	24.9
2. Land put to non-agricultural use	9.8	9.8	10.6	11.6	12.9	13.6	13.6
3.Barren and uncultivable land	23.1	23.1	20.2	19.6	18.6	18.6	18.4
4.Permanent Pastures and other grazing land	3.0	3.0	2.7	2.3	2.1	2.1	2.0
5.Land under Misc. tree crops and groves not included in net area	3.2	2.9	3.0	3.1	2.8	3.0	2.7
6.Culturable land	2.4	2.4	2.0	1.3	1.1	1.0	1.0
7.F.L other than current fallow	2.5	2.1	1.9	1.1	0.9	0.8	0.8
8.Current Fallow	2.0	1.6	1.4	1.1	0.9	1.4	1.6
9.Net Sown Area	27.3	28.5	31.3	34.5	35.4	34.8	35.1
Total Geographical Area	100	100	100	100	100	100	100

Source: *For columns 2-4 Das (1984); and*
For columns 5-8 computed from Directorate of Economics and Statistics, Government of Assam.

By the early 1980s, the limits to expansion of area under cultivation had been reached (Table 3.6). The scope for further expansion of cultivation is rather limited. The area under forest has been reported to be 25 percent of the total area in the state. But the need is to extend the forest cover to 33.3 percent of the total geographical area as per the National Forest Policy of India. Therefore, there is hardly any scope of extending the cultivation to the forest land. It goes without saying that further growth of arable land at the expense of forests can adversely affect the environment and the ecological balance of the state.

Moreover, it cannot be expected that the existing non-agricultural land may be brought under cultivation because the stride in urbanization will rather occupy some of the existing land under crops. Huge cost becomes necessary to make the barren and uncultivable lands that exist in Karbi-Anglong and N.C Hills cultivable. Apparently, the possibility of raising the area under cultivation has exhausted in the state by 1981-82.

Table 3.7: Compound annual growth rates of area under different land use classes, 1965-66 to 2006-07 (in percent)

Districts/ Category	Forests	Land not available for cultivation	Other uncultivated land excluding Fallow Land	Fallow Lands	Net sown area
1	2	3	4	5	6
Cachar	0.20	-0.14	-0.38	-2.35	0.34
Darrang	0.35	0.20	-1.83	-1.81	0.46
Goalpara	0.38	-1.00	-0.64	-0.10	0.66
Kamrup	-0.61	0.25	-0.22	-1.44	0.39
Lakhimpur	-1.31	0.91	-0.72	-1.44	0.95
Nagaon	0.12	-0.43	-1.79	-1.51	0.56
Sibsagar	-0.15	0.76	-1.30	-1.73	0.39
Karbi-Anglong and N.C Hills[3]	0.33	N.A	N.A	N.A	2.44
Assam	-0.15	-	-	-1.49	0.61

Source: *Computed from Economic Survey of Assam, 1971; and Directorate of Economics and Statistics, Government of Assam.*

The expansion in net sown area has taken place in all the districts during the last four decades (Table 3.7). Sibsagar and Kamrup show a relatively slower expansion while Karbi-Anglong and N.C Hills, Goalpara, Nagaon, and Lakhimpur show a higher expansion. In all the districts, the expansion in area under cultivation has been contributed by the decline in fallow land. In Lakhimpur, Kamrup and Sibsagar the decline in area under forest land has also been a contributing factor. But it is to be noted that extension of cultivation had largely taken place in the period from 1965-66 to 1981-82; the latter period of 1981-82 to 2006-07 had shown meagre and even negative growth in NSA for a few districts (Goalpara and Sibsagar). The period classification has been done to capture the inter-district variations and see whether some of the districts continued to expand area under cultivation even after 1981-82 when the process of extensive cultivation for the state as a whole came to a stop.

[3] For the Karbi-Anglong and N.C Hills, data for the columns 3-5 are not available because the mode of cultivation being different from the plains, it is difficult to estimate barren land, fallow land etc.

Table 3.8: Compound annual growth rates of area under different land use classes, 1965-66 to 1981-82 (in percent)

Districts	Forests	Land not available for cultivation	Other uncultivated land excluding Fallow Land	Fallow Land	Net Sown Area
1	2	3	4	5	6
Cachar	0.50	-0.57	-0.69	-1.95	0.42
Darrang	0.58	0.38	-3.08	-4.98	0.99
Goalpara	1.63	-2.61	-2.55	-6.11	1.60
Kamrup	-1.61	0.20	1.97	-3.65	0.78
Lakhimpur	-1.73	1.32	-1.29	-3.87	1.94
Nagaon	-0.70	-0.36	-1.51	-6.93	1.22
Sibsagar	-0.37	1.09	-1.98	-3.30	1.07
Karbi-Anglong and N.C. Hills	0.01	N.A	N.A	N.A	5.41
Assam	-0.26	-	-	-	1.33

Source: *Computed from Economic Survey of Assam, 1971; and Statistical Abstract of Assam, 1990.*

For the state as a whole the growth in the area under cultivation had been 1.33 percent per annum during 1965-66 to 1981-82 with almost negligible growth (0.07 percent) during 1981-82 to 2006-07. Most of the districts of the state show a similar pattern. In Goalpara, land used for cultivation earlier had been kept fallow as reflected in a 4 percent increase in the area under fallow during 1981-82 to 2006-07 .In Sibsagar, the area used for cultivation earlier had been put to non-agricultural uses resulting in a fall in the NSA during this period. Karbi-Anglong and N.C Hills, Cachar, and Lakhimpur are the only exceptions to have expanded NSA in the latter period.

Table 3.9: Compound annual growth rates of area under different land use classes, 1981-82 to 2006-07 (in percent)

Districts	Forest	Land not available for Cultivation	Other uncultivated Land excluding Fallow Land	Fallow Land	Net Sown Area
1	2	3	4	5	6
Cachar	-0.03	0.16	-0.14	-2.44	0.25
Darrang	0.16	0.06	-0.82	0.51	0.06
Goalpara	-0.51	0.19	0.73	4.07	-0.05
Kamrup	0.13	0.26	-1.71	0.20	0.09
Lakhimpur	-0.92	0.56	-0.27	0.35	0.20
Nagaon	0.68	-0.45	-1.84	2.36	0.06
Sibsagar	0.02	0.48	-0.73	-0.51	-0.11
Karbi-Anglong and N.C. Hills	0.53	N.A	N.A	N.A	0.19
Assam	-0.06	-	-	-	0.07

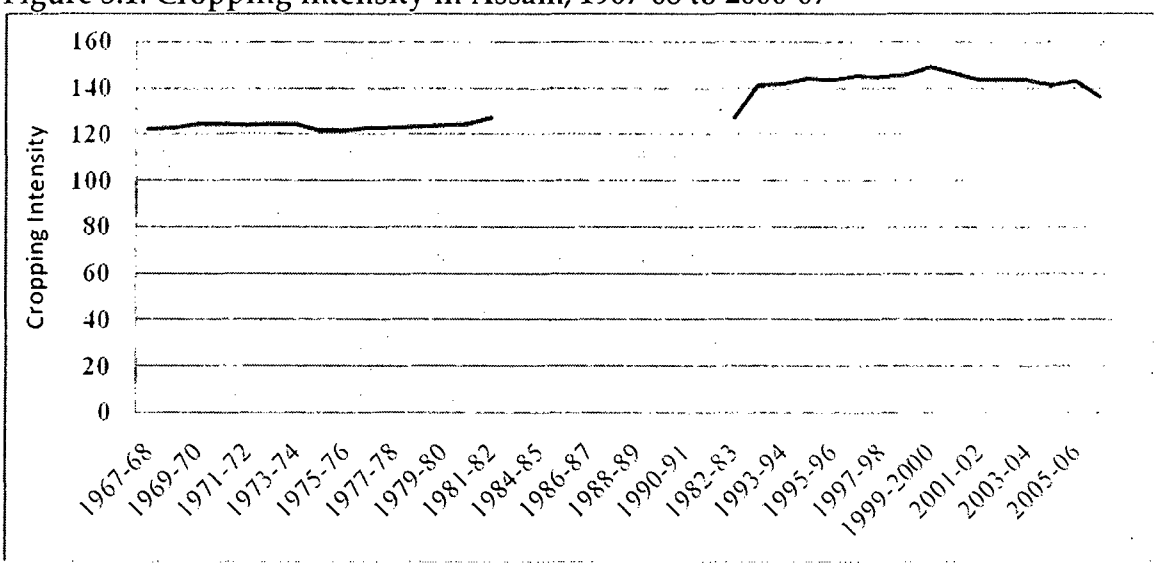
Source: *Computed from Statistical Abstract of Assam, 1990; and Directorate of Economics and Statistics, Government of India.*

3.5 Cropping Intensity

From the previous sections it is apparent that extensive cultivation has lost significance in the state with the disappearance of fallow land and the difficulty[4] associated with extending cultivation to the non-cultivable land; it can be expected that the peasants would raise more than one crop on the same plot of land to meet the needs of the growing population. Thus, intensive use of the net sown area is an effective measure in the face of a fast growing population. The cropping intensity is measured in terms of percentage as follows:

$$\text{Cropping intensity} = (\text{Gross Cropped Area} / \text{Net Sown Area}) \times 100$$

Figure 3.1: Cropping intensity in Assam, 1967-68 to 2006-07



Source: *Computed from Directorate of Economics and Statistics, Government of India and Assam.*
Note: The Net Sown Area and the Gross Cropped Area figures for the period 1983-84 to 1991-92 included are not available; hence the break in the line graph.

The cropping intensity for the state as a whole has shown a sharp increase from 125 percent in 1969-72 to 146 percent in 1999-02. The increase has taken place only after the period 1979-82. Little scope for expanding the net sown area since the early 1980s has led to more intensive use of land. The significant increase in

[4] Das (1984) in his analysis has conclusively found that a large proportion of the total geographical area is unsuitable for cultivation and whatever land was available has been brought under cultivation. In other words, the state has exhausted all possibilities of extending the area under cultivation. The extensive cultivation in the Karbi-Anglong and N.C Hills is constrained by its topography. In the plains the rivers often changing their courses, beels, swamps, deep forests and scattered hillocks have made a large proportion of lands unfavorable for growing crops.

cropping intensity might have been brought about by the higher adoption of the new agricultural strategy; it is well known that the spread of Green Revolution to the eastern part of the country happened only in the 1980s. The change in cropping intensity from 1967-68 to 2006-07 for the state as a whole is shown in the Figure 3.1.

Table 3.10: Cropping intensity across districts in Assam, 1969-72 to 2006-07

Districts	1969-72	1979-82	1999-02	2006-07
Cachar	130	130	131	142
Darrang	118	124	151	136
Goalpara	137	129	155	154
Kamrup	137	137	148	128
Lakhimpur	114	121	149	151
Nagaon	124	128	151	122
Sibsagar	109	114	128	118
K.A and N.C Hills	121	114	148	157
Assam	125	126	146	137
C.V	8.4	6.6	6.8	10.8

Source: *Computed from Directorate of Economics and Statistics, Government of India and Assam.*

The cropping intensity shows increase in all the districts in the period 1969-72 to 1999-02 but there has been variation in increase (Table 3.10). Cachar and Sibsagar have shown the slowest increase during the period. It is to be noted that these are districts with relatively lower increase in population pressure. Cachar had shown expansion in the net sown area in the period 1981-82 to 2006-07. Darrang, Lakhimpur, Nagaon, and Karbi-Anglong and N.C Hills have shown higher increase in cropping intensity. If we look at the levels, we find that in 1969-72 cropping intensity ranged from 109 percent in Sibsagar to 137 percent in Goalpara and Kamrup. In 1999-2002, cropping intensity ranged from 131 percent in Cachar to 155 percent in Goalpara.

It has been found that there has been increase in cropping intensity in the state as a response to population pressure. The districts that have relatively lower population pressure have shown relatively slower increase in cropping intensity. Cropping intensity is affected by the number of crops cultivated in a year; in a multi-cropping system the cropping intensity is likely to be higher.

3.6 Cropping Pattern

When there is population pressure, one can expect the area under food crops to go down as diversification is adopted especially from food crops to cash crops (Krishnaji, 1994). In Assam, the area under food grains has come down gradually over the years nonetheless the cropping pattern is still dominated by food grain production; and among the food grains; it is rice that dominates. Table 3.11 shows that there has been a steady fall in the area under food grains in the 30 years period of 1967 to 2007. Food grains constituted 75 percent of the gross cropped area in the period 1967-75 which fell to 68 percent in 2000-07.

Table 3.11: Percentage distribution of area under food grain crops and non-food grain crops in Assam, 1967-75 to 2000-07

Period	Food grains	Non-Food Grains	Total
1967-75	75.0	25.0	100
1975-83	74.0	26.0	100
1992-00	69.5	30.5	100
2000-07	67.6	32.4	100

Source: *Computed from Statistical Abstract of Assam, various issues; Statistical Hand Book of Assam, 2009; and Directorate of Economics and Statistics, Government of Assam.*

Table 3.12 shows the proportion of area under food grain crops across the districts. In the period 1969-72 to 2004-05, barring Nagaon, there has been a fall in the proportion of area under food grain crops in all the districts. In Nagaon, proportion of area under food grains had increased by 3 percentage points. Goalpara, Sibsagar, Lakhimpur, and Karbi-Anglong and N.C Hills have shown relatively higher fall in the proportion of area under food grains among all the districts. In Goalpara, it is the increase in the proportion of area under oilseeds, and vegetables and fruits which has led to fall in the proportion of area under food grains. In Lakhimpur and Sibsagar, the shift in cropping pattern has been towards tea. It can be recollected that Sibsagar has shown the slowest progress in cropping intensity during 1969-72 to 1999-02, this may be due to the proportion of area under tea showing a relatively higher increase; in 2006-07 (see Appendix, Tables B1, B2, and B3). In Karbi-Anglong and N.C Hills, the proportion of area

under condiments and spices, vegetables and fruits and others category [5] has shown a significant increase (10 percent points).

Table 3.12: Changes in gross cropped area under food grains across the districts, (in percent)

Districts	1969-72	1979-82	2004-07
Cachar	78.7	77.7	71.3
Goalpara	78.7	79.7	70.1
Kamrup	79.5	78.7	71.7
Darrang	70.4	67.7	65.8
Nagaon	70.3	72.2	73.3
Sibsagar	70.3	66.0	61.1
Lakhimpur	69.4	65.4	57.9
K.A and N.C Hills	75.8	77.0	65.8
Assam	74.5	73.1	67.0
C.V	6.0	8.2	8.2

Source: *Computed from Directorate of Economics and Statistics, Government of India.*

In order to understand the magnitude of changes in cropping pattern, the standard measure that is often used, namely the Herfindhal Index (HI) has been estimated (Sharma, 2005). It is computed by taking the sum of the squares of acreage proportion of each crop in the gross cropped area, as shown in the formula:

$$HI = \sum_{i=0}^{n} P_i^2$$

Where n is the total number of crops and P_i represents the acreage proportion of the i^{th} crop in the gross cropped area. With the increase in diversification, HI would decrease. It is bounded by '0' (complete diversification) and '1' (complete specialisation).

Table 3.13 shows HI for three time points. For the state as a whole the HI shows a gradual fall indicating an increase in crop diversification in the state. Crop diversification is observed for all districts in 2006-07 compared to 1970-71, as reflected by the fall in HI. For the districts of Goalpara, Nagaon and the hill district, crop diversification is seen only after 1980-81. In 2006-07, it is found that crop diversification is higher in the districts of Lakhimpur, Sibsagar and Darrang and lower in Cachar and Goalpara.

[5] Others include non- Food Crops such as Dyes and Tanning Materials, Drugs, Narcotics and Plantation crops excluding Tea, Fodder, Green Manure Crops etc.

Table 3.13: Crop diversification indices (Herfindhal) across districts, 1970-71 to 2006-07

District	1970-71	1980-81	2006-07
Cachar	0.643	0.624	0.510
Goalpara	0.634	0.658	0.500
Kamrup	0.646	0.638	0.489
Darrang	0.509	0.483	0.370
Nagaon	0.535	0.534	0.450
Sibsagar	0.546	0.461	0.371
Lakhimpur	0.522	0.461	0.384
Karbi-Anglong and N.C Hills	0.597	0.598	0.443
Assam	0.576	0.551	0.428

Source: *Computed from Directorate of Economics and Statistics, Government of India.*

3.7 Labour Intensification

As the population grows creating pressure on land, the labour per unit of land employed will increase. Such a response is plausible in a land-scarce and small holders' economy of Assam. Labour intensification as measured by agricultural workers per hectare of land had increased in the state during 1974-75 to 2001-02; the increase had been from less than one person in 1974-75 to almost two persons in 2001-02 (Table 3.14).

All the districts had experienced increase in labour intensity during 1974-75 to 2001-02. The increase in labour intensity (number of agricultural workers per hectare) during this period had been found higher for Lakhimpur (1.49), Goalpara (1.07) and Karbi-Anglong and N.C Hills (0.95). The increase had been lower in Sibsagar (0.88), Kamrup (0.71), and Cachar (0.43)

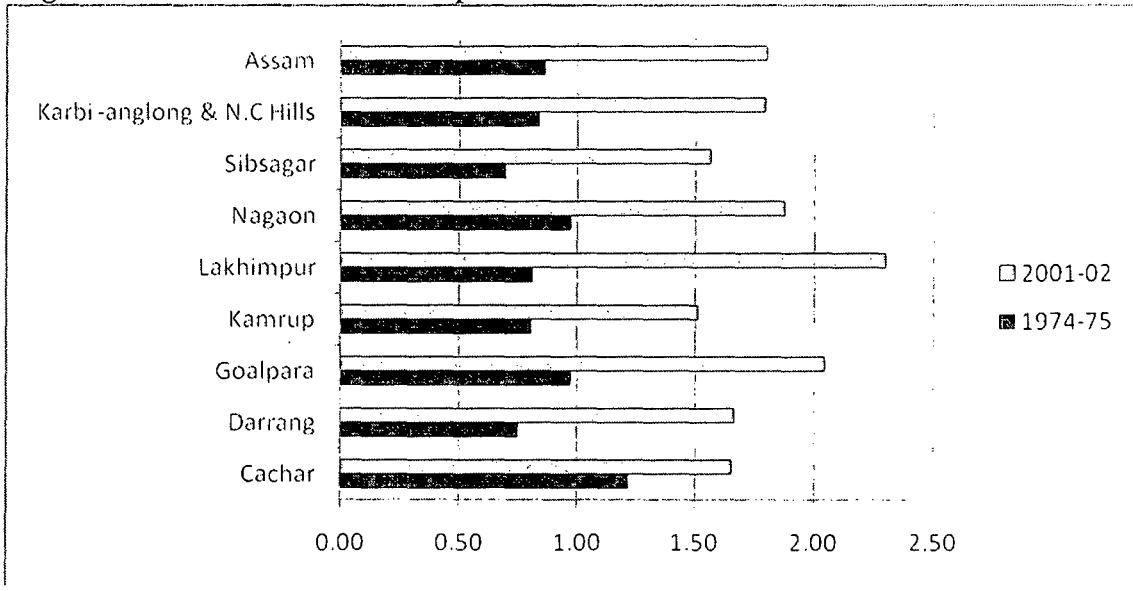
Table 3.14: Number of agricultural workers per hectare of net sown area across districts, 1974-75 and 2001-02

Districts/Year	1974-75	2001-02
Cachar	1.22	1.65
Darrang	0.75	1.66
Goalpara	0.97	2.04
Kamrup	0.80	1.51
Lakhimpur	0.81	2.30
Nagaon	0.97	1.88
Sibsagar	0.69	1.57
Karbi-Anglong and N.C Hills	0.84	1.79
C.V (%)	18.92	14.76
Assam	0.87	1.80

Source: *Computed from Census Reports, 1971 and 2001; Statistical Abstract of Assam, 1978; and Directorate of Economics and Statistics, Government of Assam.*

In 2001-02, labour intensity has been relatively higher in Lakhimpur, Goalpara, and Nagaon and the lower in Sibsagar and Kamrup (Table 3.14). Lakhimpur is the only district that showed an increase in the proportion of agricultural workers in the period 1971-2001 which explains its higher labour intensity (Table 3.3). In Sibsagar, the fall in the area under cultivation might have absorbed the displaced agricultural workers in the arable land resulting in sharp increase in labour intensity.

Figure 3.2: Number of workers per hectare of net sown area, 1974-75 and 2001-02



Source: *Same as Table 3.14.*

3.8 Adoption of Technology

The process of intensification is determined by the kind of inputs adopted in agriculture. If agriculture is traditional and less input intensive then agricultural intensification will naturally be low. In the following is discussed the adoption of mechanical and bio-chemical technology in Assam. The bio-chemical technology is discussed in reference to the new agricultural strategy that was introduced during the Green Revolution in the mid 1960s.

3.8.1 Mechanical Technology in Assam Agriculture

Table 3.15 shows that traditional implements are still adopted on a large scale which requires human and animal labour for operation. The number of operated implements shows an increase in 1988-2003 but adoption has been slow. A

comparison of the number of pump sets and tractors in Assam agriculture with that of the all-India average over the years (Table 3.16) reflects the sluggish rate of mechanization in the state.

Table 3.15: Agricultural implements and machinery in Assam, 1988 and 2003 (in numbers)

Sr. No.	Item/Year	1988	2003
1	Hand Operated implements *	39780	19584
2	Animal Operated Implements		
	a) Wooden Plough	**1738872**	**1546825**
	b)Steel Plough	9345	nil
	c)Seed cum fertilizer drill and Seed drill	591	2246
	d)Leveler	319806	1730489
	e)Wet land paddler	-	263992
	f)Animal Cart	**79459**	**49666**
3	Power Operated Implements		
	a)Power operated Sprayer/Duster	420	1349
	b)Diesel engine pump set	3786	572
	c)Electric pump set	498	94
	d) Agricultural power tillers	**720**	**13218**
	e)Tractors	**738**	**1468**
	f) Seed cum fertilizer drill	23	90
	g)Leveler	**2987**	**18151**
	h) Combine Harvester **	-	283
	i) Power Operated Thresher	125	476

Source: *Computed from Statistical Abstract of Assam, 2000 and 2005.*

Note: *includes seed cum fertilizer drill; seed drill; chaft cutter; wheel hoe; sprayer and duster; rice planter; and thresher.

**includes tractor operated and self propelled.

As against 167 tractors employed (per '0000 hectares) in the country as a whole, only 5 tractors were employed in Assam. The number of pump sets (per '000 hectares) in 2003 had been non-existent in the state while the same for the country was 111. Less intensive use of land explains such low adoption of mechanical technology in the state.

Table 3.16: Number of tractors and pump sets in Assam Agriculture, 1962 to 2003

	Tractors (Number/'0000 ha.)			
Year	1962	1982	1992	2003
Assam	3	1	3	5
All-India	3	37	86	167
	Pump sets (Number/000 ha.)			
Year	1962	1982	1992	2003
Assam	0	1	2	0
All-India	5	49	79	111

Source: *Bhalla and Singh, 2010.*

3.8.2 Green Revolution Technology in Assam: Spread and Effect

The adoption of bio-chemical technology is discussed in terms of the green revolution technology that is HYV seeds, fertilizer, and irrigation. But before discussing the adoption and spread, the effect of green revolution in Assam agriculture is discussed.

Effect of Green Revolution

Prior to the advent of the green revolution, it was found that on an average the yields were very low. The low yields made area the sole contributor of growth in output in the country. During 1949-50 to 1964-65, area growth contributed 50.16 percent to output growth while that of yield was only 38.41 percent (Bhalla and Singh, 2009). However, in the post green revolution with the introduction of the new agricultural technology, yield became the main source of growth contributing 85.2 percent to the growth in output while area contributed only 14.4 percent during the period 1962-65 to 2003-06 (Bhalla and Singh, 2009). In Assam, the growth in productivity has been sluggish (see Appendix, Table B6). Table 3.17 shows the yield growth in Assam for rice and wheat with the corresponding all-India yield growth rates. The yield growth rates in both the crops have remained much lower in Assam than the national average. Also the yield growth rates show virtually no improvement in the 1970s and 1980s even after the introduction of the Green Revolution Technology. The yield growth rate of wheat however, showed a significant improvement in the decade of the 1970-80 and had been higher than the all-India average. Barring this period, the growth has remained lower than the national average; growth in yield has indeed fallen sharply in the subsequent periods.

Table 3.17: Growth in productivity of rice and wheat, 1960-70 to 2000-09

	Rice		Wheat	
Year	Assam	all-India	Assam	All-India
1960-70	0.16	0.36	-4.02	4.36
1970-80	0.16	1.01	2.30	1.85
1980-90	-0.92	3.14	-1.62	3.06
1990-2000	1.07	1.33	-0.83	1.80
2000-09	-0.31	1.88	0.01	0.61

Source: *Computed from Directorate of Economics and Statistics, Government of Assam and Government of India.*

Table 3.18 gives the estimated yield gap for four important crops in Assam during the last five decades. These crops namely rice, wheat, rape and mustard and sugarcane comprise nearly 75 percent of the total cropped area in the state. Clearly, the differences in yield per hectare in these crops between the state and all-India have shown increases over the years. In the case of rice, the yield gap increased from 46 kg per hectare in 1961-71 to 567 kg per hectare in 2001-09. The yield per hectare in rice was only 4.6 percent short of the all-India rice yield in 1961-71; it increased to 27.5 percent in 2001-09. Among the four crops the yield gap is found relatively higher in wheat. In 2001-09, the relative yield gap in wheat amounted to 58 percent. In case of rapeseed and mustard and sugarcane also, the difference in yield per hectare has been increasing over the years. The yield gap has shown sharper increase in the last two decades; the yield rates in Assam for these two crops have fallen below the all-India yield rates by more than 40 percent. The inference that can be drawn from the analysis of the productivity growth and productivity gap in Assam is that the Green Revolution has had virtually no impact on Assam agriculture.

Table 3.18: Productivity gaps of selected crops in Assam, 1961-71 to 2001-09

Year	Rice		Wheat		Rapeseed and Mustard		Sugarcane	
	YG (kg)	RYG (%)	YG (kg)	RYG (%)	YG (kg)	RYG (%)	YG (kg)	RYG (%)
1961-71	46	4.6	273	27.8	51	11.1	7534	16.8
1971-81	173	14.7	232	16.5	79	15.5	15280	29.6
1981-91	379	25.1	867	43.7	257	35.1	17041	28.4
1991-01	503	27.0	1305	51.4	375	42.4	287953	42.1
2001-09	567	27.5	1566	57.7	539	51.3	222012	42.3

Source: *Computed from Directorate of Economics and Statistics, Government of Assam and India.*
Note: Yield Gap (YG) = (All India average yield per hectare) - (yield per hectare in Assam)
Relative Yield Gap (RYG) = (Yield Gap/All India average yield per hectare) * 100.

Spread of Green Revolution Technology in Assam

The Green Revolution Technology that was introduced in the mid 1960s in India constitutes three principal components that were of complementary nature. These inputs were the use of High Yielding Variety seeds and application of chemical fertilizers together with a water control system. In the following we analyse the adoption of HYV seeds, fertilizers and the spread of irrigation in the state and across the districts in the post-green revolution period. The area under

HYV of rice is only considered as rice is the principal crop of the state which constitutes nearly 74 percent of the gross cropped area in the state (see Appendix Table B7).

3.8.2.1 High Yielding Varieties

As in the foregoing sections, we have seen that there is no further scope for more land to be put under cultivation wherein comes the importance of bio-chemical technology (viz., high yielding varieties or genetically modified crop varieties) to increase the productivity of crops which, in-turn, drives the output growth in the agriculture. It is in this context that we have viewed the adoption of HYVs for the state of Assam as a whole as well as for the districts along with other inputs.

Table 3.19: Area under HYV of rice, 1969-70 to 2007-08

Year	1969-70	1979-80	1989-90	1999-2000	2006-07	2007-08
Area under HYV (in '000 hectares)	99.85	458.23	953.65	1401.08	1345.08	1395.55
Percentage of Total Rice area	5.07	20.80	38.58	52.95	61.45	60.05

Source: *Computed from Statistical Abstract of Assam, 1978; 1990; 2000; 2005; and Statistical Hand Book of Assam, 2009.*

It is seen that the adoption of HYVs shows a steady improvement over the years. In 1969-70 only 5 percent of the total rice area was under HYV. In 2007-08, the HYVs have been adopted in 60 percent of the area under rice.

Table 3.20: District-wise percentage of the total rice area under HYV of rice

District/Year	1987-88*	2006-07	2007-08
Cachar	48.69	50.10	49.45
Darrang	45.09	62.87	59.90
Goalpara	38.70	64.59	64.38
Kamrup	30.16	65.94	67.66
Lakhimpur	45.40	52.82	48.31
Nagaon	49.11	68.61	65.80
Sibsagar	42.31	58.99	54.90
Karbi-Anglong and N.C. Hills	41.58	67.31	67.41
Assam	41.38	61.41	60.05
C.V (%)	14.42	11.13	13.27

Source: Computed from Directorate of economics and Statistics; and Statistical Abstract of Assam, 1990

Note: *computed taking the total area of rice for the year 1988-89

The adoption of HYV across the districts and over time indicates that there has been an increase in the area under HYV for all districts. Goalpara, Kamrup,

Nagaon, and the hill district show higher increase in the area under HYV of paddy during 1987-88 to 2007-08 (Table 3.20).

In 1987-88, Nagaon, Cachar, Darrang and Lakhimpur had relatively higher levels of adoption of HYVs and Kamrup and Goalpara had lower levels of adoption. In 2007-08, Goalpara, Kamrup, Nagaon, and the hill district became the leading districts in the adoption of HYVs. The proportion of area under HYVs in the total cropped area ranged from the highest of 67 percent in Kamrup to the lowest of 48 percent in Lakhimpur. Kamrup showed a rapid increase in the area under HYV as it is the fast urbanizing district where there is better access to market facilities for the purchase of improved variety of seeds. Lakhimpur being flood prone shows relatively lower spread of HYVs as farmers are reluctant to adopt them because being dwarf, they get submerged easily and cannot withstand floods. To avoid losses the local varieties are preferred though the yields are lower.

3.8.2.2 Fertilizer consumption

It is clear from Table 3.21 that fertilizer consumption in Assam had been gradually increasing with rapid improvement in recent years. The increase has been from 1.73 kg per hectare in 1975-79 to 51.24 kg per hectare in 2004-08. Despite such increases, consumption of fertilizer in Assam is much lower than the all-India average. Table 3.21 shows that the difference in fertilizer consumption between Assam and all-India has been increasing over the years; the difference was 22 kg in 1975-79 that increased to 56 kg in 2004-08.

Table 3.21: Consumption of fertilizers (N+P+K) in Assam agriculture (Kg per hectare)

Year	Assam	All-India	Difference
1	2	3	col(3)-col(2)
1975-79	1.73	22.14	20.41
1979-83	2.97	32.73	29.76
1992-96	9.87	70.70	60.83
1996-2000	19.69	88.94	69.25
2000-04	41.10	90.57	49.47
2004-08	51.24	107.23	55.99

Source: *Computed from Directorate of Economics and Statistics, Government of Assam; and Statistical Abstract of Assam, various issues.*

Across the districts, there is wide variation in fertilizer consumption (Table 3.22). In 1988-89, the consumption was highest in Sibsagar (11 kg per hectare) and the lowest in Karbi-Anglong and N.C. Hills (2.13 kg per hectare). In 2007-08, the consumption was highest in Nagaon (109.4 kg per hectare) and the lowest in Karbi-Anglong and N.C. Hills (8.7 kg per hectare). During this period Goalpara, Kamrup, and Nagaon have shown higher increases and Sibsagar, Lakhimpur, and K.A and N.C hills have shown lower increases in fertilizer consumption

Table 3.22: Fertilizer consumption across districts, 1988-89 to 2007-08 (Kg per hectare)

Districts/Year	1988-89*	1997-99	2006-07	2007-08
Cachar	10.62	17.40	46.88	42.47
Darrang	6.84	16.25	37.15	37.89
Goalpara	7.20	16.13	92.41	73.06
Kamrup	5.98	18.99	67.97	94.98
Lakhimpur	5.00	11.23	23.93	35.86
Nagaon	9.29	37.93	104.80	109.41
Sibsagar	11.14	14.56	26.31	28.84
Karbi-Anglong and N.C. Hills	2.13	1.47	6.69	8.68
C.V (%)	41.46	60.70	68.28	64.74
Assam	7.41	17.84	54.12	58.43

Source: *Computed from Statistical Abstract of Assam; and Directorate of Economics and Statistics, Government of Assam and Government of India.*

Note: *Figures are computed taking the gross cropped area for 1981-82.

3.8.2.3 Irrigation

Clearly, irrigation played an insignificant role in Assam agriculture. Barely 8 percent of the net sown area was irrigated in the state in 2007 (Table 3.24). Table 3.23 shows that against 40 percent of the total cropped area under irrigation for the country as a whole, only 5 percent of the total cropped area is irrigated in the state. While the level of irrigation for the country has been steadily increasing over the last four decades, Assam shows a precipitous fall.

Table 3.23: Percentage of total crop area irrigated in Assam, 1962-65 to 2003-06

	Percentage of the Total Cropped Area Irrigated			
Year	1962-65	1980-83	1990-93	2003-06
Assam	20	17	15	5
All-India	19	29	36	41

Source: *Bhalla and Singh, 2010.*

In Table 3.24 is shown the proportion of the net sown area irrigated across the districts in Assam for the year 2007. There is wide variation across the districts

ranging from less than one percent in Cachar to over 20 percent in Nagaon and K.A and N.C. Hills.

Table 3.24: Distribution of the net area irrigated across districts, 2007

Districts	NSA (in ha.)	Net Area Irrigated (in ha)	Percentage of the NSA Irrigated
Cachar	96828	115	0.12
Darrang	129819	16465	12.68
Goalpara	213836	12817	5.99
Kamrup	140354	10311	7.35
Lakhimpur	203217	1047	0.52
Nagaon	71335	14926	20.92
Sibsagar	67404	366	0.54
Karbi-Anglong and N.C. Hills	87512	19718	22.53
Assam	1010305	75765	7.50

Source: *Computed from Statistical Hand Book of Assam, 2009.*

Darrang, Nagaon, Kamrup, Goalpara, and Karbi-Anglong and N.C Hills report relatively higher level of irrigation. The districts with better irrigation also show relatively higher adoption of HYVs of paddy and more fertilizer consumption indicating the complementary nature of the three inputs. It is to be noted that the districts which have relatively high population pressure are among the well-irrigated districts of the state. Thus, cropping intensities are also found to be relatively higher in these districts. Lakhimpur, Sibsagar, and Cachar have lower proportion of area under irrigation. Low irrigation indeed explains the lower cropping intensities in Cachar and Sibsagar. In Lakhimpur, though irrigation is low cropping intensity is high. This may be due to the fact that it is the most labour intensified district in the state; employing more labour per unit of land might have enabled the cultivation of land more number of times in a year.

3.9 Conclusion

Over a period of four decades (mid 1960s to late 2000s), the peasant economy of Assam has notably responded to increasing population pressure by way of extending area under cultivation, increasing cropping intensity and by labour intensification. While a shift in cropping pattern has been observed, it has been rather slow with rice continuing to be the dominant crop. The HYVs and fertilizers have also been adopted to intensify cultivation over time. But

intensifying cultivation through increasing cropping intensity, labour intensity, and adoption of HYVs and fertilizers has not raised production and yield in agriculture over the long stretch; in fact, production and yield has shown a declining trend in recent years (see Appendix, Tables B4, B5 and B6). One of the main reasons for this depressing scenario is the state of poor irrigation development in Assam.

Increasing population pressure has induced the peasants to take all possible initiatives within their means to promote growth in agriculture in Assam. However, they are constrained in their efforts to further intensify the use of land because of lack of a proper water control system. Irrigation infrastructure or water control system cannot be developed solely by individual initiative but has to be undertaken by public/government initiative which is found lacking in the state. The next chapter therefore examines the role of the government and what have been its efforts to develop agriculture in Assam.

Appendix B

Table B1: Percentage distribution of area under various crops across districts in Assam, 1970-71

District	Food grain crops	Sugar cane	Condiments and Spices	Fruit and Vegetable including Root crops	Total Oilseeds	Fibres	Tea	Others	TCA
Cachar	79.1	1.6	1.7	3.7	0.7	0.4	12.0	0.8	100
Goalpara	78.8	0.5	1.3	3.8	6.5	7.9	0.4	0.8	100
Kamrup	79.8	0.7	1.5	5.1	6.0	5.1	0.4	1.3	100
Darrang	70.1	0.7	2.0	4.5	7.1	6.1	8.2	1.3	100
Nagaon	71.6	1.0	1.1	3.4	8.0	11.9	2.0	1.0	100
Sibsagar	72.2	2.6	1.5	3.8	4.1	0.6	14.2	0.9	100
Lakhimpur	70.0	1.0	1.7	4.8	4.2	1.0	16.4	0.9	100
Karbi-Anglong and N.C Hills	76.4	2.9	1.5	7.3	5.7	5.6	-	0.6	100
Assam	75.1	1.1	1.5	4.3	5.5	5.0	6.4	1.0	100

Source: *Computed from Directorate of Economics and Statistics, Government of India.*

Table B2: Percentage distribution of area under various crops across districts in Assam, 1980-81

District	Food grain crops	Sugarcane	Condiments and Spices	Fruits and Vegetables including Root crops	Total Oilseeds	Fibres	Tea	Others	TCA
Cachar	78.0	2.3	2.4	4.5	0.9	0.3	11.2	0.4	100
Goalpara	80.5	0.2	2.1	3.8	6.2	6.5	0.5	0.3	100
Kamrup	79.3	0.5	2.7	5.7	6.0	4.2	0.5	1.1	100
Darrang	68.1	1.0	3.2	6.3	7.1	4.9	7.8	1.7	100
Nagaon	71.9	2.3	1.9	3.7	9.5	7.2	1.7	1.8	100
Sibsagar	65.9	2.7	2.2	4.8	5.5	0.6	13.2	5.0	100
Lakhimpur	65.6	1.5	2.4	5.6	8.4	0.7	14.3	1.6	100
Karbi-Anglong and N.C Hills	76.4	3.2	1.8	4.2	10.2	3.0	0.8	0.4	100
Assam	73.4	1.4	2.4	4.9	6.6	3.7	5.9	1.6	100

Source: *Computed from Directorate of Economics and Statistics, Government of India.*

Table B3: Percentage Distribution of area under various crops across districts in Assam, 2006-2007

District	Food grain crops	Sugarcane	Condiments and Spices	Fruits and Vegetables including Root crops	Total Oilseeds	Fibres	Tea	Others	TCA
Cachar	69.6	0.3	1.5	10.7	1.1	0.1	9.7	7.0	100
Goalpara	69.1	0.1	2.5	10.0	9.2	3.8	0.7	4.6	100
Kamrup	68.2	0.2	2.6	10.3	8.2	2.0	0.6	7.8	100
Darrang	57.8	0.7	2.4	10.3	10.5	2.3	8.4	7.6	100
Nagaon	65.1	1.7	1.9	6.5	7.3	3.0	2.2	12.4	100
Sibsagar	56.0	0.8	1.5	10.1	3.4	0.2	20	8.0	100
Lakhimpur	57.0	0.1	1.4	8.0	7.1	0.1	21.2	5.1	100
Karbi-Anglong and N.C Hills	64.7	3.7	3.0	9.1	9.9	1.3	2.6	5.8	100
Assam	63.3	0.7	2.1	9.4	7.3	1.7	8.3	7.1	100

Source: *Computed from Directorate of Economics and Statistics, Government of India.*

Table B4: Trend growth rate in area of some principal crops (in percent)

Year/Crop	Rice	Wheat	Maize	Pulses	Total Oilseeds	Sugarcane
1960-70	1.48	8.57	5.54	2.68	1.33	1.93
1970-80	1.53	8.70	8.85	1.38	3.01	4.72
1980-90	0.75	0.14	-1.77	0.64	4.58	-2.40
1990-2000	0.01	0.83	0.05	2.17	0.92	-2.97
2000-09	-1.43	-4.53	-1.87	-1.33	-3.57	0.41

Source: *Computed from Statistical Abstract of Assam, various years.*

Table B5: Trend growth rate in output of some principal crops (in percent)

Year/Crop	Rice	Wheat	Maize	Pulses	Total Oilseeds	Sugarcane
1960-70	1.67	4.30	8.49	2.75	3.38	2.66
1970-80	0.72	10.84	10.10	0.99	2.38	3.43
1980-90	1.61	-1.34	-1.81	1.17	4.55	-1.14
1990-2000	1.05	-0.06	1.20	4.98	0.94	-2.98
2000-09	-1.60	-3.78	-1.32	-0.72	-4.24	0.83

Source: *Computed from Statistical Abstract of Assam, various years.*

Table B6: Trend growth rate in yield of some principal crops (in percent)

Year/Crop	Rice	Wheat	Maize	Pulses	Total Oilseeds	Sugarcane
1960-70	0.16	-4.02	0.66	0.71	1.02	0.73
1970-80	0.16	2.30	1.06	-0.36	-0.59	-1.28
1980-90	-0.92	-1.62	0.46	0.68	-0.03	1.26
1990-2000	1.07	-0.83	1.65	2.83	0.00	0.01
2000-09	-0.31	0.01	0.71	0.56	-0.68	0.60

Source: *Computed from Statistical Abstract of Assam, various years.*

Table B7: Distribution of gross cropped area among different crops, 2007-08

Crop	Proportion of GCA (in percent)
Rice	**73.64**
Wheat	0.57
Maize	1.77
Other cereals and small millets	0.22
Pulses	3.58
Oilseeds	8.75
Fibres	2.09
Fruits and Vegetables	5.13
Miscellaneous crops	4.25
All crops	100

Source: *Statistical Hand Book, Assam 2009.*

Note: Here the gross cropped area does not include the area under tea.

CHAPTER IV

PLAN STRATEGIES, INVESTMENT, AND OUTCOME IN ASSAM AGRICULTURE

4.1 Introduction

In the previous chapter it was found that the agrarian economy of Assam had responded by adopting a number of strategies to intensify cultivation in the context of increasing population pressure. There had been improvements in cropping intensity, shifts in cropping pattern, labour intensification, and increase in adoption of High Yielding Variety (HYV) seeds and chemical fertilizers. However, these agricultural changes were not able to raise agricultural output due to the want of irrigation infrastructure in the state. Development of irrigation is an exogenous factor that has to do more with the economic policies of the government than with population pressure. The present chapter builds on the hypothesis that agricultural changes beyond a certain threshold are conditional on government facilitating infrastructural development.

Planned economic development in Assam began in 1951 along with the start of the national Five Year Plans. The Five Year Plans are the major vehicles for channelling public investment in to rural infrastructure for agricultural growth. The growth and development in agriculture is determined by the amount and sectoral allocation of public investment in agriculture. Keeping these aspects in view, the present chapter analyses the development planning efforts of the government to enhance agricultural growth in Assam.

The chapter is divided into five sections. The next section examines the plan-wise focus and strategy adopted to attain higher growth in agriculture in Assam .This section is prepared in reference to the various Draft Plan Documents of Assam published by the Planning and Development Department. However, due to non-accessibility of the plan documents of Assam for the Ninth and the Tenth Five Year Plan, the focus and strategy of these two plans have not been covered. The

third section analyses the outlay/expenditure in agriculture during the Five Year Plan periods. The fourth section captures the progress of infrastructural facilities in Assam that are a pre-requisite for higher agricultural growth. The fifth section examines the government's role in bringing about institutional changes with focus on the consolidation of fragmented holdings in the state. The final section concludes the present chapter.

4.2 Assam Agriculture through the Five Year Plans: Focus and Strategy

This section presents the strategies adopted for agricultural development in each Five Year Plan starting from the First to the Eleventh Five Year Plan. The commonalities and differences in approaches of the Plans have been elucidated. The section ends with a brief sketch of the agricultural development strategy as evolved through the Five Year Plans.

4.2.1 First Five Year Plan (1951-56)

The objectives framed for the Five Year Plans in Assam have not been very different from that of the objectives of the National Five Year Plans. The First Five Year Plan (1951-56), first and foremost, focused on removing the shortage and disequilibria in the supply of food and industrial raw materials that was a backlog of the world war; and secondly, focused on fulfilling the need of a few most essential items of development in which the state was lacking till then. With these objectives in view, importance was laid on items like agricultural production, setting up and development of communication in the rural areas and inaccessible hills. Unlike the First National Five Year Plan, the State Five Year Plan did not lay top priority on agriculture. The First Plan of Assam followed different priorities with social services receiving the highest priority followed by irrigation and power; agriculture and community development occupied the third place in the state's plan.

The main object of the First Five Year Plan (1951-56) of Assam was to increase food production to tide over the difficulties of food shortages, then existing in an

acute form in the economy (Government of Assam, 1977). The food production was to be increased by bringing more cultivated area under irrigation and also by a process of land reclamation. There were schemes taken up for minor and pump irrigation. For land reclamation and land development, a mechanized cultivation scheme was undertaken primarily to reclaim jungle land and thereby extend cultivation to these lands. To achieve higher yield, emphasis was laid on production and distribution of improved seeds. The production of nucleus seeds of improved varieties was to be carried out in government farms and multiplied and distributed through the registered private growers. However, there was no specific focus or allotment for the intensification of agricultural research in the state in the First Plan (Government of Assam, undated).

4.2.2 Second Five Year Plan (1956-61)

The Second Five Year Plan (1956-61) of did not mention agriculture among the basic objectives of development. It was more or less a continuation of the development efforts of the First Plan. The objectives laid in the Second plan document of Assam were the same as those in the national Second Five Year Plan. The state did not formulate any specific objectives taking into account the specificities of the regional economy.

4.2.3 Third Five Year Plan (1956-61)

The Third Five Year Plan (1961-66) recognized a number of factors which were peculiar to the state and were not pronounced in other parts of the country. These factors relate to the unstable political situation (brought about by partition and insurgency) and the recurrent floods and erosion that disrupted the development process in the economy. The Plan stated that Assam started with initial handicaps due to its geographical location and therefore no industrial development had taken place in the post-war decade. Assam had been deprived of the benefit of both Government investments and private investments. There was virtually no private investment in the state in the First and the Second Plan. Planning for economic development was sought to be initiated in the Third Five

Year Plan taking full account of the problems peculiar to the state keeping the overall national objectives in view (Government of Assam, 1960).

Given that per capita income in the state was low at Rupees 276 in 1958-59 (compared to Rupees 294 for the country as a whole) but the cost of living the highest in the country (Government of Assam, 1960), the state formulated its objectives keeping this issue at the forefront. Along with the principal aim to achieve self-sufficiency in food-grains and increase agricultural production to meet the requirements of industry and exports, the Third Plan stated the need for stabilizing the food situation and to keep the cost of living at reasonable levels, at the same time, maintaining proper parity between agricultural prices and prices of non-agricultural goods (Government of Assam, 1960).

In the Third plan the area development approach was adopted in the state. Two area development projects were undertaken, namely, Intensive Agricultural District Programme (IADP) and Intensive Agricultural Area Programme (IAAP). Under the projects the activities that had been taken up in the earlier two plans were intensified. Use of fertilizers, pesticides, and adoption of improved methods such as the Japanese Method of Cultivation that was started in the First Plan, Double Cropping, and Mixed Farming were sought to be made more accessible. It was during the Third plan period that major/medium irrigation projects were started in the state.

4.2.4 Fourth Five Year Plan (1969-74)

The Fourth Five Year Plan (1969-74) laid objectives considering both the national objectives of the Fourth Plan, level of economy of Assam and the various problems of growth peculiar to the state. It mentioned agriculture in its basic objectives. The Fourth Plan was formulated with two main objectives; first, to create conditions conducive to maximization of agricultural production and to achieve a growth of 5 percent per annum in the agricultural sector; and second, to provide for participation by all including small farmers and landless agricultural labourers in adopting improved agricultural practices. The Target

Group Approach was initiated during the Fourth Plan for the development of the small, marginal, and landless cultivators as it was realized that the benefits of the agricultural development programmes so far were available to comparatively affluent sections of the cultivators.

In the Fourth Plan, highest priority has been accorded to agricultural production and its stabilization and diversification. With regard to the strategy of development, the plan called for an intensive agriculture where the role of technology was recognized as a major input. The plan mainly aimed at progressive increase of area under High Yielding Variety of seeds; conversion of traditional monoculture system into a multiple cropping one and increasing cropping intensity; increase use of fertilizers and strengthening the distribution system; and increase of irrigation potential from various sources. The Plan included programmes for rational land use, improved cropping pattern, improved seeds, plant protection, irrigation, use of fertilizers, increased credit facilities, flood control measures etc.

4.2.5 Fifth Five Year Plan (1974-79)

Though the Third and the Fourth plans have claimed to have kept in view the peculiar problems of the state, the stated objectives of the plan were not significantly different from the national objectives. It is in the Fifth Plan for the first time that the development planners of the state framed objectives taking due note of the socio-economic reality of the state and the problems peculiar to the region. As such, development of a proper irrigation and flood control system was proposed as one of the objectives, given the recurrence of droughts and floods in the state. It was felt that self-reliance in the matter of food-production and basic consumer goods must be attained during this plan period through diversification of agriculture and by setting up consumer goods industries.

The objectives of the Fifth Five Year Plan were not only to increase the production of food grains but also to increase production of non-food grains such as jute, oilseeds, potatoes and leafy vegetables and of fruits specially pine-apples,

citrus fruits and banana. Increasing the area under irrigation was also included in the main objectives of the plan. The strategies for stepping up agricultural production in the fifth plan were greater adoption of HYV seeds, fertilizers and pesticides; multiple cropping and also a change in cropping pattern especially in the flood affected areas to eliminate too much dependence on flood prone crops. Thus, raising the cropping intensity through intensive input usage was a major thrust area of the plan. The plan suggested a pattern of land-utilization that implied cropping intensity of 150 percent by 1978-79.

4.2.6 Sixth Five Year Plan (1980-85)

The Sixth Five Year Plan of Assam more or less accepted the basic objectives of the national Sixth Plan as prepared by the Planning Commission and as approved by the National Development Council; these are as follows:

(1) To generate maximum employment and income in the agricultural sector and to ensure that the benefits of investment reach the rural poor and backward sections of the society by increasing the area under multiple cropping, HYVs and efficient use of irrigation water and increasing farm productivity of small and marginal farmers.

(2) To achieve an annual growth rate of 8 percent.

(3) To overcome food deficit and to reduce dependence on outside sources in oilseeds and pulses. (4) To extend the area and productivity of principal cash crops thereby providing a base for agro-based industries.

(5) To adopt adaptive research and extensive field technology for increasing productivity and dissemination of the same to the farming community through a sound agricultural extension service.

(6) To develop organizations and conditions in co-operatives and private sectors favourable to large scale investment in agricultural land.

The major thrust areas to achieve higher agricultural production in the Sixth Plan were extension services and farmers training and an expanded development of irrigation through both minor and medium/major irrigation projects. The development strategy of the Sixth Plan was designed so as to benefit the farmers by exposing them to modern methods and inputs. Since most of the farmers are small with a low level of technology and investment capacity, this approach was expected to benefit mostly the small and marginal farmers. Institutional finance was prioritized during the sixth plan. 'Institutional Finance was to play a crucial role mainly by providing short term crop loan and medium and long term loans for development of horticulture, land development, construction of go-downs, markets, (particularly for establishment of regulated markets) etc. (Government of Assam, 1980).

4.2.7 Seventh Five Year Plan (1985-90)

Following the objectives of the Seventh national Five Year Plan, the state plan also aimed at achieving self-sufficiency in the production of food grains by raising the rate of growth of production in the agricultural sector. The Approach Paper of the State Seventh Five Year Plan (1985) estimated that the economy will grow at a rate little over 5 percent during the plan period and the agricultural sector at the rate of 4 percent. Agriculture, during this plan was accorded the third highest priority; power followed by irrigation and flood control got the top most priorities. During the Seventh Plan, the government introduced the system of decentralized planning by forming a sub-divisional Planning and Development Committee for preparing development plan relating to agriculture, minor irrigation and also other aspects of rural development at the village levels.

4.2.8 Eighth Five Year Plan (1992-97)

During the Eighth Five Year Plan expansion of irrigation and flood control continued to be the thrust area for raising agricultural production. Another thrust area to develop agriculture was rural electrification so as to increase consumption of power for agricultural purposes. Agriculture and allied activities received the

third highest priority in the eighth plan, and plan outlay under this head constituted 11 percent of the total outlay (Government of Assam, 1996).

During the Eighth Plan, increase in cropping intensity and multiple cropping was emphasised. It was aimed at raising the cropping intensity from 138 percent during the Seventh Plan to 150 percent, and this was sought to be achieved in the first year of the Eighth Plan itself (Government of Assam, 1992). "Multi-storied cropping" method had been emphasised whereby it was strategized to grow three consecutive crops on the same plot of land. To popularize this new cropping, a massive demonstration programme through extension services was planned.

The Special Sub-Project Scheme launched by the state was expected to connect larger number of village Panchayat level Co-operative Societies (GPSS) as distribution centres for different inputs to farmers. At the start of the Eighth Plan, the Scheme covered 300 GPSS and it aimed to connect another 200 in the first year of the plan (Government of Assam, 1992). The Eighth Plan aimed to expand the number of Agricultural growth centres from 39 to 51 in the beginning year of the Plan. These Agricultural growth centres were introduced by the government in every agricultural sub-division to provide all inputs to farmers at their door step. Besides the general focus to higher input usage (HYV seeds and fertilizers) and improved mechanization for multiple cropping of the earlier plans, the Eighth Plan laid special emphasis on the input delivery system and extension services.

4.2.9 Eleventh Five Year Plan (2007-2012)

The lack of accessibility to the plan documents inhibits us from taking up a connected account of the Ninth and the Tenth Five Year Plans. While discussion of the strategies for agricultural development in these plans cannot be carried out, the analysis of data pertaining to these periods is not precluded in the subsequent sections. Hence, discontinuity in this section does not get carried forward to later sections.

The Eleventh Plan envisaged that the benefits of development should trickle down to the poorer segments of the population. The main thrust area would be the rural economy which provides livelihood for 70 percent of the population in Assam. The Approach paper of the 11th plan has seen the agricultural sector as a focused area for development as it has enough potential for income and employment generation and to provide a wide spectrum of the benefits to the rural poor. The plan aimed at improving production strategy, input, credit, and marketing and provides insurance support to achieve at least a growth rate of 2 percent per annum during the 11th Five Year Plan. The National Draft Approach paper envisaged having a growth of 4 percent in agriculture during the Eleventh Plan but for Assam it was not possible to set such a target because of the negative growth in agriculture during the Tenth Plan.

To achieve the growth of 2 percent during the Eleventh Plan, emphasis has been laid on location specific research; high yielding varieties that suit the agro-climatic region and can withstand the floods are to be developed. Building of additional irrigation potential and renovating the existing major/medium irrigation projects has been emphasized. Consumption of fertilizers was sought to be increased to the national-average and if required by providing subsidy to the cultivators. The cropping intensity has to be increased to 300 percent to achieve the growth target. Another strategy adopted to develop agriculture in the Eleventh Plan is diversification of cropping pattern from low-value to high value crops such as sugarcane, oilseeds, fruits, vegetables, and other horticulture crops which have much potential for growth in the state. Mechanization has also been taken as a priority work during the plan.

So far as the strategies to attain higher agricultural growth were concerned, the early Five Year Plans aimed at bringing more area under cultivation by reclaiming and developing wasteland. Minor irrigation projects were undertaken to improve agricultural production. After the advent of the new agricultural strategy in 1965, the plans in Assam also laid emphasis on the use of HYV seeds,

increased use of fertilizers, irrigation facilities, multiple cropping, and adoption of improved agricultural practices including mechanization.

4.3 Allocation of Plan Expenditure under the Five Year Plans

Table 4.1 shows the per capita plan outlay in the various Five Year Plans in Assam with the corresponding national figures. It is found that the national per capita outlay has been higher than that of the state in all the plan periods and the difference between the two has been increasing. In the Third Plan, the ratio of the state to the national per capita plan outlay was nearly 57 percent. In the subsequent plans, the ratio had shown a gradual fall. Only in the Ninth Plan, the proportion of per capita plan outlay has shown an increase and is higher relative to all the other plan periods.

Table 4.1: Per capita plan outlay (in rupees) in Assam and all- India

Five Year Plans	Assam	All-India	Ratio of col. II and III (in percent)
I	II	III	IV
1st (1951-56)	27	-	-
2nd (1956-61)	72	-	-
3rd (1961-66)	111	195	56.9
4th (1969-74)	206	359	57.4
5th (1974-79)	324	719	45.1
6th (1980-85)	762	1779	42.8
7th (1985-90)	1164	3196	36.4
8th (1992-97)	2590	6343	40.8
9th (1997-02)	7871	10152	77.5
10th (2002-07)	7285	18027	40.4

Source: *Computed from Economic Survey of India, various years; and Planning Commission, Government of Assam.*

A similar picture emerges when per capita plan outlay in Agriculture and allied activities and Irrigation and Flood Control is considered (Table 4.2). In the Third Plan, the ratio of the state per capita outlay and the national per capita outlay was 56 percent that shows a gradual increase in the subsequent plan periods. However, the per capita plan outlay is still much lower than the all-India average.

Table 4.2: Per capita plan outlay (in rupees) in agriculture and allied activities and irrigation and flood control in Assam and All- India

Plans	Assam	All-India	Ratio of col. II and III (in percent)
I	II	III	IV
3rd (1961-66)	27	49	56.2
4th (1969-74)	66	84	79.0
5th (1974-79)	126	199	63.3
6th (1980-85)	212	326	65.2
7th (1985-90)	437	536	81.6
8th (1992-97)	571	804	71.0
9th (1997-02)	1000	1430	69.9

Source: *Computed from Economic Survey of India, various years; and Planning Commission, Government of Assam.*

During the First Five Year Plan the expenditure in agriculture and allied activities was Rupees 3.63 crore which constituted 17.7 percent of the total expenditure in the plan (Table 4.3). In the Second and the Third Plans there was a relative fall in the expenditure on agriculture. The proportion of expenditure on irrigation, power and flood control showed a significant upsurge in the Third Plan as compared to the earlier two plans.

In the 4th and the 5th plans, higher priority was accorded to agriculture and irrigation as is evident from Table 4.3. Expenditure on Agriculture and allied activities and Irrigation, Power and Flood Control constituted almost 60 percent of the total plan expenditure. In the 4th and the 5th plans, the proportion of expenditure in agriculture showed an increase from the previous plans. In the 6th plan though expenditure on Irrigation, Power and Flood control showed dominance, the proportion of expenditure on agriculture had fallen to 11.2 percent from 20.5 percent in the 5th plan. Thereafter, in the 7th, 8th, and the 9th plans, the proportion of expenditure on agriculture in the total has been hovering around 11 percent which had fallen further to only 5.9 percent in the 10th Five Year Plan.

The analysis of expenditure in the various plan periods from 1951-56 to 2002-07 indicates that agriculture has lost priority in the development of the state. However, there has been a continuous increase in the proportion of expenditure on Co-operation, Community Development, and Rural Development. During the

Table 4.3: Expenditure under different development heads, 1st Plan to 10th Plan in Assam (Rupees in crore)

Heads of Development	1st 1951-56	2nd 1956-61	3rd 1961-66	4th 1969-74	5th 1974-79	6th 1980-85	7th 1985-90	8th 1992-97	9th 1997-02	10th 2002-07*
Agriculture and allied activities	3.6 (17.7)	7.3 (13.5)	12.4 (9.4)	36.5 (18.4)	57.0 (20.5)	143.2 (11.2)	337.4 (13.2)	527.5 (10.9)	671.7 (11.3)	443.6 (5.9)
Co-operation, Community Development and Rural Development	1.2 (6.0)	7.6 (14)	10.1 (7.6)	7.66 (3.9)	6.71 (2.4)	84.5 (6.6)	206.1 (8.2)	378.5 (7.8)	446.9 (7.5)	1333.9 (17.8)
Irrigation, power, flood control	4.60 (22.4)	6.83 (12.5)	57.43 (43.4)	71.16 (35.9)	113.53 (40.8)	630.24 (49.2)	929.47 (36.3)	1134.3 (23.4)	965.5 (16.3)	851.2 (11.4)
Industries and Mining	0.10 (0.5)	4.4 (8.1)	8 (6.1)	16.9 (8.5)	15.19 (5.5)	59.0 (4.6)	139.8 (5.5)	235.1 (4.8)	217.7 (3.7)	234.0 (3.1)
Transport and Communication	3.49 (17)	6.55 (12)	7.5 (5.6)	25.9 (13.1)	29.7 (10.7)	104.4 (8.2)	191.9 (7.5)	399.1 (8.2)	627.2 (10.6)	856.1 (11.4)
Services-General, Economic, Miscellaneous	7.5 (36.6)	21.7 (39.9)	36.9 (27.9)	40.2 (20.2)	55.6 (20.1)	257.8 (20.2)	757.1 (29.6)	2178.7 (44.9)	3004.9 (50.6)	3760.1 (50.3)
Total	20.5 (100)	54.4 (100)	132.3 (100)	198.4 (100)	277.9 (100)	1279.0 (100)	2561.8 (100)	4853.3 (100)	5933.8 (100)	7478.8 (100)

Source: *Statistical Hand Book of Assam, various years;*
Statistical Abstract of Assam, various years; and
Five Year Plan document, Government of Assam.

Notes: 1) Figures in brackets indicate the proportion (in percent) of the total.
2) * Does not include the annual expenditure of the year 2006-07.

Tenth Five Year Plan, the expenditure on Co-operation constituted 7 percent of the total and that in Rural Development constituted 10 percent of the total plan expenditure. The level and proportion of expenditure under these heads had shown significant increase since the 6th plan. The expenditure increased from Rs 84.5 crore, constituting 6.6 percent of the total plan expenditure in the 6th plan to Rs 1333.9 crore (that constituted 17.8 percent) in the 10th plan. Developing these heads has an important bearing on the agrarian economy of the state.

4.3.1 Agriculture and Allied Activities

The highest proportion of plan expenditure under agriculture and allied activities went to agriculture proper; it constituted almost 50 percent of the total expenditure in most of the plans (Table 4.4). Under agriculture proper, the sub-heads are crop husbandry, assistance to small and marginal farmers, agricultural research and education and marketing and quality control. Within agriculture proper, it is crop husbandry or agricultural production which was accorded the top priority followed by research and education. The assistance to small and marginal farmers was included as one head in the 7th plan and allocation was made, however the sources do not report the actual expenditure under this head.

Agriculture proper had been the focus of the development plans in the states. However, if we look at the actual expenditure as a proportion of the plan outlay, we find that expenditure has fell short of the targeted outlay (Table 4.5); the 5th and the 6th plans in particular showed very low proportions. In the 5th plan only 58 percent of the outlay was spent which rose to 71 percent in the 6th plan. In recent plans, the proportion showed improvement: for example in the 8th plan nearly 94 percent of the outlay was spent.

Table 4.4: Actual expenditure under different heads of agriculture and allied activities, 4th plan to 9th plan (Rupees in lakh)

Heads of development	4th 1969-74	5th 1974-79	6th 1980-85	7th 1985-90	8th 1992-97	9th 1997-02
Crop Husbandry/ Agricultural Production	1045.32 (41.1)	1081.26 (28.33)	3268.09 (26.48)	8768.05 (31.85)	18911 (35.85)	24365 (36.42)
Assistance to SF/MF	-	-	-	-	-	-
Agricultural Research and Education	188.15 (7.4)	315.45 (8.27)	953.09 (7.72)	3094 (11.24)	7003 (13.28)	7447 (11.13)
Marketing and Quality Control	-	75.08 (1.97)	128.18 (1.04)	351.68 (1.28)	455 (0.86)	410 (0.61)
Agriculture Sub Total	**1233.47 (48.5)**	**1471.79 (38.57)**	**4349.36 (32.25)**	**12213.73 (44.36)**	**26369 (49.99)**	**32222 (48.16)**
Soil and Water Conservation	266.27 (10.47)	282.54 (7.4)	661.39 (5.36)	1243.66 (4.52)	2221 (4.21)	1372 (2.05)
Animal Husbandry	410.87 (16.15)	530.82 (13.91)	1285.68 (10.42)	2736.61 (9.94)	4154 (7.87)	7466 (11.16)
Dairy Development	75.58 (2.97)	73.7 (1.93)	307.93 (2.50)	842.11 (3.06)	1226 (2.32)	1156 (1.73)
Fisheries	102.92 (4.05)	216.13 (5.66)	369.43 (2.99)	1184.99 (4.30)	2789 (5.29)	4024 (6.01)
Forestry and Wild Life	-	487.79 (12.78)	2636.52 (21.37)	6566.16 (23.85)	11346 (21.51)	17092 (25.55)
Plantation	-	-	-	-	48 (0.09)	17 (0.03)
Food, Storage and Ware Housing	19.75 (0.78)	-	85 (0.69)	109 (0.40)	195 (0.37)	47 (0.07)
Co-operation	434.53 (17.08)	671.36 (17.59)	2560 (20.75)	2554.5 (9.28)	4312 (8.17)	3504 (5.24)
Agricultural Financial Institutions	-	82 (2.15)	85 0.69)	80 (0.29)	90 (0.17)	-
Total	2543.39 (100)	3816.13 (100)	12340.31 (100)	27530.76 (100)	52750 (100)	66900 (100)

Source: *Statistical Abstract of Assam, various years and Statistical Hand Book of Assam, various years.*
Note: Figures in brackets are proportion (in percentage) of the total actual expenditure.

Table 4.5: Actual expenditure as a proportion of the total outlay, 4th plan to 8th plan (in percent)

Heads of development	4th 1969-74	5th 1974-79	6th 1980-85	7th 1985-90	8th 1992-97
Crop Husbandry	94.2	64.4	66.0	87.7	90.9
Agricultural Research and Education	94.7	90.1	105.9	110.5	103.3
Marketing and Quality Control	-	51.8	51.3	100.5	85.4
Agriculture sub total	**94.3**	**58.3**	**71.3**	**82.4**	**93.7**
Soil and Water Conservation	96.3	56.5	88.2	103.6	100.6
Animal Husbandry	124.0	61.6	77.9	140.3	76.2
Dairy Development	94.8	53.0	77.0	105.3	90.1
Fisheries	86.2	69.9	61.6	118.5	70.8
Forestry and Wild Life	-	58.4	104.6	93.8	103.4
Plantation	-	-	-	-	82.8
Food, Storage and Ware Housing	105.3	-	85.0	72.7	108.9
Co-operation	89.8	59.8	100.0	73.0	81.2
Agricultural Financial Institutions	-	59.9	68.0	53.3	85.7
Total	86.6	59.3	83.4	90.0	91.4

Source: *Computed from Statistical Abstract of Assam, various issues and Statistical Hand Book of Assam, various issues.*

Note: In the 7th Plan assistance to small and marginal farmers was included as a category and there was an outlay of Rupees 1675 lakh; however there has been no report of expenditure made under this category.

4.4 Agricultural Infrastructure

"The adequacy of infrastructure helps to determine the state's success or failure in agriculture in terms of level of production and diversifying the sector" (Bhatia, 1999: A43). A better infrastructure encourages multiple cropping and hence a more intensive system of cultivation. Irrigation and power development; credit availability and accessibility; and market access are the critical determinants of agriculture development in general and technology adoption in particular. The expansion of these infrastructures requires a sustained investment by the state. In Assam, as seen in Section 4.3 the overall expenditure and also the expenditure in agriculture, irrigation and power in the plan periods had remained much lower than the national average. Low public investment may be a hindrance to greater expansion of infrastructure in the economy of Assam. Therefore, it is of interest to analyze the progress of infrastructure in the state over time. The infrastructure that have been taken into account are irrigation and flood control; rural electrification, road infrastructure and agricultural credit.

4.4.1 Irrigation and Flood Control

Availability of assured irrigation facility is undoubtedly the most important prerequisite for sustained development in the agricultural sector of Assam. The modernization of agricultural practices vis-à-vis increase in productivity of crops cannot be conceived in the absence of assured irrigation facilities. In Assam, agriculture is heavily dependent on rainfall, which is not even over all seasons. Floods have been a recurrent phenomenon during the monsoons. The National Flood Commission has estimated the area vulnerable to floods in Assam as 31.60 lakh hectares against 335.16 lakh hectares for whole India. Assam thus accounts for 9.4 per cent of total flood prone area of the country (Government of Assam, 2004). The assessed flood-prone area in the state is thus 92.6 per cent of the cultivated land, and it is found that almost half of it (16.3 lakh hectares) lacks proper flood management structures (Goyari, 2005).

Table 4.6: Area affected and crop damage by floods, 1954 to 2006

Year	Area affected in '000 hectares	Percentage of the total area affected by floods	Extent of damage of cropped area (in '000 hectares)	Percentage of total cropped area damaged
1954	2900	46.5	305	13.3
1962	1595	25.5	361	14.7
1966	1511	24.1	369	14.4
1972	997	15.8	359	12.5
1977	1024	16.2	453	14.6
1984	936	11.9	490	14.2
1988	4650	59.2	1335	38.6
1998	966	12.3	289	7.3
2002	674	8.6	-	-
2004	2364	30.1	522	13.4
2006	5773	73.5	1041	27.7

Source: *Goswami (1989); and*
Statistical hand Book of Assam, various years.

Note: 1.Flood damage is in calendar year (January-December) and Gross Cropped Area in financial year (April to March). The percentage of total cropped area damaged has been computed by dividing the cropped area damaged in a calendar year by the gross cropped area of the financial area beginning in the 1st of April of the same calendar year.

2. Due to non availability of TCA for 1984-85 and 1988-89, the Total Cropped Area of 1982-83 is taken.

Table 4.6 shows the area affected and the extent of damage of cropped area in the state for those years when the magnitude of flood had been greater relative to the other years (between 1950 and 2008); in the state flood of less magnitude occurs almost every year. In 1954, 47 percent of the total area was affected by floods and

it caused damage to 13 percent of the total cropped area in the state. The years 1962-84, showed fall in the proportion of area damaged but the year 1988 showed a significant increase in the area affected by floods. In 1988, almost 60 percent of the total area in the state was affected by floods and the cropped area damaged constituted 39 percent of the total cropped area. Even the recent years showed increase in the intensity of flood. Compared to earlier years, 2006 had the highest proportion of the total area affected by floods (73.5 percent). The percentage of total cropped area damaged during 2006 was 28 percent. Thus, we see that flood is a major impediment to agricultural growth of the state. Even six decades of economic planning has not been able to reduce the severity of floods.

Table 4.7: Expenditure in irrigation and flood control during plan periods per hectare of net sown area in Assam and India (in Rupees)

Plan	Assam	All-India	Expenditure per ha in Assam as percent of all-India
1st (1951-56)	-	36	-
2nd (1956-61)	-	45	-
3rd (1961-66)	-	81	-
4th (1969-74)	147	184	79.9
5th (1974-78)	229	301	76.1
6th (1980-85)	439	871	50.4
7th (1985-90)	911	1408	64.7
8th (1992-97)	1649	2570	64.2
9th (1997-02)	2116	4494	47.1

Source: *Computed from Planning Commission, Government of India;*
Statistical Hand Book of Assam various issues;
Statistical Abstract of Assam, various issues; and
Directorate of Economics and Statistics, Government of India.

A system of assured and controlled water supply is of prime importance in the state to save agriculture from the vagaries of monsoon. Analysis of plan allocation suggests that outlay/expenditure on irrigation has been inadequate. The poor development in Assam is mainly due to late start of these activities and inadequate plan allocation under irrigation provided in subsequent plans (Government of Assam, 2004). Table 4.7 shows the comparison of plan expenditure in Irrigation and Flood Control per net sown area between Assam and India. Clearly, the expenditure in Assam has been lower than the national expenditure in all the plan periods. The difference between the two has also been increasing over the periods. In the Fourth plan the Assam's expenditure in

Irrigation and Flood Control was nearly 80 percent of the national average. The proportion had been falling over the years. In the Ninth Plan, the expenditure in irrigation and Flood Control had been only 47 percent of the national average. The falling proportion of expenditure per hectare area in Assam is a concern given that nearly 93 percent of the cultivated area in the state is prone to floods and the need to develop a proper flood management system.

Like other leading States in India, Assam too has initiated Major and Medium Irrigation, and Minor Irrigation Projects. In the first two plans, only minor irrigation projects were undertaken in the state. Major and Medium irrigation projects were initiated from the 3rd plan onwards. However, the expenditure on Irrigation and Flood Control as a proportion of the outlay has been low (see Appendix, Table C4) in the plans though there has been some improvement in the 8th and the 9th plans. The expenditure under Command Area Development has been only 50 percent of the provision in the 6th, 7th and the 9th plans; however, in the 8th plan the laid provision was entirely spent. Despite the large need for irrigation and flood control in the state, the planned efforts have been on the lower side; further, expenditure as a proportion of outlay has also been low during all the plan periods. The same story runs with regard to the physical targets and achievements of the irrigation sector which is taken up in the next section.

4.4.1.1: Physical Targets and Achievement

Out of the total geographical area of 78.44 lakh hectares, the Gross Cropped Area of Assam is 40.87 lakh hectares (1999-2000). The ultimate gross irrigation potential (Annually Irrigable Area) that could be created has been assessed at 27 lakh hectares (66.06 per cent of the Gross Cropped Area). Against this, the Gross Irrigation Potential created up to 2003-04 is only 11.26 lakh hectares (27.55 per cent of Gross Cropped Area[1]) and 41.70 per cent of ultimate irrigation potential. The overall irrigation development in the State is 25percent of its ultimate

[1] Earlier Table 3.23 had reported 5 percent as the gross cropped area irrigated in Assam in 2003-06 which is the actual utilisation. The figure presented here is at variance with the earlier figure as it is the irrigation potential created reported by the Irrigation Department.

irrigation potential against 50 - 90percent in case of other states of India (Government of Assam, 2004).

Table 4.8: Achievement of irrigation potential as proportion of the targeted potential (in percent)

Year	Minor	Major/Medium	Total
1990-91	33.1	10.1	20.3
1991-92	45.2	25.7	35.6
1992-93	23.5	22.2	22.9
1994-95	30.9	62.0	44.8
1995-96	21.6	8.8	15.5
1996-97	9.7	100	4.2
1997-98	6.3	100	6.1
2002-03	42.6	14.4	20.0
2003-04	16.8	3.7	4.9
2004-05	55.6	3.7	8.5
2006-07	32.0	57.3	38.1
2007-08	47.6	84.9	57.9
2008-09	5.1	18.1	20.6

Source: *Computed from Statistical Hand Book, Assam, various years.*

Table 4.8 shows the additional irrigation potential created annually from 1990-91 to 2008-09. Clearly, the additional irrigation potential created has always been lower than the targeted potential. In the year 1990-91, it was targeted to create an additional potential to the tune of 37 thousand hectares but achievement was only 7 thousand hectares (see Appendix, Table C2). Thus, only 20 percent of what was targeted could be achieved. The picture seem to be depressing in particular for the years 1996-97, 1997-98, 2003-04 and 2004-05 where the achievement has been less than 10 percent of the target. A relatively higher proportion (58 percent) of the targeted potential was achieved in the year 2007-08. But in absolute terms, the targeted area for the year had been relatively lower than the previous years; it was targeted to create additional irrigation potential of 18.8 thousand hectares and the achievement was 10.9 thousand hectares. Thus, it is seen that the ultimate irrigation potential has not been realized in the state.

However, the most disconcerting aspect of irrigation development in the State is that the irrigation potential already created has not been fully utilized and the trend of utilization has been decreasing. Table 4.9 shows the utilization of irrigation potential from 1980-81 to 2003-04. In 1980-81, 59 percent of the

irrigation potential created had been utilized in the state which fell to 30 percent in 2003-04.

Table 4.9: Irrigation potential available and irrigation potential utilised in Assam, 1980-81 to 2002-03

Year	Irrigation potential available at the end of the year in thousand hectares	Potential utilized during the year in thousand hectares	Potential utilized as percentage of potential available at the beginning of the year	Potential utilized as percentage of potential available at the end of the year	Estimated utilization ratio as percentage
I	II	III	IV	V	VI
1980-81	201.19	118.56	-	56.68	-
1983-84	305.22	165.2	63.88	54.12	59
1986-87	448.02	225.75	57.55	50.39	53.97
2000-01	513.34	113.48	33.30	71.97	35.07
2003-04	530.00	69.48	19.25	41.11	30.18

Source: *Office of the Chief Engineer, Irrigation, Government of Assam.*
Economic Survey of Assam, 2004-05.

Note: Own calculation following the method in Bezbaruah (1994).

"It is reasonable to assume that irrigation potential created during a year is partly available for use in the same year, but wholly available for use only in the next year. On these assumptions the figures in columns IV will be over estimates and those in column V will be under estimates of the rates of utilization of available irrigation potential. The utilization ratio (column IV) has therefore been estimated taking the mean of the figures in column IV and column V for each year" (Bezbaruah, 1994: 45).

4.4.2: Rural Electrification

Availability of assured power is a pre-requisite for the introduction of irrigation in the agricultural fields. But the level of rural electrification in Assam is low (Table 4.10). Up to 2009, only 15066 villages were electrified (out of the 25222 villages) which constituted 60 percent of the total in the state. This compares unfavourably with the 100 percent electrification attained by Punjab and Haryana in the early 1970s. A sharp increase in the proportion of villages electrified is observed since 1980. The proportion increased from less than 10 percent in 1978 to 19 percent in 1980 and further to 46 percent and 80 percent in 1985 and 1990 respectively. Table 4.11 shows the proportion of villages electrified in Assam across the districts in 2008-09. It is found that there is not much variation in the proportion of villages electrified across the districts of Assam. In Karbi-Anglong and N.C Hills, the proportion of villages electrified is very low, probably owing to the low density of population and the hilly terrain.

Table 4.10: Percentage of electrified villages of the total villages in Assam

Year	Number of Villages Electrified	Total Number of Villages	Percentage of Villages Electrified
1961	44	11000	0.4
1966	96	24000	0.4
1974	1400	21995	6.4
1978	2176	21980	9.9
1980	4558	23989	19.0
1985	11806	25890	45.6
1990	20984	26002	80.7
1993	21481	26006	82.6
2003	19039	24685	77.1
2009	15066	25222	59.7

Source: *Computed from Economic Survey of Assam, various issues.*

Table 4.11: District-wise percentage of villages electrified, 2008-09

Districts	2008-09
Cachar	70.0
Darrang	70.3
Goalpara	62.7
Kamrup	74.3
Lakhimpur	58.7
Nagaon	67.9
Sibsagar	64.1
K.A and N.C Hills	17.3
Assam	59.7

Source: *Computed from Statistical Hand Book of Assam, 2009.*

The proportion of villages electrified in the state has been increasing but the real test of whether electricity has reached the farmers is its consumption. The consumption of electricity for agricultural purposes is low in the state (Table 4.12). In 2008-09, only 0.77 percent of the total consumption went for agricultural purposes compared to 21 percent for the country as a whole (see Appendix, Table C3). Table 4.12 indicates the low position of Assam in respect of per hectare consumption of electricity for agricultural purposes which has shown virtually no improvement over two decades. In 1988-89, the consumption of electricity per hectare of total cropped area was only 3.8 KWh compared to 213.3 KWh for the country as a whole. In 2007-08, per hectare consumption went up to 533.8 KWh for the country as a whole with the corresponding consumption of only 5.1 KWh per hectare for the state. This shows that the use of power for agricultural development has received little attention in Assam. This is closely related to the meagre spread of irrigation in the state.

Table 4.12: Consumption of electricity (in kwh) for agricultural purposes per hectare of the total cropped area in Assam and All-India

Year	Assam	All-India
1988-89	3.8*	213.3
2000-01	10.0	457.2
2001-02	2.4	433.8
2004-05	3.7	462.3
2005-06	6.1	467.1
2006-07	4.5	514.4
2007-08	5.1	533.8

Source: *Computed from Directorate of Economics and Statistics, Government of India.*
Note: 1. * for 1988-89, the total cropped area of 1982-83 is taken.
2. The TCA in Assam for 2007-08 and for all-India the periods after 2004-05 is provisional.

4.4.3 Agricultural Credit

Agricultural credit is necessary to enable the agrarian economy to use modern inputs. The co-operatives were started in Assam with this purpose in view. Although the co-operative movement in Assam made its beginning with the passing of the Co-operative Societies Act, 1904, much concerted efforts were made only from 1951 with the introduction of economic planning in the state. The co-operatives since then have been functioning to provide not only rural credit but also facilities for marketing, processing, distribution, and storage of agricultural products.

Table 4.13: Loans and advances per total cropped area by primary agricultural credit societies (at 1999-2000 prices)

Period	Assam		All-India	
	Rupees in crore	Rupees per hectare	Rupees in crore	Rupees per hectare
2002-03	5.7	14	30791.9	1620
2003-04	5.5	14	30755.1	1606
2004-05	5.2	13	32549.5	1684
2005-06	4.9	12	34023.3	1768
2006-07	4.6	12	37242.1	1908
2007-08	5.6	15	41025.7	2103
2008-09	5.3	14	38778.1	1988

Source: *Computed from National Federation of State Cooperative Banks Ltd. (NAFSCOB), various years.*
Note: 1.The loan and advances figures are adjusted for inflation by using GDP deflators at 1999-2000 prices.
2. For the period 2008-09 for Assam the Total cropped Area of 2007-08 is used.

Although co-operatives have an important role to play in meeting the credit requirements of the farmers and ensuring timely credit, it is argued that co-operatives have largely failed in fulfilling the needs of agriculture (Government

of Assam, 1975). Table 4.13 presents the loans and advances per TCA from the Primary Agricultural Credit Societies (PACS) in Assam compared to the country as a whole for the years from 2002-03 to 2008-09.

The agricultural loans and advances at real 1999-2000 prices per hectare in Assam is meagre. In 2002-03, while the loans per hectare for the country as a whole was Rupees 1620, it was only Rupees 14 for the state (one percent of that of the country). Over the recent years, when so much is being talked about reaching credit to the farmers, the loan per hectare showed no improvement in Assam. While for the country as a whole the increase in the credit disbursed was of the order of 25 percent over a period of seven years, it has stagnated for Assam. With such low disbursement of loans, the adoption of modern farming inputs cannot be expected to increase in the state.

4.4.4 Roads

Investment in roads and transportation reduces the cost of transportation of goods and tends to enhance the share of farmers in the final realization of farm produce. Road development, in particular can help the small and marginal farmers to grow vegetables and other high value crops on their tiny plots and to find a market for these in nearby towns. The road connectivity in Assam is in a poor state. Table 4.14 compares the length of surfaced roads per hundred sq. km. and per lakh population between Assam and all- India. In 1990-91, the length of surfaced roads per hundred sq. km. in Assam was only 13 km compared to 31 km for the country as a whole. Between 1990-91 and 2000-01, there has been hardly any road development in Assam whereas for the country as a whole the road length per hundred sq. km. has increased by nearly 40 percent. Between 2000-01 and 2003-04, the road length seems to have shown a remarkable increase in Assam. However, this is not consistent with figures provided by the P.W.D which is shown in Table 4.15.

Table 4.14: Length of surfaced roads (in km), 1970-71 to 2003-04

Year	Road Length per hundred sq. km.		Road Length per lakh Population	
	Assam	All-India	Assam	All-India
1970-71	-	12	-	73
1980-81	-	21	-	100
1990-91	13	31	45	121
1993-94	14	35	42	135
2000-01	16	43	48	138
2003-04	29	48	84	153

Source: *Computed from CMIE Infrastructure, 2003 and 2009.*

The progress in road connectivity is also examined across the districts in the state (Table 4.15). In Assam, the Roads wing of the Public Works Department (PWD) is chiefly responsible for improvement of road communication. Over a period of 15 years (1995-96 to 2008-09), the road length in Assam has shown no improvement.

Table 4.15: District-wise P.W.D road length in Assam, 1985-86 to 2008-09 (Per hundred sq. km.)

Districts	1985-86	1995-96	2005-06	2008-09
Goalpara	33	40	37	38
Kamrup	45	54	53	54
Darrang	36	42	53	55
Lakhimpur	29	36	38	39
Sibsagar	48	55	57	58
Nagaon	46	61	57	60
Cachar	27	31	31	32
K.A and N.C Hills	21	31	37	40
Assam	34	42	44	46
C.V	27.8	26.4	23.4	23.1

Source: *Computed from Statistical Abstract of Assam, various years; and Statistical Hand Book of Assam, various years.*

Compared to this, the previous ten years (1985-86 to 1995-96) had shown 25 percent increase in road length. The pattern of growth in road connectivity across the districts corresponds to that of the state. However, Darrang and Karbi-Anglong and N.C. Hills have shown a steady increase over the entire period.

Agricultural change beyond a certain threshold requires heavy public investment in agricultural infrastructure. It has been found that in Assam, over the last quarter of a century, there has been practically no improvement in irrigation, credit, electrification and road length. Not a single district of the state shows behaviour different from the overall pattern.

4.5 Agrarian reform: Institutions

The size of land has an important bearing on the growth of agriculture. Continuous fragmentation and sub-division of land holding hinders agricultural development in an economy. Uneconomic farm size holding stands in the way of modernizing agriculture. "A lack of consolidation of fragmented and scattered holdings remains a major impediment to the propagation of extensive irrigation for modernization of agriculture in Assam" (Goswami et al., 2004:419). 'In Assam, the increasing pressure of population on arable land and the working of the law of inheritance has led to fragmentation of large size holdings into smaller sizes' (Das, 1984:162). Assam's economy is dominated by marginal holdings.

Table 4.16: Percentage distribution of operational holdings and area operated by size categories of operational holdings, 1971-72 to 2002-03

Size of holdings (ha.)	Percentage of operational holdings				Percentage of area operated			
	1970-71	1981-82	1991-92	2002-03	1970-71	1981-82	1991-92	2002-03
Marginal (≤ 1.000 ha)	52.4	61.6	70.8	76.2	21.6	22.1	34.2	42.0
Small (1.001-2.000 ha)	30.2	24.3	20	18.4	34.9	33.5	31.2	36.0
Semi-Medium (2.001-4.00 ha)	14.3	11.3	7.5	4.7	30.5	29.3	22.9	17.1
Medium (4.001-10.000 ha)	3.0	2.7	1.5	0.6	12.2	13.7	9.1	4.9
Large (≥ 10.01 ha)	0.1	0.1	0.2	0.0	0.7	1.4	2.6	0.0
All classes	100	100	100	100	100	100	100	100

Source: *Computed from NSSO, 59th round, Some Aspects of Operational Land Holdings in India, Report No. 492.*

The proportion of operational holdings of the small and the marginal holders has been increasing over the years (Table 4.16). In 1970-71, 82 percent of the operational holdings belonged to the marginal and small category, 17 percent to the semi-medium and medium category, and 0.1 percent to the large category. The proportion in the marginal and small category increased to 95 percent in 2002-03. The proportion of operational holdings in the semi-medium and medium category declined to 5 percent and that of the large category becoming negligible in 2002-03 as per the NSSO survey. In 2002-03, the land holding of size

of over 4 hectare which is considered as an economic holding (Das, 1984) constituted less than 5 percent of the total operational holding in the state.

To deal with the problems of fragmentation and sub-division of land holdings in the state, the Government of Assam has adopted measures of consolidation of holdings and co-operative farming during the plan periods. The consolidation of holdings started during the Third Five Year Plan when the consolidation of the Land Holdings Act was passed.

The Assam consolidation of the Land Holdings Act was passed in 1960 to prevent fragmentation of agricultural holdings in the plain districts of Assam. Among the two approaches - voluntary (or permissive) and compulsive approach, the state adopted the voluntary approach that was based on the initiative of the land owners. In the compulsive method the initiative is taken by the government and the decision is based on the parties. Apparently because of the voluntary nature of the scheme, there has been no progress in the process of consolidating holdings. The government amended the Act in 1966 so as to provide for consolidation if necessary. However, the scheme of consolidation did not spread across the state. The consolidation scheme has been in abeyance since 1969 as the government had prioritized other institutional changes such as conferring ownership to tenants over the consolidation of land holdings.

Co-operative farming is an initiative that has been encouraged in the various plans so that the small holders can organize into joint cultivation that will enable them to achieve the required minimum economies of scale. Under co-operative farming, the small farmers are required to come together by pooling their land to cultivate them. During 1973-74, the government of Assam introduced the scheme of setting up of Agricultural Farming Corporation in each sub-division of the state under which the cultivators were required to organize into corporate bodies and cultivate agricultural land.

Despite the measures undertaken to make land holdings economic and viable, sub-division and fragmentation has occurred over the years. The number of

operational holdings has shown a significant increase in a period of three and a half decades resulting in a fall in the average size of operational holdings from 1.47 hectare in 1970-71 to 1.11 hectare in 2005-06 (Table 4.17). A comparison with all-India average shows that the average size of holding in Assam is smaller than that of all-India (Table 4.17).

Table 4.17: Number, area and average size of operational holdings, 1970-71 to 2005-06

Year	Assam			Average size in India (ha.)
	Number of Holdings	Area (in thousand hectares)	Average Size (ha.)	
1970-71	19,64,376	2883	1.47	2.28
1976-77	22,53,654	3079	1.37	2.00
1980-81	22,97,588	3121	1.36	1.84
1985-86	24,19,156	3161	1.31	1.70
1990-91	20,75,959	2616	1.26	1.55
1995-96	26,82,997	3138	1.17	1.41
2000-01	27,12,137	3114	1.15	1.33
2005-06	27,50,114	3049	1.11	1.23

Source: *Computed from Statistical Hand Book of Assam, various years.*

The problem of small-sized holdings in the state is further accentuated by the fact that one operational holding does not consist of a single compact block of land, but a number of small parcels scattered over different parts of the village and even outside the village. 'In Assam, most of the cultivators do not have their agricultural land in one plot. These are scattered all over and in many cases, these are scattered over more than one village. Not that these are big plots, but are of small sizes again, incapable of receiving modern inputs. Such fragmentation not only results in waste of time but also creates very many management problems' (Bhattacharya, 1998). In Assam, the average number that an operational holding consists of is 2 parcels and the average area of the parcels is about 0.5 hectare. Table 4.18 shows the average area of parcels under the different categories- marginal, small, semi-medium, medium, and large. In 1976-77, the average area of parcel for all sizes was 0.46 hectare which fell slightly to 0.42 hectare in 2001-02.

Size-wise, it is evident that the marginal and small holders operate in smaller size parcels. The average area of parcel of the marginal holders was 0.23 hectares in

1976-77. The area virtually remains the same in 2001-02. For the small, semi-medium and the medium holders the area has remained around 0.5, 0.6, and 0.9 hectares respectively over the years. The large holders show a relatively higher average area of parcel with the area hovering around 2-3 hectares over the years.

Table 4.18: Average area (in hectare) of parcels, 1976-77 to 2001-02

Year	Marginal (<1.0)	Small (1.0-1.99)	Semi-Medium (2.0-3.99)	Medium (4.0-9.99)	Large (> 10)	All-sizes
1976-77	0.23	0.46	0.63	0.99	2.38	0.46
1981-82	0.23	0.46	0.65	0.93	3.17	0.45
1991-92	0.23	0.50	0.66	2.28	3.17	0.52
1995-96	0.30	0.49	0.67	0.92	2.61	0.49
2001-02	0.22	0.45	0.65	1.02	3.94	0.42

Source: *Computed from Input Survey, various years.*

District-wise it is seen that barring Karbi-Anglong and N.C Hills, the average area per parcel had gone down for all the districts during the period 1996-97 to 2001-02 (Table 4.19). The fall has been relatively high in Darrang and Nagaon. As far as average number of parcels is concerned for the state as a whole it has become 2 in 2001-02 from 3 in 1996-97 which seems encouraging. Nagaon is the only district showing increase in the average number of parcels.

Table 4.19: District-wise average number of parcels per holding and average area per parcel and per holding, 1996-97 and 2001-02

Districts	Average no. of parcels per holding		Average area per parcel		Average area per holding	
	1996-97	2001-02	1996-97	2001-02	1996-97	2001-02
Cachar	3	2	0.56	0.55	1.43	1.34
Darrang	3	2	0.57	0.42	1.46	0.88
Goalpara	3	3	0.43	0.37	1.13	1.06
Kamrup	3	2	0.42	0.41	1.22	0.95
Lakhimpur	2	2	0.67	0.62	1.29	1.17
Nagaon	2	3	0.43	0.32	1.02	1.08
Sibsagar	3	3	0.44	0.38	1.24	1.00
K.A and N.C Hills	3	1	0.56	0.88	1.68	1.25
Assam	3	2	0.49	0.41	1.25	1.03

Source: *Computed from Input Survey, 1996-97, and 2001-02.*

The average area per operational holding shows fall for the districts, except Nagaon in the period 1996-97 to 2001-02. Nagaon registers a marginal increase from 1.02 in 1996-97 to 2001-02. Darrang, Kamrup, and Karbi-Anglong and N.C Hills show a higher fall relative to other districts. As we have seen in the

previous chapter that these are the districts with relatively high population pressure, therefore have high fall in the average size of operational holdings.

4.6 Conclusion

In Assam, policies have been framed to lay agriculture in a higher growth trajectory as it is evident from our analysis of the Five Year Plans. The government has devised strategies and designed programmes to develop agriculture. However, the devised plans and policies have not been translated into better performance of the agricultural sector. The case of low expenditure in agriculture is one of the major factors as we have seen that agriculture in general has lost priority over the plan periods. It is to be noted that in the various plan periods the fall in the outlay/expenditure on agriculture is followed by a concomitant increase in the proportion of expenditure in the categories of irrigation, power, rural development, and co-operation. The increasing expenditure has not been translated into productive outcome. Irrigation infrastructure remains in a poor state and so does power. The government's role to make institutional changes has not been effective; there has been continuous fragmentation of land holdings resulting in smaller parcels.

The study highlights the fact that Assam agriculture is a case of poor investment and ineffective governmental efforts. Irrigation, power, road, and credit infrastructures that are the crucial factors for developing agriculture are in a poor state in Assam. This becomes apparent from the comparison of Assam with the all-India average. Although plans have been devised to develop agricultural infrastructure, yet the planned efforts have not been effective due to two reasons; first low plan outlay compared to the national average and second, whatever outlay sanctioned is not fully spent.

Appendix C

Table C1: Outlay and expenditure in irrigation and flood control under different plans (in crore)

Heads/ Plans		Major and Medium Irrigation	Minor Irrigation	Command Area Development	Flood Control	Total
4th (1969-74)	output	6.5	12.4	-	23.3	42.3
	actual expenditure	3.6	2.2	-	28.4	34.2
5th (1974-79)	output	29.0	28.4	-	14.8	72.2
	actual expenditure	24.8	20.3	-	8.4	53.5
6th (1980-85)	output	63.7	74.0	1.6	23.0	162.3
	actual expenditure	45.1	57.4	0.8	15.0	118.4
7th (1985-90)	output	137.0	160.0	10.0	27.0	334
	actual expenditure	90.7	123.3	4.5	27.1	245.6
8th (1992-97)	output	118.1	215.1	16.2	103.5	452.9
	actual expenditure	116.9	226.0	17.0	94.9	454.7
9th (1997-02)	output	135.1	430.0	25.1	120.2	710.4
	actual expenditure	170.1	323.2	12.8	75.9	582.0

Source: *Statistical Abstract of Assam, various years.*

Table C2: Target and Achievement of Additional Irrigation Potential (area in thousand hectares)

	Minor irrigation		Medium/Major		Total	
	Target	Achievement	Target	Achievement	Target	Achievement
1990-91	16.20	5.37	20.39	2.05	36.59	7.42
1991-92	27.80	12.57	26.80	6.88	54.60	19.45
1992-93	30.01	7.05	25.00	5.55	55.01	12.60
1994-95	13.10	4.05	10.50	6.51	23.60	10.56
1995-96	10.30	2.23	9.50	0.84	19.80	3.07
1996-97	5.30	0.51	7.00	-	12.30	0.51
1997-98	5.30	0.33	0.20	-	5.50	0.33
2002-03	6.70	2.85	26.80	3.85	33.50	6.70
2003-04	4.84	0.81	47.53	1.78	52.37	2.59
2004-05	4.84	2.69	47.53	1.78	52.37	4.47
2006-07	11.05	3.54	3.50	2.00	14.55	5.54
2007-08	13.62	6.48	5.20	4.42	18.82	10.89
2008-09	22.82	1.17	48.48	8.80	48.48	9.96

Statistical Hand Book, Assam, various years

Table C3: Consumption of Electricity for Agricultural Purposes (million kwh)

Year	Assam			All-India		
	Agricultural Purposes	Total	Percent share in Total	Agricultural Purposes	Total	Percent share in Total
1988-89	13	1227	1.06	38878.37	160196.43	24.27
2000-01	41	1911	2.15	84729	316539	26.77
2001-02	9.5	1817.98	0.52	81673.39	322459.33	25.33
2004-05	14.31	1837.98	0.78	88555.35	386133.66	22.93
2005-06	24.00	2203.00	1.09	90292.4	411886.93	21.92
2006-07	16.78	2575.35	0.65	99023.39	455748.47	21.73
2007-08	19.54	2544.48	0.77	104181.69	501977.11	20.75

Source: *Directorate of Economics and Statistics, Government of India.*

Table C4: Expenditure as a proportion of outlay and in irrigation and flood control under different plans (in percent)

Plans	Major and Medium Irrigation	Minor Irrigation	Command Area Development	Flood Control	Total
4th plan 1969-74	55.48	17.89	-	121.79	81.00
5th plan 1974-78	85.62	71.39	-	57.02	74.17
6th plan 1980-85	70.84	77.63	50.03	65.08	72.92
7th plan 1985-90	66.22	77.09	44.80	100.25	73.53
8th plan 1992-97	98.95	105.09	104.89	91.68	100.42
9th plan 1997-2002	125.90	75.16	50.90	63.16	81.92

Source: *As in Table C1.*

CHAPTER V

CONCLUSION AND POLICY IMPLICATIONS

5.1 Summing up

Assam is primarily an agrarian economy with a large proportion of the total workforce dependent on agriculture. Moreover, agriculture caters to the need of a large segment of the rural population that is indirectly dependent on it for livelihood. With increasing population in the state, the dependency on agriculture has increased over the years; although the proportion of workforce engaged has fallen yet the number of persons dependent on it is still large. But agriculture in Assam is characterised by low growth, poor yield and little diversification. Increasing population pressure and a poorly performing agriculture raises serious concerns as agriculture has to provide for and support a growing rural population in the state.

Population pressure on land leads to many changes in the system of cultivation. With land available, there will be extensification of cultivation when population exerts pressure on land. With little scope for extensification, an intensive system of cultivation will be adopted. An intensive system will be in the form of increasing the frequency of cultivation, shifts in the cropping pattern, labour intensification and improvements in technology. The changes along these lines will take place to improve agricultural production and productivity. However, government intervention in terms of infrastructure development becomes a necessity to effect these agricultural changes. An intensified agriculture follows from greater government intervention and policy initiatives. The present study has examined Assam agriculture from this broader perspective of population pressure on land at a disaggregated level.

It has been found that population pressure is relatively higher in the districts of Darrang, Goalpara, Kamrup, Nagaon and Karbi-Anglong and N.C. Hills. The population pressure is relatively lower in the remaining districts of Cachar, Lakhimpur, and Sibsagar. The analysis taking the last four decades has shown

that as an initial response to population pressure, there has been extensification of area under cultivation but it has been largely confined to the first two decades (mid 1960s to early 1980s). Karbi-Anglong and N.C Hills, Lakhimpur, Goalpara and Nagaon are the districts with relatively higher expansion of net sown area.

With increase in population pressure, the number of agricultural workers per unit of net sown area has gone up for all the districts. Lakhimpur, Goalpara, and Karbi-Anglong and N.C Hills have shown relatively higher increase in the number of agricultural workers per unit of land.

The level of irrigation for the state as a whole is low. Darrang, Nagaon, Kamrup, Goalpara and Karbi-Anglong and N.C Hills report relatively higher levels of irrigation and higher intensities of cultivation. These districts show relatively higher adoption of HYVs of paddy and higher fertilizer consumption indicating that water is the leading input in agriculture. It is to be noted that districts which have relatively high population pressure are relatively the well-irrigated districts of the state. The shifts in cropping pattern as a response to population pressure are relatively higher in Lakhimpur, Sibsagar and Darrang. However, it is food grain crops that are dominant in all the districts of the state.

With increasing population pressure, the agrarian economy has undergone a change in its system of cultivation. Extensification of cultivation has taken place as the initial response. While a system of intensive cultivation has developed in the state, the intensity of cropping has not gone beyond 140 percent, whereas it is nearly 200 percent in Punjab. One of the main reasons for this is the state of poor irrigation development in Assam; only 7.5 percent of the net sown area has been irrigated in the state in 2007.

Lack of a proper irrigation system has been a constraint to the efforts of the farmers to further intensify the use of land. Farmers' initiatives to intensify cultivation through irrigation development are severely handicapped by the fact that a major proportion of the cultivated area is prone to floods. The infrastructure for irrigation and flood control cannot be developed by individual

initiatives but has to be undertaken by public/government initiatives which are severely wanting in Assam.

The strategies devised by the government as seen through the Five Year Plans of Assam has not been able to render the kind of development thrust required to achieve high agricultural growth. Irrigation and flood control infrastructure has been in a poor state. The consumption of electricity for agricultural purposes and credit disbursement in agriculture has been on the lower side. Although road connectivity in the state has shown some signs of improvement in recent years yet the connectivity is still low. The government's attempt to consolidate land holdings by developing co-operatives has yielded poor results as is evident from the continuous fragmentation of land holdings.

The low infrastructural development in the state reflects lack of concerted efforts by the government. Plans have been devised to develop agricultural infrastructure, yet the planned efforts have not translated themselves into infrastructure mainly due to low plan outlay. Besides, in most of the plan periods, the outlay sanctioned has not been fully spent. Given that agricultural changes beyond a certain threshold are conditional on infrastructural development, Assam's low agricultural development has largely been due to lack of government initiatives.

5.2 Policy Implications

Assam has largely missed the green revolution bus. While some spill over effect of the green revolution can be seen during and after mid-1980s (Barah, 2001) and there have been some increases in cropping intensity, adoption of HYVs and fertilizers, such improvements have failed to have any major impact on the increasing yield gaps between the state and the country. The production and productivity growth has continued to remain low and Assam agriculture has remained stagnant over the long stretch.

In Assam, except the hill district of Karbi-Anglong and N.C. Hills, all the plain districts of Brahmaputra and Barak Valley are susceptible to floods (Mandal, 2010). Given the magnitude of floods and the extent of crop damages caused, it becomes necessary to initiate effective long term projects for flood control and water management: "For effective management of flood and erosion in both Brahmaputra and Barak valleys, long-term measures in the form of multi-purpose storage reservoirs in the upper catchments of the river basins, dams, big sluice gates and water shed management are must" (Goyari, 2005: 2729).

Higher agricultural growth rates require a system of proper water control as the experience of the dynamic states show. This can be achieved mainly through public investment in irrigation and flood control. But by their very nature, these will require large initial investment and will have long gestation periods. To cater to the interim needs of irrigation, emphasis should be laid on ground water based irrigation systems.

In Assam, it is not just a matter of creating additional irrigation potential, it has to be ensured that the created potential is utilised. It has been argued that one of the reasons for low utilisation of irrigation in Assam is the lack of proper distribution channels to carry water from the main channels to the farmers' fields (State Development Report, 2004). Such impediments have to be overcome to ensure high utilisation of irrigation potential.

Infrastructures such as rural electrification, agricultural credit and road connectivity that are pre-requisite for agricultural development have remained in a poor state. These infrastructures are necessary to stimulate crop diversification and commercialization of agriculture. Public investment in these aspects will crowd in private investment that will raise agriculture from its stagnancy.

It has been found that population pressure on land has led to high labour intensification in the state. The underperforming agricultural sector has adversely affected the economic conditions of the rural households. With the slow growth of urbanisation and poor development of the informal sector, there

is little scope for the rural households to move out of agriculture. Efforts have to be made to develop the rural non-farm sector so as to generate employment opportunities. Given the linkages between the farm and the non-farm sector, growth of the non-farm sector will promote growth in the farm sector as well (Mellor, 1976). As this is conditional on infrastructural development, to realise the growth of the non-farm sector major initiatives have to be undertaken to develop road and electricity infrastructure in the state.

5.3 Issues for Further Research

- In an agrarian economy where majority of the farmers are small, the production of low-valued crops like cereals may not be able to sustain their livelihoods. How can the small farmers shift to high-valued crops with minimum transaction cost and market risk? What are the determining factors which facilitate the production of high valued crops in these economies?
- In agrarian economies which are under increasing population pressure, falling land-person ratio, small and fragmented land-holdings, poorly performing agricultural sector and slow urbanisation, agriculture alone cannot sustain the income of the rural households. Therefore, alternative sources become important for rural livelihoods. What is the role of the rural non-farm sector as an employment generating strategy in such economies? It becomes necessary to understand the dynamics of the rural non-farm sector in relation to its importance in employment generation strategies. It may be expected that urbanised regions and regions with better connectivity would have better scope for non-farm employment. In the context of Assam these are issues of importance as agriculture has virtually been stagnating and urbanisation is confined to a few districts.
- In Assam, the system of water control is in a poor state. While the need is large, the efforts have been scanty. The annual targeted area to be brought under irrigation is hardly achieved. Besides there is no fuller utilisation of the created potential. This reflects poorly on planning and implementation of irrigation projects in the state. In this context, a critical examination of the process of

irrigation development becomes necessary. Also, what had been the role of the central government to facilitate infrastructural development in such a strategic state as Assam needs to be examined.

- Farmers are usually constrained to use modern inputs and technology if availability of credit is not adequate. Despite the government's initiatives to ensure minimum institutional lending to the priority sectors, the disbursement of institutional credit to agriculture has been low in Assam. What are the supply and demand factors that impede institutional lending in the state? This is an issue of importance in an era when so much is talked about financial inclusion.

BIBLIOGRAPHY

Acharya, S.S. (2004). *State of the Indian Farmer: A Millennium Study.* Academic Foundation: New Delhi.

Ahmad, Alia (1984). *Agricultural Stagnation under Population Pressure: The Case of Bangladesh.* Vikas Publishing House: New Delhi.

Barah, B.C. (2001). Prioritization of strategies for agricultural development in north-eastern India. *National Centre for Agricultural Economics and Policy Research (ICAR)*: New Delhi.

Barah, Bimal (2003). *Population Characteristic and Agricultural Development in Jorhat District, Assam.* Unpublished Ph. D Thesis submitted to Department of Geography, North East Hill University: Shillong.

Bezbaruah, M.P. (1994). *Technological Transformation of Agriculture: A Study from Assam,* Mittal Publications: New Delhi.

Bezbaruah, M.P. and Niranjan Roy (2002). Factors affecting cropping intensity and use of fertilizers and high yielding varieties in Barak valley. *Indian Journal of Agricultural Economics,* Vol. 57 (2).

Bhagabati, D. (2000). Population Pressure on Land and associated Problems in Selected Areas of Nalbari District, Assam. M.phil Disseratation submitted to the Department of Geography, Gauhati University: Guwahati.

Bhalla, Surjit S. (1979). Appendix A (on India). In R.A. Berry and W.R. Cline (eds.), *Agrarian Structure and Productivity in Developing Countries.* The John Hopkins University Press: London.

Bhalla, G.S., and Gurmail Singh (2010). Final report on planning commission project, growth of Indian agriculture: a district level study. *Centre for the Study of Regional Development,* JNU: New Delhi.

Bhalla, G.S., and Gurmail Singh (2009). Economic liberalisation and Indian agriculture: a statewise analysis. *Economic and Political Weekly,* Vol. 44 (52).

Bhattacharya, Hiranya Kumar (1998). *Economic Development of Assam.* A.P.H Publishing Corporation: New Delhi.

Bhatia, M.S. (1999). Rural infrastructure and growth in agriculture. *Economic and Political Weekly, Vol. 34* (13), pp. 43-48.

Bhowmick, B.C., B.C. Barah, Sushil Pandey and N. Barthakur (2005). Cahanging pattern of rice production systems and technology in Assam: a spatio-temporal analysis of performance and prospects. *National Centre for Agricultural Economics and Policy Research Policy Paper 22.* Indian Council of Agricultural Research: New Delhi.

Boserup, E., (1965). *The Conditions of Agricultural Growth.* Aldine Publishing Company: New York.

Boserup, E., (1975). The impact of population growth on agricultural output. *The Quarterly Journal of Economics, Vol. 89.* (2), pp. 257-270.

Boserup, E. (1981). *Population and Technology.* Basil Blackwell: Oxford.

Boyce, James K. (1987). *Agrarian Impasse in Bengal: Institutional constraints to Technological Change.* Oxford University Press: USA.

Brookfield, H. C. (1972). Intensification and disintensification in pacific agriculture: a theoretical approach. *Pacific Viewpoint 13,* pp. 30-48.

Chadha, G.K (1993). Non-farm employment for rural households in India: evidence and prognosis. *The Indian Journal of Labour Economics,* Vol. 36, (21).

Chand, Ramesh (1999). Are disparities in Indian agriculture growing? Policy Brief. *National Centre for Agricultural Economics and Policy Research*: New Delhi.

Centre For Monitoring Indian Economy Pvt. Ltd. (CMIE) (Feb 2003): *Infrastructure*: Mumbai.

Centre For Monitoring Indian Economy Pvt. Ltd. (CMIE) (Dec 2009): *Infrastructure*: Mumbai.

Cuffaro, Nadia (1997). Population growth and agriculture in poor countries: a review of theoretical issues and empirical evidence, *World Development, Vol. 25(7),* pp. 1151-1163.

Das, M.M. (1984). *Peasant Agriculture in Assam,* Inter India: New Delhi.

Ehrlich, P.R. and A.H. Ehrlich. (1990). *The population explosion:.* New York:. Simon and Schuster.

Evenson, Robert E. (1983). India: population pressure, technology, infrastructure, capital formation and rural incomes. Paper presented at a committee on population workshop on population growth and land use changes in developing countries. 5-6, 1991 December. *National Academy of Sciences*: Washington, D.C.

Government of India (1951). *Census of India* 1951.

_____ (1961). *Census of India* 1961.

_____ (1971). *Census of India* 1971.

_____ (1991). *Census of India* 1991.

_____ (2001). *Census of India* 2001.

_____(2010). *Agricultural Statistics at a Glance,* Agricultural Statistics Division, Directorate of Economics and Statistics, Department of Agriculture and Co-operation. Ministry of Agriculture: New Delhi.

Government of Assam (2008). *Statistical Hand Book of Assam* 2008, Directorate of Economics and Statistics: Guwahati.

_____ (2009). *Statistical Hand Book of Assam* 2008, Directorate of Economics and Statistics: Guwahati.

_____(1978). *Statistical Abstract of Assam* 1978, Directorate of Economics and Statistics: Guwahati.

_____(1990). *Statistical Abstract of Assam* 1990, Directorate of Economics and Statistics: Guwahati.

_____ (2000). *Statistical Abstract of Assam* 2000, Directorate of Economics and Statistics: Guwahati.

_____ (2005). *Statistical Abstract of Assam* 2005, Directorate of Economics and Statistics, Guwahati.

_____ (1971). *Economic Survey of Assam*, 1971.

_____ (1975). *Economic Survey of Assam*, 1974-75.

_____ (1981). *Economic Survey of Assam*, 1980-81.

_____ (2004). *Economic Survey of Assam*, 2003-04.

_____ (2003). *Assam Human Development Report*, 2003. Planning and Development Department.

_____ (2004). *Assam Development Report*, 2004.

_____ (undated). Assam Five Year Plan: A Review. Planning and Development Department, Assam.

_____ (1960). Draft Third Five Year Plan, Assam. Planning and Development Department: Shillong.

_____ (1978). Draft Five Year Plan, 1978-83. General Areas, Vol. II. Agriculture and Allied Services including Co-operation. Planning and Development Department.

_____ (1975). Report of the Assam Agriculture Commission.

_____ (2002). *Sectoral Policies and Programmes, Tenth Five Year Plan*, Vol. 2.Planning Commission.

Goswami, P.C. (eds.) (1989). *Agriculture in Assam.* Assam Institute of Development Studies: Guwahati.

Goyari, Phanindra (2005). Flood damages and sustainability of agriculture in Assam. *Economic and Political Weekly*, Vol. 40 (26), pp. 2723-2729.

Grigg, D.B. (1980). *Population Growth and Agrarian Change: An Historical Perspective*. Cambridge University Press: Great Britain.

Harris, J.R. and M.P. Todaro. (1970). Migration, unemployment and development: A two sector analysis. *American Economic Review* 60 (March): 126-142.

Hayami, Y. and V. W. Ruttan. (1985). *Agricultural development: An international perspective.* The Johns Hopkins University Press: Baltimore

Jha, Brajesh (2006). Rural non-farm employment in india: macro-trends, micro-evidences and policy options. *Working Paper 272.* Institute of Economic Growth: New Delhi.

Keys, Eric McConnell and J. William (2005). Global change and the intensification of agriculture in the tropics, *Global Environmental Change,* assessed from www.sciencedirect.com.

Krishnaji, N. (1994). Population pressure 1891-1981: regional variations and consequences. Working paper no. 25, *Centre for Economic and Social Studies:* Hyderabad.

Malthus, T.R. (1989). *An Essay on the Principle of Population. Verrion published in 1803, wirh variora.* Cambridge University Press: Cambridge.

Mandal, Raju (2010). Cropping patterns and risk management in the flood plains of Assam. *Economic and Political Weekly. Vol. 45(33).*

Mellor, J.W. (1976). *The New Economics of Growth- A Strategy for India and the Developing World.* Cornell University Press.

Narayanmoorthy, A. (2007). Deceleration on agricultural growth: technology fatigue or policy fatigue? *Economic and Political Weekly, pp.* 2375-2379.

Netting, R. C. (1993). *Small-Holders, Householders: Farm Families and the Ecology of Intensive, Sustainable Agriculture.* Stanford University Press: Stanford, CA.

NSSO (2006). Some Aspects of Operational Land Holdings in India, NSS 59th Round, January to December 2003, Report No. 492 (59/18.1/3), National Sample Survey Organization, Ministry of Statistics and Programme Implementation, Government of India.

Levi, J. F. S. (1976). Population pressure and agricultural change in the land-intensive economy. *Journal of Development Studies* 13, pp. 61-78.

Lipton, M. (1990). Responses to rural population growth: Malthus and the moderns. In G. McNicoll and M. Cain (Eds.), *Rural Development and Population. Population and Development Review. A Supplement to Vol. 15.* Oxford University Press: Oxford.

Pani, Narendar (1981). *Production Conditions in the Rice Economy: Case Studies of Tamil Nadu and Assam.* Unpublished Ph. D Thesis submitted to University of Mysore through the Institute of Social and Economic Change: Bangalore.

Pingali, P. Y. Bigot and H.P. Binswanger (1987). *Agricultural Mechanization and the Evolution of Farming Systems in Sub-Saharan Africa.* Baltimore: Johns Hopkins University Press.

Pender, John (1999). Rural population growth, agricultural change and natural resource management in developing countries: a review of

hypotheses and some evidence from Honduras. EPTD Discussion Paper No. 48. Environment and production technology division, *International Food Policy Research Institute*, Washington D.C.: U.S.A.

Phukan, Umananda (1990). *Agricultural development in Assam, 1950-1985.* Mittal Publications: New Delhi.

Prasad, Arbind and Jagdish Prasad (1994): *Development Planning for Agriculture: Policies, Economic Implications, Inputs, Production, and Marketing.* Mittal Publications: New Delhi.

Rao, P. Parthasarathy, P. S. Birthal and P.K. Joshi. (2006). Diversification towards high value agriculture: role of urbanization and infrastructure. *Economic and Political Weekly* pp. 2747-2753.

Roy, Niranjan (1999). *Problems and Prospects of Agricultural Growth in the Barak Valley Region of Assam.* Unpublished Ph. D Thesis submitted to Department of Economics, Gauhati University: Guwahati.

Ruthenberg, H. (1980). *Farming systems in the tropics, 3rd ed.* Clarendon Press: Oxford.

Sarma, J.S. (1991). Agricultural policy in India. In Devendra Thakur (eds.), *Planning and Development of Key Sectors in India: Agriculture Sector Development, Vol. 3.* Deep and Deep Publications: New Delhi.

Scott, J. C. (1976). *The Moral Economy of the Peasant* .Yale University Press: New Haven, CT.

Sharma, H.R. (2005). Agricultural development and crop diversification in Himachal Pradesh: understanding the patterns, processes, determinants and lessons. *Indian Journal of Agricultural Economics. Vol. 60 (1).*

Singh, Vijay P., Narayan Sharma and C. Shekhar P.Ojha (2004). The Brahmaputra Basin Water Resources. Kluewer Academic Publishers: Netherlands.

Singh, Surendra and Bimal Sharma. (2007). Changing pattern of agricultural productivity in the brahmaputra valley. *Indian Journal of Agricultural Economics, Vol. 62* (1).

Soni, R.N. (1987). Population growth and land use pattern: a critical appraisal of Boserup's thesis. In B.N Ghosh (eds.), *Studies in Population and Economic Development. Vol.* 2. Deep and Deep Publications: New Delhi.

Schulter, M. and John W. Mellor. (1972). New seed varieties and small farmers. *Economic and Political Weekly*, Vol. 8 (12).

Turner II, B.L. and A.M. Shajaat Ali, (1996). Induced intensification: agricultural change in Bangladesh with implications for Malthus and Boserup, Vol. 93, pp. 14984-14991.

Turner II, B.L., Robert Q. Hanham, Anthony V Portararo. (1977). Population pressure and agricultural intensity. *Annals of the Association of American Geographers, Vol. 67* (3), pp. 384-396.

Turner II, B. L., G. Hyden, & R. W.Kates (eds.) (1993). *Population Growth and Agricultural Change in Africa*, University Press Florida: Gainesville, FL.

Vaidyanathan, A. (2002). India's agricultural development policy. In Raj Kapila and Uma Kapila (eds.), *Indian Agriculture in the Changing Environment* . Academic Foundation: Delhi.

Vasey, D.E. (1979). Population and agricultural intensity in the humid tropics. *Human Ecology* 7(3), pp. 269-281.

Weir, D.R. (1988). Malthus's theory of population. In J. Eatwell, M. Milgate. and P. Newman (eds.), *The New Palgrove*, pp. 290-293. Macmillan: London and Basingstoke.