The Factors Causing Agrarian Crisis in India:
A Study from Four Agro-ecological Regions in India

Final Report

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Executive Summary

India is the second most populous country in the World. It is a middle income country in terms of per capita incomes. While agriculture accounts for only 12% of the national GDP, 55% of the people in rural areas are directly dependent on this sector as a major source of livelihood. That makes it nearly 520 million people. While the economy continued to grow, the agricultural component of the GDP has been falling consistently, but not so much the proportion of people living on farming. The primary sector of India's economy is therefore in a crisis.

The following characterize the growing agrarian crisis in India. *First*: the overall profitability in farming is reported to be declining. S*econd*: farming is increasingly becoming a risky enterprise, with increasing production, technology, credit and market related risks. *Third*: with declining size of operational holdings, the average potential surplus from farming is becoming insignificant. *Fourth*: there is growing dis-interest and lack of motivation amongst the rural youth in farming, with a resultant increase in average age of population engaged in farming, and consequent lack of ability to make use of state of the art technologies and equipments for farm modernization. There is a need to examine the root cause of this vexing phenomenon. Particularly, it is important to know how various physical, socio-economic, institutional and policy factors have contributed to the current crisis.

With this backdrop, a research study led by Institute for Resource Analysis and Policy, by a consortium of three research institutions was undertaken in January 2014. The aim of the study was to identify the various physical, socio-economic, institutional and policy factors causing the current agrarian crisis in India, and to suggest institutional and policy measures for their mitigation. The study involved the use of new conceptual framework and empirical methods. The study was grounded in four agro-ecological regions from four states in India, viz., Gujarat, Andhra Pradesh, Maharashtra and West Bengal, on the theme of Agrarian Crisis. The locations covered are: Palanpur district in semi-arid and alluvial north Gujarat; districts of Hooghly and 24 North Parganas in west Bengal; West Godavari district of coastal Andhra Pradesh; Chandrapur district in the semi-arid, hard rock area of Vidharbha region in Maharashtra.

The study addressed the following key research questions:

- To what extent physical factors such as resource depletion and degradation primary productivity of land and changing weather patterns, have contributed to the current agrarian crisis in India?

- To what extent socio-economic factors such as increasing employment opportunities in the non-farm sector in the rural as well as urban areas, and outward movement of people from rural areas to urban areas as a result of better education and declining size of operational holdings and better wages have contributed to the crisis?

- To what extent, the institutional and policy factors such as reduction in input subsidies, globalization of agriculture and creation of non-farm employment through legislative measures and crop insurance have precipitated or reduced the crisis?

- To what extent, the nature of crisis in agriculture change from region to region?

Methodology

The study involved a longitudinal analysis involving time series data of farm inputs, outputs and throughputs at the level of individual farms to understand the changes in agricultural production situation from the point of view of farming as an economic enterprise. The study comprised four distinct regions, each one characterized by a unique 'agro climatic and socio-economic setting', to enable the influence of these factors on the nature and magnitude of the crisis. The time frame considered was thirty five years, beginning 1980. The time series data were obtained from the farm households using recall method. From each region, a total of five villages were chosen for the field investigation. A total of 526 households were chosen for the survey. The five villages from each location were selected in such a way that they together represent the unique characteristics of the region by capturing the variations in agro climate, geo-hydrology and land holdings and overall socio-economic conditions.

A range of analytical procedures were used to estimate the changes in net income from farming at the farm level over time, changes in opportunity cost of engaging in farming operations for the farm households, changes in size of operational holdings of farmers over time, and changes in risk involved in farming. The study assessed the magnitude of the crisis and the physical, socio-economic, institutional and policy factors causing it. Based on the identification of these factors, the institutional and policy measures were suggested for each region.

A questionnaire was designed to collect data from sample households on the following: a] extent of use of farm inputs, and farm outputs; b] market price of inputs; c] farm gate price of farm outputs; d] time series data on historical changes in use of inputs and volume of outputs produced for crops and livestock; and, e] time series data on historical changes in the price of inputs, farm gate price of produce and wage rates for farm labourers. A separate questionnaire was also designed to collect data at the village level for sample villages on the following: a] total number of operational holdings in at present; b] total number of farmers; c] land holding pattern; d] total number of wage labourers engaged in farming operations; e] wage rates in non-farm sector; f] market price of agricultural land in the village, and, f] time series data on historical changes in all of the above.

Secondary data was collected from each region on the overall physical environment, socio-economic conditions including agricultural scenario, migration, non-farm employment, wage rates in farm sector and non-farm sector, education, market dynamics in agriculture, and government interventions in agriculture sector.

Net income from farming at any given point of time was estimated by considering the following: i] the net return from each crop per household; and ii] the percentage area under each crop considering all the crops grown during the year. Further, revenue from dairying was separately estimated using; i] the milk yield from each category of livestock per livestock unit and its selling rate; and, ii] the number of animals under each livestock type. All the income figures will be adjusted to real prices (2013-14 prices) using Consumer Price Index for comparison.

Farming risks were assessed considering the physical and socio-economic factors causing crisis in the agriculture sector in the selected regions. Impact of institutional and policy factors on reduction in input cost, improvement in infrastructure for procurement and marketing, and creation of non-farm employment through legislative measures are also analysed.

The report contains the following important sections: a historical perspective to the agrarian crisis in India; an analysis of historical changes in farming systems in India, with particular reference to the four states chosen for the study; and the results of the analysis of primary data collected from the four districts, each one representing a distinct agro-climatic region in the country; findings; and conclusions and policy inferences. The results are with respect to the characteristics of the farm households, including their family size, landholding size and income expenditure in the four study locations; the changes in cropping pattern and irrigation pattern, cropped area and irrigated area over time for the sample households; changes in their farm inputs and expenditure over time; changes in their crop yield and crop income per unit area over time; changes in livestock holding, milk yield and income from dairy farming over time; and the

changes in the overall net income from unit gross cropped area and for the household as a whole. The major findings of the study are summarized below:

Findings of the Study

Where is the Crisis Most Severe?

Both the nature and severity of agrarian crisis change across regions. Among all the four regions, the farm income for the households is lowest in Vidarbha. Also, the degree of reduction in farm income over time is also the highest here. It goes without saying that among the four regions, the crisis is most severe in Vidharbha. This corroborates with the widely studied other manifestations of the agrarian crisis in the region in terms of farmer suicides, and large scale migration of farm workers to the urban areas.

In West Godavari, there is a minimal crop diversification and farmers entirely depend on paddy for their livelihoods. This can have serious implications for their earnings during an extremely-wet or a dry year. During a year of below normal rainfall, irrigated area will reduce, whereas floods can damage the entire standing crop. Dependence on just one crop and rainfall variability might be responsible for decline of contribution of agriculture to household's total income and reduction in milk yield as availability of green fodder becomes an issue. Nevertheless, the district has been able to register a substantial increase in farm income over a period of 35 years but it still remains one of the lowest among the selected regions.

In Hooghly and North 24 Parganas of West Bengal, very small landholdings and difficulty in accessing irrigation water is having an impact on farm income for small and marginal farmers. Starting from 1980-81, the net farm income per household had declined drastically till 2000-01, but picked thereafter. Though the average farm income is the highest here among the selected regions, rising fertiliser cost is resulting in significant increase in input cost for rabi and summer crops. As a result, net income per unit cropped area has begun to decline. But, this is offset by increase in gross cropped area owing to irrigated area expansion. The non-existence of proper infrastructure for milk procurement and marketing affects income from dairy farming.

In Banaskantha, a water scarce district, returns from agriculture are seriously impacted due to low farm gate prices for most of the crops. However, dairy as an enterprise is booming and emerged as a major livelihood activity for the households. However, due to groundwater overexploitation in the region, farmers' expenditure on either deepening wells or arranging for the alternate source of water for irrigation will rise. Though the farmers have also adopted micro-

irrigation technologies such as drips and sprinklers, water use in agriculture hasn't reduced much as they bring more area under irrigation with the saved water.

In Chandrapur, most of the households depend on agriculture as the only source of income. However, farmers have to be content with growing crops in only two of the agricultural seasons. Water availability for irrigation during winter season is a major limiting factor for achieving higher crop yield. Availability of water in wells becomes a serious constraint during the droughts, which recur in the region. Large scale seasonal failure of agro-wells is also reported. Average household income is one of the lowest and agriculture is subsistence in nature. As the availability of water is an issue, most of the households do not own cattle.

What are the physical factors causing crisis in the agriculture sector?

In Coastal Andhra, as most of the groundwater is saline it is not used and canals are the major source of irrigation. However water availability from them depends on release from the reservoirs which is again dependent on the occurrence of rainfall during a hydrological year. Thus most of the irrigated agriculture in the region depends on monsoon.

In North Gujarat, low rainfall and high aridity are the most significant physical factors affecting water availability and hence leading to a sort of agrarian crisis. As the average water consumption for crop production far exceeds the average rainfall in the region owing to intensive cultivation of crops which are grown during non-rainy season, groundwater gets depleted. During drought years, groundwater replenishment drastically reduces, but overall water withdrawal for crop production increases. After droughts, farmers have to incur extra cost on well deepening. As a result, farmers have to spend a substantial portion of their net income on deepening the existing wells. A large proportion of the wells, i.e. about 68%, are deepened every year. The receding ground water levels have also resulted in decline in average area irrigated per tube well.

In Vidarbha, droughts resulting from monsoon failure are a major reason for farmers' distress. In combination with the regions geo-hydrology, it seriously affects the groundwater availability for irrigation. While during monsoon, water overflows from the large number of open wells tapping the un-weathered portion above the hard rock aquifers due to their limited storage potential. By late winters, most of the groundwater gets used up for irrigation or household consumption or flows out as base flows. Hence by summers, most of the wells become dry.

In Gangetic Plains of West Bengal, farmers have reported reduction in soil fertility. This is mainly due to high cropping intensity and increased use of fertilisers which deplete soil of its

essential micro-nutrients. Also, in a number of areas groundwater is unusable as it is highly saline.

What are the socio-economic factors causing the crisis?

In Gangetic plains of West Bengal, declining land holding size is a major problem. One of the major consequences of this is on the gross cropped area per household which has declined. As a result, household's overall earning has declined. Further, the region has mainly marginal and small farmers and their dependence on rented diesel pumps to lift groundwater for irrigation is quite high. Erratic electricity supply makes it difficult for even those who own electric pumps. This social set up is leading to an agrarian crisis in the region which is further substantiated by the fact that close to 7% of the surveyed households has confirmed that there is increased migration to the cities in search of better employment opportunity.

In Vidarbha, where farmers are engaged in subsistence agriculture which yield low returns and which is subject to vagaries of monsoon, easy availability of non-farm labour work reduce their interest in agriculture. Availability of wage labour for unskilled work in industries is also a deterrent for farmers to rely only on agriculture. Since no crops are taken during summer, farmers take up these works to supplement the household income. In the process, some even permanently migrate to nearby towns like Ballarpur for better earning opportunities.

In North Gujarat, there are problems with the farm gate price offered to farmers for some of their produce. Though the region has a large number of milk cooperatives, with every village having one dairy at least and in some cases even two, there are no such influential cooperatives for selling agricultural crops, which can help farmer to get right rate of their produce.

A considerably large proportion of the children from the households surveyed from North Gujarat, Gangetic Plains of West Bengal and Coastal Andhra are studying in schools. A high proportion of households in these regions want their children to take up jobs and migrate to cities. This indicates that there would be a great reduction in number of people engaged in agriculture from these regions in the years to come.

What are the institutional and policy factors?

Subsidy on energy and fertiliser continue to play an important role in reducing expenditure on agricultural inputs for medium and large farmers in North Gujarat and Costal Andhra, whereas, they occupy a major proportion of the total input costs for small and marginal

farmers in Gangetic Plains and Vidarbha. Nevertheless, electricity subsidy for agricultural pumping of groundwater is one of the factors responsible for decline in groundwater levels in North Gujarat, which, in turn, has adversely affected farmers' income by increasing the cost of irrigation and expenditure on well deepening. Further, in Coastal Andhra, where farmers are content with mono-cropping, the current cultivation practices are producing low returns in comparison to other regions and can also affect region's soil productivity in long run.

Marginal and small farmers in Gangetic Plains of West Bengal were found to be spending a high amount on fertilisers. As a result farm income has declined substantially. Considering that the region is one of the largest producers of vegetables, lack of policy initiatives to reduce input cost is detrimental for the sustainability of agriculture in the region.

In Vidarbha, small farmers are unable to access a sustainable source of irrigation. The wells in this hard rock region are poor-yielding and dry up much before summer. Therefore, farmers take less risk and apply agri-inputs at sub-optimal level. As a result, both crop yields and returns are low. This has created a vicious cycle in the region where farmer apply low inputs, gets low yields and returns and further reduces expenditure on crop inputs.

In dairy development, North Gujarat has a well-developed dairy structure which is supported by a professional milk marketing agency. However, lack of infrastructure for milk procurement in Coastal Andhra and Gangetic Plains of West Bengal is making farmers disinterested in dairy as it is yielding low returns. Also the milk prices offered to farmers in Gangetic plains are lower than in other States.

Conclusions and Policy Inferences

The study clearly shows that the widespread perception about a growing agrarian crisis in India is largely true. However, the degree of crisis varies across regions--being highest in regions such as Chandrapur where natural endowment of water is poor; access to irrigation water is low; the farmers have poor land holdings; and the access to institutional credit and markets are also very poor. Also, the factors which act as drivers for this crisis can vary from region to region. In the semi-arid, Coastal Andhra, North Gujarat and Vidarbha regions, physical factors, such as rainfall variability, overall scarcity of water, groundwater depletion, limited availability of groundwater, are causing stress on farming enterprise, whereas in West Bengal socio-economic factors, such as declining size of landholding, migration and poor market conditions are the key factors. Non-availability of labours to work in farms, owing to large-scale migration of rural wage labourers to urban areas and engagement of a large number of those who are left behind in

public works under the rural employment guarantee scheme was also significant in Vidarbha region.

But, even within the same region, the crisis is not uniform across different socio-economic segments of the farming community. The institutional and policy regimes governing the access to and use of water and distribution of input subsidy benefits ultimately decide how this crisis actually get played out across different socio-economic segments. The existing energy and fertilisers subsidies are providing more benefit to large farmers in North Gujarat and Coastal Andhra Pradesh. For instance, in north Gujarat, the large and medium farmers who own wells are able to access groundwater at considerably low costs, which do not reflect the social cost of resource depletion because of heavy electricity subsidies. Whereas small and marginal farmers who dominate agricultural sector in the Gangetic Plains of West Bengal and Vidarbha continue to incur high input costs. Further, apart from North Gujarat where a proper infrastructure for milk collection, its distribution, processing and marketing is in place, dairy is unable to take off in other regions due to either low milk yields or low milk procurement prices. In Vidarbha it is a complete non-starter. Therefore, a blanket policy across regions will not work in making agriculture a lucrative enterprise, especially for small and marginal farmers.

In naturally water scarce areas like North Gujarat where groundwater is the major source of irrigation, establishing system of water rights and efficient pricing of energy used for groundwater pumping would not only lead to resource sustainability but will also reduce farmer's expenditure on well deepening. It will also help small and marginal farmers, who are now dependent on water purchase to secure water rights in the region. Further, establishing a proper post-harvest marketing system to give farmers fair return of their produce needs to be established. In areas which are largely under mono cropping, such as Coastal Andhra, incentives in the form of easy availability of seeds and proper market for produce should be given to promote adoption of other remunerative crops. This will help in increasing farmers' income and also restore soil fertility.

In areas where rainfall variability is high, and groundwater resources, which act as drought buffer, are extremely limited due to the hard rock geology, such as Vidarbha, an effective drought monitoring and prediction system needs to be established. It will help farmers in making judicious decision on crop choice based on the information on the water availability during a particular hydrological year and help them reduce their losses. Along with this, long term plans for investment in surface irrigation systems also will have to be explored, provided they are economically viable.

In areas where water is abundant but land is scarce, such as Gangetic Plains of West Bengal, any policy intervention which is based on the strategy of intensifying land and water use will not work, unlike what some researchers have recently claimed, as land use intensity is already very high there. However, technological and institutional interventions to improve the economic access of small and marginal farmers to irrigation water can be explored such as introduction of micro diesel engines and targeted subsidies for poor farmers. Simultaneously, a new policy for agricultural growth, which is driven by the strategy of enhancing the productivity of land and water and which is built on the concept of multiple use systems, needs to be adopted. Along with modification in farming systems, the markets for high value agricultural produce need to be strengthened, so as to encourage farmers to go for crop diversification. For dairy to become attractive in West Godavari and Gangetic Plains a proper infrastructure for milk procurement needs to be established.

1 Introduction

India is the second most populous country in the World. Though it is one of the fastest growing economies in the World, it is a still a middle income country in terms of per capita incomes. While agriculture accounts for only 12% of the national GDP, majority of the people in rural areas (nearly 55%), wherein nearly 68% of the country's population live, are directly dependent on this sector as a major source of livelihood. That makes it nearly 520 million people, nearly twice the population of United States. While the economy continued to grow, the agricultural component of the GDP has been falling consistently since Independence[1], but not so much the proportion of people living on farming. The primary sector of India's economy is therefore in a crisis. Some scholars believe that by the time India becomes a developed economy, a large proportion of the rural populations would have eventually moved to cities and towns, and only a small fraction of the people living in rural areas would be engaged in farming, a phenomenon observed in many developed countries, and that this crisis is only a temporary phenomenon.

It is true that many developed and industrialized nations around the World had experienced major structural changes in their economy from agriculture to manufacturing and service sector and have seen remarkable shift in occupational profile of their people. However, assuming a similar trajectory for India would be problematic. There are two vital reasons for this. First of all, it took a couple of centuries for this transition to happen in the case of most developed countries of the west. Secondly, if manufacturing sector has to absorb a vast majority of these people (500 + million), the scale of industrialization required would be massive and this would be hard to achieve in the next few decades, as the growth in that sector will have to be primarily driven by growth in domestic consumption, and not exports[2]. On the other hand, given the fact that the size of average land holding in the most backward regions (Bihar, West Bengal, Assam, Orissa and Uttar Pradesh) is very small (Kumar *et al*., 2012), and is constantly on the decline, the ability of a large section of the rural people dependent on farming directly or indirectly, to generate surplus, and get the necessary education and skills to move up in the economic ladder and increase their purchasing power in the near future, is highly questionable.

This scenario suggests that a vast majority of the people would continue to live in rural areas with low incomes, in spite of demographic shift, in view of the growth in rural population. This can threaten the sustainability of the very growth, which is witnessed in the country's economy in the past two decades as such a growth will not be broad based. Therefore, the crisis may not be temporary and cannot be ignored.

With this backdrop, a research study led by Institute for Resource Analysis and Policy, by a consortium of three research institutions was undertaken in January 2014. The aim of the study was to identify the various physical, socio-economic, institutional and policy factors causing the current agrarian crisis in India, and to suggest institutional and policy measures for their mitigation. The study involved the use of new conceptual framework and empirical methods. The study was grounded in four agro-ecological regions from four states in India, viz., Gujarat, Andhra Pradesh, Maharashtra and West Bengal, on the theme of Agrarian Crisis. The locations covered are: Palanpur district in semi-arid and alluvial north Gujarat; districts of Hooghly and 24 North Parganas in west Bengal; West Godavari district of coastal Andhra Pradesh; Chandrapur district in the semi-arid, hard rock area of Vidharbha region in Maharashtra.

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[1] It consistently dropped from 51.4 per cent of the total GDP in 1950-51 to 15.5%of the GDP in 2010-11 (MoA, 2012).

[2] This is in lieu of the fact that most of the countries where the consumption levels are very high are already highly industrialized and India cannot compete with these countries in terms of advanced technologies. The only possibility is that the underdeveloped countries of Africa to grow rapidly to become major importers of manufacturing from India. This is also very unlikely.

2 What Constitutes the Current Agrarian Crisis in India?

The following characterize the growing agrarian crisis in India. *First*: the overall profitability in farming is reported to be declining. S*econd*: farming is increasingly becoming a risky enterprise, with increasing production, technology, credit and market related risks. *Third*: with declining size of operational holdings, the average potential surplus from farming is becoming insignificant. *Fourth*: there is growing dis-interest and lack of motivation amongst the rural youth in farming, with a resultant increase in average age of population engaged in farming, and consequent lack of ability to make use of state of the art technologies and equipments for farm modernization. There is a need to examine the root cause of this vexing phenomenon. Particularly, it is important to know how various physical, socio-economic, institutional and policy factors have contributed to the current crisis.

3 Agrarian Crisis in India: A Historical Perspective

From Neolithic age (10000-800 BC) to neoliberal times of 1991 onwards agriculture in India occupied a crucial place in the lives of the people and in the development of its economy. Apart from providing food grains to the nation, it released labour, generated savings and promoted the markets of individual goods. Agriculture has been instrumental in earning foreign exchange. This is the brighter and also at the same times the dark side of the country's economic growth. Important chronological documentation of events and dates in early Indian history was poor. Sanskrit samhitas, *puranas* archaeological evidences and travelogues of foreign travellers form the basis for interpretations. India under the British rule got a chronology of historical events written by Europeans, which after 1947 was corrected by several Indian scholars. This bears testimony to the existence of agriculture in Indian sub- continent ever since 9000 BCE with domestication of wheat and barley plants and animals like sheep, goat and elephants. The encyclopaedia Britannica mentions that in the latter Vedic texts (1000-500 BC) references are replete on the cultivation of a wide range of cereals, vegetables and fruits. Milk and milk products were part of the diet and animal husbandry was an important activity.

The Indus valley civilization more correctly called the Indian –Saraswati. Rivers civilization (Nene, 2012) flourished in India and Pakistan. This civilization was most prosperous, produced surplus grain and shipped to countries in West Asia and North and East Africa (Kalyanaraman, 2000) for trade. Kautilya (321-296 BC) authored 'Arthasastra' a great remarkable treatise of the times on state craft. It contains the 'Varta' the science of agriculture animal husbandry and trade as one of the four sciences included in the book. For the art of management of crops, sowing intercultural practices, plant protection in addition to describing the advancements made in agriculture during that times and also delineating organization roles for the administrators of agriculture were all detailed in the book. References to agriculture were not restricted to northern parts of the country but also to the South Indian context. Tirukkural (70 BC) a famous Tamil classic had several comments on agriculture. With the decline of Maurya Empire, Gupta dynasty ruled the country. Varahamihira wrote *Brihat Samhita* (505-587 AD) which contains modes of detecting ground water resource predicting, rainfall, and guidelines for crop choices which were widely acclaimed by scholars.

The Arab agriculture revolution from 700AD bloomed with the rapidly expanding Arab empire. The global economy brought in by Muslim traders across the old world enabled diffusion of many crop and farming techniques among different parts of the Islamic world. Several crops like mangoes, rice, cotton and sugarcane grow in India spread throughout in Muslim ruled areas. The Arab Agricultural Revolution continued until 1300 AD. Several texts in Sanskrit and other languages were written, which dealt with agriculture, horticulture and fauna. Irrigation and

storage systems were built in India like in other places such as Mesopotamia, Egypt, Iran, China and Srilanka right from the early period. Thus the glimpses of the fascinating accounts of development of agriculture which had parallels and adoptions in India from the advancements made elsewhere shows that it kept pace with the march of history.

From early 18th century there has been gradual development in agricultural machinery, fertilizers and recognition of plant diseases. Indians from late 17th century AD had used manure which they had innovated called 'Kunjapajala[1]' (Nene, 2012). The latter Indian economic history provides pointers on the long term dynamics of agricultural growth in the south Asia region.

The shift in the trajectory of economic growth is worth recalling. "According to the best estimates available India's national income increased between 1870 and 1914 at a rate of 1-2 per cent per year, and per capita income at the rate of 0.5-1 per cent per year. Simon Kuznets' calculations showed that the growth rate of national income ranged between 1.5 and 3.1 per cent per year (except US, Japan and Canada) among the industrializing countries in the late 19th century. Pre-war India was not far behind this standard. What made these other countries special was that growth was sustained there for a much longer period of time than in India. In interwar India, by contrast, rate of growth of per capita income declined to near zero[2]". Here came the shift in economic growth in the second decade of 20th century (Roy, 2006).

The growth of manufacturing industry though compensated the slump in the growth of agriculture to an extent after the first war it was too small to outweigh the stagnation. From 1930's to mid70's, real agricultural wages showed continued stagnation and the number of agricultural labourers increased. The historiographical explanations of class-cum-capital arguments could not shed much light on the agrarian crisis of 1920's. Shrinking of the extent of land availability on one hand and growing population on the other were attributed by some scholars as the reason for the looming crisis in the economic growth during this period. However, the statis of interwar period was over by the late 1950's when area, land productivity and cropping intensity were growing at a much better rate than in the earlier period. The trajectory of agricultural growth was accentuated with the development process and initiatives from the government in 1950's through 1970's (Sivamohan, 1990).

It took five years for India after Independence to slowly gear up for development activities in 1951. The planning commission was established to initiate planned development. During the first decade after 1951 emphasis was laid on welfare goals and infrastructural works for rural development. The community development programme was launched in 1952. The programme envisaged the development of rural areas through concentration of efforts on individuals, Primary cultivators and some changes in government administration at the district and below. The programme's origin was in the early experiments especially the Etawah project and Nilokheri experiments of S.K. Dey in rehabilitating the refugees from Pakistan. Its thrust was promotion of welfare in the villages. The Community Development Programme was implemented along with National Extension service to bring about progressive outlook among people, promote cooperative action and enhance increased production and employment in rural areas. Thus the first phase of development efforts was in attempting to create an egalitarian rural society. The strategy adopted was based on the recognition of the need for structural changes such as land reforms.

The model as it was implemented however was of low political intervention with a reformist thrust against an essentially semi- feudal, pro-capitalist peasant society. Therefore, without radical transformation of rural society the programmes of Community Development, National Extension Service, and Cooperatives – did not make substantive impact on rural life. Ideology was quite strong as reflected in the strategy, but lukewarm commitment at the implementation level minimised good results trickling from the programme. In the second phase of developmental efforts, during sixties, productivity goals dominated the planning. As the growth rate in agricultural sector was not found satisfactory, in 1958 the government of India approached the Ford Foundation to examine the ways and means of increasing food production

in the country. Their report entitled, India's Food Crisis and Steps to meet it, identified pitfalls in food production. It suggested a programme entitled Intensive Agricultural Development Programme (IADP) to be introduced in 18 selected districts, based on a set of criteria. This report according to American and Indian experts accurately hit every bull's eye of the programme or programmes which India needed if she was to attain the increase in agricultural production which she sought. This programme has changed the direction and structure of development efforts by making them function on the basis of dominant goals.

While the community development strategy spread resources thinly across all the area, the IADP strategy was based on intensive approach to maximize the gains through integrated efforts administrative, technical and financial on an area basis did not achieve rapid increase in the levels of agricultural production. Only in three of the 18 selected districts perceptible changes in food grain yields were noticed (Brown, 1971). The lessons from IADP showed that creating irrigation potential and providing extension support is not sufficient to step up agricultural production. Hence, High Yielding Variety (HYV) programme was introduced in IADP as a component of IADP wherein high yielding seeds, chemical fertilizers etc., were also provided as a package. Around this time local pressures were building up in districts where the IADP was not introduced for launching of identical agricultural development programme. These pressures resulted in starting Intensive Agricultural Area Programme (IAAP) in as many as 114 districts with identical philosophy and approach that of IADP. The second decade thus saw the emergence of area based programmes such as IADP, HYVP and IAAP. All aimed at accelerating technological change to induce output and productivity in the agricultural sector. The approach was proved correct and resulted in the spread of Green Revolution.

Then came the third phase of developmental efforts where focused attention was given to those who could not derive benefit from the earlier developmental programme. In 1970 a special agency called the Small Farmers Development Agency (SFDA) was established in 46 districts, following the advice of the All India Credit Review Committee of the Reserve Bank of India. This programme was in several ways different from the earlier programmes. Firstly, the difference was in approach which was largely group oriented. Secondly, in this programme loan with subsidy as financial assistance was given. Lastly, the focus of attention was to enable the small landholders to become viable and approach which was not found in the past development efforts. Marginal farmers and landless labourers were also concurrently catered through yet another development programme called Marginal Farmers and Agricultural Labourers (MFAL) programme. The activities included under SFDA and MFAL programmes were minor irrigation schemes (wells), agricultural development, sheep rearing, goat rearing, fisheries, sericulture, dairying and the like. During the seventies attempts were made through development programmes to generate employment in rural areas. During 1971-72, a Crash Scheme for Rural Employment (CSRE) was launched which was later on intensified under the Pilot Intensified Rural Employment Project (PIREP).

4 Changing Agricultural Production Systems in India, with particular reference to the Four States: Emerging Scenario

4.1 Changing Land Holding Size and Land Use Patterns

4.1.1 Reducing Landholding size, and farm size

The last four decades has witnessed a sharp decline in the average size of operational land holdings in India (NABARD, 2014), reducing by half from 2.28ha in 1970-71 to 1.16ha in 2010-11. This was mainly contributed by the sharp increase in the number of holdings in the

marginal category, which swelled by 56 million. On the other hand, the number of large farmers reduced to 1.0 million in 2010-11 from 2.766 million in 1970-71.

Land holdings in the marginal category constituted 67% of the operational holdings in the country during 2010-11. In terms of area operated, their share increased to 22% in 2010-11 from a mere 9% during the year 1970-71. The land holdings in the small category constitute 17.9% of the operational holdings in the country in 2010-11. In terms of area operated, the share of small holdings has nearly doubled to 22.1% in 2010-11 from 11.9% in 1970-71. Land holdings in the semi-medium category constituted 16.0% of the operational holdings in 2010-11. In terms of area operated, the share of semi-medium holdings increased to 23.6% from 18.5%. As regards the medium category, they constituted 4.3% of the operational holdings in 2010-11. In terms of area operated, their share reduced to a mere 4.3% in 2010-11 from 11.2%. As regards the large holders, they constituted a mere 0.7% of the holdings in 2010-11. In terms of area operated, their share reduced to one third (10.9%) of what it used to be in 1970-71 (i.e., 30.9%).

The reduction in holding size affected almost every category of holders. In the marginal holding category, the average operational holding size slightly decreased from 0.4 ha in 1970-71 to 0.38 ha in 2010-11, a 5% reduction. In the case of medium farmers, a modest 5% reduction was seen. A mere 4% reduction was seen in the case of large farmers. However, what is most important from a macro policy perspective is that the reduction in average size of operational holding in the country at the aggregate level is as high as 49.4%.

4.1.2 Increasing Cropping Intensity and irrigation intensity

The land use categories in India are: 1] forest land; 2] non-agricultural land; 3] barren and un-culturable land; 4] permanent pastures and other grazing land; 5] land under miscellaneous tree, crops and groves; 6] culturable waste land; 7] fallow land; and 8] sown area.

The forest area which was 40.5 m. ha in 1950-51 increased to 70.0 m. ha in 2009-10. The area under barren and un-culturable land decreased from 38.2 m. ha in 1950-51 to 16.8 m. ha in 2009-10. Permanent pastures and other grazing land increased from 6.7 m. ha to 10.2 m. ha during the same period. The land under miscellaneous tree, crops and groves decreased sharply from 19.8 m. ha to 3.4 m. ha. The area under culturable waste land decreased from 22.9 m. ha to 12.9 m. ha. Area under fallow land reduced from 28.1 m. ha to 26.2 m. ha.

What is most remarkable is the change in area under crops, which increased from 118.8 m. ha to 140.0 m. ha. It constitutes 42.6% of the total geographical area in 2009-10. The net sown area peaked in 1990-91, with 143 m. ha sown. More importantly, there has been steady increase in the intensity of land use, with area cropped more than once increasing as a result of increase in irrigation facilities. The net irrigated area increased by 42.4 m. ha from 20.9 m. ha to 63.3 m. ha. The GIA increased by 63.8 m. ha from 22.6 m. ha to 86.4 m. ha. However, the increase in GIA (63.8 m. ha) did not result in proportional increase in GCA, due to the reason that the net (maximum) sown area which must have been under purely rain-fed cultivation was only 109.3 m. ha in 1970-71 against a net sown area of 118.8 m. ha, and it further reduced to 105.8 m. ha by 2010-11, if we assume that there is no double cropping under rain-fed condition. This means that there is significant amount of area in India, which receives irrigation water for the first crop itself and its proportion to the total cropped area, is on a steady rise. This area was a minimum of 9.5 m. ha in 1970-71 and this went up to 34.2 m. ha (i.e., 140.0-105.8)[3]. In other words, even the expansion in NSA was possible with expansion in irrigation, with a minimum of around 25 m. ha of additional irrigation (of 63.8 m. ha) going to the first crop itself.

[3] However, we still do not know how much the actual and the figure can only be higher than the estimates, because of the fact that there is no data on the area which is double cropped and under rain-fed conditions. As a matter of fact, in many high rainfall areas such as West Bengal, Assam and Kerala, two crops are taken under rain-fed conditions.

4.2 Changing Cropping Pattern and Livestock Composition

4.2.1 Changes in Cropping Patterns --rain-fed crops; irrigated crops

The cropping pattern in India has undergone significant changes over time. As the cultivated area remains more or less constant, the increased demand for food because of increase in population and urbanisation has put agricultural land under stress and thus resulting in crop intensification and substitution of food crops with commercial crops (Kannan and Sundaran, 2011).

The area under rice as a proportion of the total area declined from 23.02% in 1970-71 to 22.57% in 2007-08. In case of wheat the area increased from 10.42% in 1970-71 to 14.18% in 2007-08. As regards the total area under food grains, the percentage declined from 75.54 in 1970-71 to 63.52 in 2007-08, which is remarkable. There was sharp decline in the proportion of area under coarse grains, which include bajra and jowar, from 24.48% to 15.14%. As a result, the total area under cereals declined—from 61.9% to 51.9%. Interestingly the total area under oil seed crops increased from 9.85% (in 1970-71) to 13.93% in 2007-08. An increase in area under sugarcane as a proportion of the total cropped area was observed during the reporting period. Similarly the total area under 'non-food grain crops' also increased from 19.39% to 26.41%.

However, reduction in percentage area under a crop doesn't mean that the absolute area under that crop had reduced, particularly given the fact that the gross cropped area had increased by almost 50% from 131.9 m. ha to 192.2 m. ha. Overall, cultivated area under cereals increased from 78.23 m. ha in 1950-51 to 96.69 m. ha in 2012-13. The area under paddy went up from 30.81 m. ha in 1950-51 to 44.71 m. ha in 2010-11, and then came down to 42.41 m. ha in 2012-13. The area under wheat went up from 9.75 m. ha (1970-71) to 29.65 m. ha in 2012-13. The area under coarse cereals was 45.95 m. ha in 1970-71, but came down sharply to 24.64 m. ha in 2012-13. The highest area under cultivation for coarse cereals was in 1970-71 (45.95 m. ha). Area cultivated under pulses increased from 19.09 m. ha in 1950-51 to 23.47 m. ha in 2012-13.

The total area under food grain crops (fine cereals, millets and pulses) therefore, actually increased, i.e., from 97.32 m. ha to 121.16 m. ha, though a smaller percentage of the GCA is under food crops. While the increase in area is only 22% against a much larger increase in population during the reporting period of four decades, what is important is the increase in crop productivity (yields per unit area), which had enabled much larger production from a smaller area. We would discuss this in the subsequent section. This increase in crop yields was achieved mainly through increase in irrigation and adoption of high yielding varieties, particularly in paddy, wheat and maize sectors. But, the adoption of high yielding varieties was also enabled by access to irrigation facilities. Much of the fine cereals (rice and wheat) are irrigated today. The total area under irrigated rice and wheat went up from 24.26 m. ha to 53.18 m. ha. The irrigated area under fine and coarse cereals went up from 28.09 m. ha to 57.26 m. ha, and that of total food crops from 30.12 m. ha to 61.08 m. ha.

Table 1: Share of area under major crops in India (in terms of %)

	1970-71	1980-81	1990-91	2000-01	2007-08
Rice	23.02	23.18	23.00	23.82	22.57
Wheat	10.42	12.98	13.04	14.28	14.18
Coarse Cereals	24.48	24.25	20.48	16.17	15.14
Total Cereals	61.93	60.41	56.53	54.27	51.88
Pulses	13.50	13.23	12.94	11.49	11.93
Total Food Grains	75.54	73.67	69.47	65.32	63.52

Total Oil Seeds	9.85	10.11	12.51	12.96	13.93
Groundnut	4.42	4.14	4.64	3.68	3.20
Cotton	4.70	4.27	4.08	4.70	4.68
Jute	0.42	0.51	0.39	0.45	0.41
Total Fibre	5.41	5.08	4.64	5.27	5.18
Sugarcane	1.62	1.62	1.90	2.23	2.47
Tobacco	0.27	0.25	0.22	0.21	0.19
Condiments and Spices	1.04	1.23	1.32	1.52	1.55
Potatoes	0.31	0.43	0.51	0.69	0.76
Onions		0.14	0.17	0.24	0.36
Total Fruits and Vegetables	2.24	2.77	3.57	4.35	5.10
Fodder Crops	4.15	4.50	4.59	4.55	4.26
Total Non-Food grains	19.39	20.13	23.60	25.44	26.41
Gross Cropped Area	100.00	100.00	100.00	100.00	100.00

Source: Directorate of Economics and Statistics, Government of India

Similar trend was found in sugarcane and oil seeds also. The irrigated area under oil seeds went up from 1.87 m. ha to 4.89 m. ha and for sugarcane from 1.09 m. ha to 7.3 m. ha.

4.2.2 Changes in livestock holding pattern

India has world's largest livestock population, which includes cattle, buffaloes, goat and sheep, as the most important ones. The cattle population increased from 155.3 million in 1951 to 199.08 million units in 2007. The adult female cattle population increased from 54.4 million in 1950-51 to 72.95 million unit s in 2007. Similarly the population of buffalo, adult female buffalo, sheep and goats also increased gradually from 1950-51 to 2007. The total number of livestock units (comprising cattle, goat and sheep) went up from 285 m units to 516.5m units. What is most interesting is the changing composition of livestock. *First*: the proportion of small ruminants in the livestock population has steadily increased from 31.5% to 41.1%. *Second*: the proportion of buffaloes in the bovine population increased from 24.4% to 34.6%. Third: the proportion of cows in the cattle population also increased, i.e., from 30% to 36.6%. The reason for the first trend could be the rising price of meat; the reason for the second could be the higher milk yield from buffaloes; and that for the third could be the reducing preference for draught animals in rural areas for carrying out agricultural operations, which is replaced by machine power.

4.3 Changing Production Systems and Input Levels

4.3.1 Changes in Crop Growing Practices

Over the past 40 years or so, the way, Indian farmers practice agriculture had changes dramatically. This change has essentially come from expansion in irrigation facilities, mainly gravity irrigation from canals and well irrigation. In the early 1970s, a small percentage of the total area was under irrigation, i.e., only 20 m. ha out of the 118 m. ha of net sown area was under irrigation. Today a little more than 63 out of the 140 m. ha of sown area is under irrigation, which makes it to 45%. This means that 55% of the farmed area does not use irrigation facilities (known as the rain-fed area). As we have seen earlier, this doesn't mean that the rain-fed crop area is only 55%. In fact, as per our estimates, it is 105 m. ha, which is nearly 75% of the NSA. Much larger percentage of the net sown area is under rain-fed crops during rainy season either

because of sufficient amount of rainfall (like in Kerala, Assam and West Bengal) or due to the lack of access to irrigation water during that particular season (like in western Rajasthan and some hard rock areas of Gujarat, Maharashtra and Peninsular India). The figures therefore indicate that the maximum area that can be brought under irrigation in a given season is only 45%. These figures also do not suggest that the 55% of the net sown area, which is left out without irrigation facilities, actually require irrigation. However, unfortunately, this is one of the major misconceptions that exist in the sector.

In fact, many of the regions, which do not have irrigation facilities, may not require irrigation for crop production in most parts of the year owing to the excessively high rainfall which again lasts for several months starting from June to December, followed by winter and summer rains. Investment in irrigation may not be economically viable in such areas as marginal returns would be very low. Therefore, what comes out from the foregoing analysis is that the area which actually requires irrigation could be lower than 74 m. ha. However, the distinction between rain-fed areas which actually require irrigation for better crop growth due to moisture stress during growing season, and the rain-fed areas which remain as rain-fed by virtue of having sufficient amount of soil moisture from rainfall for crop growth is hardly ever made by the official agencies dealing with rain-fed areas (see for instance, NRRA, 2012)[4]. Therefore, the differential risk faced by farmers from these two distinct regions is never considered for agricultural policies.

That said a significantly large area is under irrigation in India even during the rainy season, which was estimated to be around 34.2 m. ha as on 2010-11. The area receiving such irrigation was only 9.5 m. ha during 1970-71. Probably, owing to the access to well irrigation, which is widespread regionally, farmers in the low and medium rainfall regions are able to provide supplementary irrigation to their long duration kharif crops (like irrigated cotton and castor), which replaced their shorter duration rain-fed counterparts.

4.3.2 Changes in electricity consumption in agriculture

Per capita annual energy consumption is a widely accepted indicator of development. Indian agriculture has more become energy-intensive and fossil-fuel based over the years. The total electricity consumption in India increased from 4182 GWh in 1947 to 852903 GWh in 2012-13, which is nearly a 204 times increase. Electricity consumption for agriculture increased by a staggering 1225 times from 125 m. units in 1947 to 153 billion units in 2012-13. The total electricity consumption in 1947 was 4182 m. units of which only 3% was for agriculture. However, by 2012-13, the electricity consumption in agriculture was nearly 18% of the total electricity consumption, a clear indication of how agriculture is becoming increasingly mechanized and dependent on fossil fuel.

Irrigation is the major energy consuming areas in crop and dairy farming and agricultural processing. The electricity consumption per unit of gross irrigated area increased four times from 7KWh/ha in 1950-51 to 30 KWh/ha in 1960-61. Since surface irrigation doesn't require much energy, the analysis was done in relation to the net well-irrigated area. The same rate of increase was seen in the case of net irrigated area by wells. Interestingly the consumption went on to increase 160 times to 1154 KWh/ha of gross irrigated area in 2006-07. If we consider the net irrigated area by wells the electricity consumption increased by 100 times to 2758KWh/ha during the same time period. This drastic increase in the electricity consumption can be mainly attributed to the increase no of wells and electric pump sets, whose proportion of the total area

[4] As a result of this, the criteria used for classification of 'rain-fed areas' in India, based on extent of irrigation as a percentage of the net sown area in the district, put both Kerala and western Rajasthan under the same category, as one with more than 70% of area under rain-fed conditions and same type of recommendation is made in terms of measures to improve crop productivity. It fails to make the distinction between the two regions in terms of incidence of moisture stress during the growing season.

under irrigation has been consistently increasing over the past four decades, to become nearly 65% of the net irrigated area in the country. Over and above an increase in the amount of groundwater pumped for irrigation, the energy consumption per unit of groundwater pumped has been increasing in many semi-arid and arid areas owing to decline in groundwater levels.

4.3.3 Changes in Fertilizer Consumption

Fertilizer consumption in India has been increasing over the years and today India is one of the largest producer and consumer of fertilizers in the world. By 2009-10, total fertilizers consumption in the country was 26.49 m. nutrient ton (Jaga and Patel, 2012). Usage of fertilizers also grew as increasing number of farmers started applying fertilizers to their crops and with increasing dosage. The gap between the consumption and production is met through imports[5].

With limited arable land[6] and the burden of increasing population, efficient use of inputs will play an important role in sustaining food security in India. Therefore, the only way to improve food production is to increase crop yields through the scientific use of fertilizers along with other inputs like high yielding variety seeds, irrigation, etc., using the limited arable land, with an emphasis on protecting the environment. The Government has been consistently pursuing policies conductive to increased supply and consumption of fertilizers (Jaga and Patel, 2012).

Over the last six decades, production and consumption of fertilizers has increased in India significantly. The total fertilizer consumption in 1950-51 was 0.69 lac ton. A consistent increase in the consumption was observed during 1950-51 to 2011-12. During 2011-12, the fertilizer consumption was 277.4 lac ton (increased by nearly 402 times from 1950-51 levels). In terms of consumption per unit of net sown area, the fertilizer consumption during 1950-51 was only 0.58 kg/ha. Over the years the consumption increased to a whooping level of 189.1 kg/ha of net sown area. Per ha of gross cropped area, the consumption went up from 0.52 kg to 137 kg during the reporting period. The increased use of fertilizers had resulted in substantial increase in crop yields in the Green Revolution areas. But, the intensive use of land resources for cultivation with 2-3 crops through the help of irrigation water had also resulted in loss of primary productivity of soils. This is forcing farmers to apply higher dosage of fertilizers to maintain yield levels.

4.3.4 Changing Degree of Farm mechanization and Labour Use

Draught animals were the major source of power for farming operations till 1971-72. This was followed by the use of diesel engines, electric engines and human labour. But, gradually this is being replaced by machines, in the form of tractors, tillers, electric and diesel pumps for irrigation, which was enabled by easy access to drilling technologies, pump sets, electricity supply, diesel and machines and tractors and tillers in rural areas and access to finance for purchase of agricultural equipments. The biggest change has come in the use of tractors, which currently account for 42% of the total power use in farming, from a meagre 8.5% in 1971-72. The tractors have essentially replaced use of human labour and draught animals for ploughing. Diesel engines and electric pumps have replaced draught animals and human labour in lifting water from wells and ponds. Electric motors supply 25% of the total power requirements in farming. The level of mechanization is highest in harvesting and threshing (as high as 60-70%), followed by soil working and seed bed preparation (40%) and irrigation (37%). The total power use in farming operations has also gone up from 0.424kW/ha to 1.658 kW/ha. However, full utilization of available power for agricultural operations requires sufficient amount of land to operate, and availability of water.

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[5] India is the largest importer of urea, MAP, and DAP; second largest of ammonia; and fourth largest of potash fertilizers in the world (Sharma and Thaker 2010 as cited in Sreedhar *et. al*, 2012).

[6] It is expected that India's available arable land might drop below the current level of about 140 m. ha, if the use of farmland for commercial/non-agricultural purpose is not restricted in the near future

Economies of scale are obtained in farm mechanization if large and contiguous pieces of land are operated. However, reducing average size of operational holdings and increasing number of parcels (fragmentation) would pose big challenges to farm mechanization.

4.3.5 Agricultural Subsidies

While farming is a private enterprise in India, the government plays a vital role in agricultural development. Government interventions are diverse and varied and include providing self-sufficiency, employment creation, support to small-scale producers for adopting modern technologies and inputs, reduction of price instability and improvement of the income of farm households (Salunke and Deshmukh, 2012). An agricultural subsidy is a governmental financial support paid to farmers and agribusinesses to supplement their income, manage the supply of agricultural commodities, and influence the cost and supply of such commodities. Inputs such as fertilizers, irrigation water and electricity account for a significant share of the agricultural subsidies in India and fertilizer and electricity subsidies has attracted much attention of policymakers, and researchers in the recent past. It is often argued that the heavy input subsidies encourage wasteful use of resources such as nutrients, water and electricity in agriculture.

Table 2: Distribution of total subsidies and gross cropped area in India (1980-81 to 2008 – 09)

Subsidies	Fertilizers (IN Rs. Crores)	Electricity (In Rs. Crores)	Irrigation (In Rs. Crores)	Total subsidies (In Rs. Crores)	Gross Cropped Area (In '000 Hectares)
1980-81	471.88 (38.41)	357.56 (29.10)	399.10 (32.49)	1,228.5 (100.00)	1,73,324
1985-86	1,804.80 (37.63)	1,324.15 (27.61)	1,667.21 (34.76)	4,796.2 (100.00)	1,77,526
1990-91	4,638.56 (35.20)	4,621.00 (35.07)	3,917.41 (29.73)	13,177.0 (100.00)	1,85,403
1996-97	8,148.41 23.86)	15,594.00 (45.67)	10,404.73 (30.47)	34,147.1 (100.00)	1,88,601
2000-01	13,724.05 (24.80)	26,904.00 (48.62)	14,711.71 (26.58)	55,339.8 (100.00)	1,86,565
2008-09	1,01,180.68 (87.26)	14,771.52 (12.74)	--	1,15,952.2 (100.00)	1,95,350

Source: (1) Government of India, Fertilizers Association, Fertilizer Statistics, various issues, New Delhi. (2) Government of India, State Electricity Boards, Annual Reports, Various Years. (3) Government of Punjab, Statistical Abstract, Various Years

Table 2 presents the year wise increase in total amount of subsidies provided in agriculture sector. In 1980-81, subsidy amounted to INR 1,228.5 crore which subsequently increased to INR 115952.20 crore by 2008-09. In the year 1980-81, the GCA was about 173 m. ha which increased to about 188 m. ha by 1996-97 but then to 195.35 m. ha by 2008-09. Adjusting to inflation, with an assumed average annual inflation rate of 9%, the agriculture subsidies in real times increased manifold from 1980-81 to 2008-09 both in aggregate terms (8.45 times from Rs. 1228.5 crore to Rs. 10,383 crore) and per ha of GCA (7.5 times from Rs.70.9 to Rs. 531). Currently, the subsidy in agriculture (2008-09) stands at Rs.5935/ha of GCA at current prices.

4.3.6 Changes in Real Wage Rates in Indian Farms

The increased employment opportunities in non-farm sector and outmigration of people seeking non-farm employment from rural areas to cities & towns have been pushing the real wage rates in agriculture in the recent past. A look at the wage rates for ploughing (male), sowing (male), transplanting (male), transplanting (female), weeding (male), harvesting (male) and harvesting (female) show that there are significant regional variations in real wage rates. Highest wage rates were observed in Kerala for most occupations, followed by the north-western States of Jammu & Kashmir, Himachal Pradesh, Punjab, and Haryana. These five States almost invariably

have been at the top throughout the period. Wage rates are very low in Madhya Pradesh, Bihar, Orissa, Uttar Pradesh, and Karnataka.

However, in states viz., Karnataka, Maharashtra, Uttar Pradesh and West Bengal, though wage rates for non-agricultural occupations grew, the agricultural wages either remained stagnant or declined (Usami, 2011). This could be due to the fact that the growth in agriculture sector has been very sluggish in these states with the result that new jobs are not created in the farms, whereas the rural sector failed to supply sufficient skilled labour to the areas where it was required, which resulted in widening demand-supply gap in the non-agricultural sector.

On the other hand, wage rates for non-farm occupations declined or remained stagnant in Punjab, Haryana, Jammu & Kashmir, Gujarat, Rajasthan, and Madhya Pradesh (Usami, 2011). This might be probably because the increased demand from the non-farm sector is being met by increase outflow of people from rural areas, seeking employment in the non-farm sector in cities and towns. It is important to note that states like Punjab, Gujarat and Rajasthan experience large-scale migration of rural workforce to cities, as agricultural mechanization replaced labour force in farms. Interestingly, the labour demand in agriculture in a few states such as Haryana, Rajasthan and Punjab is being met by migrant labourers from Bihar.

4.4 Changes in Farm Yields

4.4.1 Rising Crop Yields

Remarkable yield improvements were observed across all crop sectors. The analysis of trend in yield of for various crops (including rice, wheat, coarse cereals, pulses, oil seeds, sugarcane, and other commercial crops) show the following: rice yield improved significantly from of 668 Kg/ha in 1950-51 to 2462 Kg/ha in 2012-13. The rice yield increased by nearly four times from 1950-51 to 2012-13. The wheat yield increased from 663 kg/ha in 1950-51 to 3119 kg/ha in 2012-13, which is nearly five times. However, the regional variations in yield are very high, with highest yields in paddy and wheat obtained in Punjab and Haryana and lowest in the eastern State of Bihar (Ladha *et al*., 2000). The yield in coarse cereals also showed an increasing trend from 408 kg/ha in 1950-51 to 1626 kg/ha in 2012-13. In the case of pulses the yield increased from 441 kg/ha in 1950-51 to 786 kg/ha in 2012-13.

Among oil seeds, ground nut had a yield of 775 kg/ha in the year 1950-51 which increased up to 1268 kg/ha in 2011-12 and then came down to 996 kg/ha. Similarly, yield of rapeseed and mustard increased from 368 kg/ha in 1950-51 to 1234 kg/ha in 2012-13. No cultivation of soya bean was reported until 1960-61. The yield of soya bean was 426 kg/ha in 1970-71 which increased threefold to 1354 kg/ha by 2012-13. The average yield of oil seeds increased from 481 kg/ha in 1950-51 to 1169 kg/ha in 2012-13.

The average sugarcane yields increased from 33.4 ton/ha in 1950-51 to 67.0 ton /ha in 2012-13, though there is wide variation across region--from the lowest in the sub-tropical areas of Uttar Pradesh and Bihar to highest in the hot and semi-arid areas of Tamil Nadu. This increase is nearly two times. Cotton yield also increased fivefold from 88 kg/ha in 1950-51 to 483 kg/ha in 2012-13. Other commercial crops like tea, coffee, jute and tobacco also had shown an increasing trend in the terms of yield.

The availability of HYVs of wheat and paddy in the late sixties along with technology and new institutional structures (agricultural extension, access to crop technology, and procurement system), enabled the farmers to adopt improved methods of cultivation. This was followed by provision of better irrigation facilities and input subsidies. There was relatively higher growth in the yield of all major crops during the green revolution period. It indicates that crops other than rice and wheat shared the technology benefits (Kannan and Sundaram, 2011).

4.4.2 Improvements in Milk Yields

India is home to a large number of indigeneous varieties of cattle and buffaloes, many of which are low yielding. To improve the productivity of local cattle and buffaloes, massive programme for cross-breeding of local non-descript cows with exotic ones (Holstein Friesian and Jersey) and upgrading of local buffaloes with better dairy breeds like *Murrah* buffalo and *Mehsana* buffalo varieties is being done for quite some time. However, results of cross breeding of buffaloes using artificial insemination haven't been very good. Over the years, the proportion of the CB cows and buffaloes has increased, replacing the low yielding non-descript animals. As a result of these efforts, the average daily milk yield of non-descript cows has increased by 440g (26.5%), crossbreds by 850g (15%) and buffaloes by 830g (23.2%) since 1993-94 (MoA, 2012).

4.4.3 Growth in Agricultural Outputs

As a result in continuous rise in area of operation and yield levels of all crops, the total agricultural outputs had constantly grown during the past several decades, with the exception of drought years. Rice production increased from 20.58 m. ton in 1950-51 to 104.4 m. ton in 2012-13. The increase was nearly 5 fold. Wheat production increased 14 times from 6.46 m. ton in 1950-51 to 92.46 m. ton in 2012-13.The coarse cereal production also had shown an increasing trend from 1950-51 to 2012-13--from 15.38 m. ton in 1950-51 to 40.06 m. ton in the year 2012-13, in spite of a significant reduction in area under these crops, by 13 m. ha. The total cereal production increased 6 times during the reporting period. The production of pulses increased from 8.41 m. ton in 1950-51 to 18.45 m. ton in 2012-13.

The total food grain production (fine and coarse cereals and pulses) recorded a five-fold increase from 50.83 m. ton in 1950-51 to 25.36 m. ton in 2012-13, though the increase in area under these crops was only to the tune of 24 per cent during this period.

Among oil seeds, groundnut production increased from 3.48 m. ton in 1950-51 to 4.75 m. ton in 2012-13, with a slight increase in area. The rapeseed and mustard production increased 10 times from 0.76 m. ton in 1950-51, while the area recorded a three-fold increase nearly three times. Production of soya bean witnessed a significant growth from a mere 0.01 m. ton in 1970-71 to 14.68 m. ton in 2012-13. Overall, total oil seed production increased 6 times from 5.16 m. ton in 1950-51 to 31.01 m. ton in 2012-13, while the increase in area under these crops was to the tune of nearly 150%--from 10.73 m. ha to 26.53 m. ha.

As regards commercial crops, coffee production increased from 0.110 m. ton in 1970-71 to 0.318 m. ton in 2012-13. Cotton (lint) production increased from 3.4 m. ton in 1950-51 to 34 m. ton in 2012-13. Sugarcane production increased from 57.05 m. ton in 1950-51 to 338.96 m. ton in 2012-13. Production of tea also increased from 0.419 m. ton in 1970-71 to 1.135 m. ton in 2012-13. The tobacco also maintained a steady growth in terms of production.

The milk production, which was only 17 m. ton in the year 1950-51 increased by more than 7 times to 127.9 m. ton, by 2011-12, to make India the largest producer of milk in the world. The per capita availability of milk has also increased from 130 gram/day in 1950-51 to 290 gram/day in 2011-12, though the lowest per capita milk production was during 1968-69, with the figure touching 112 gram/day. Such an impressive growth was made possible through introduction of high yielding breeds of cattle (cows and buffaloes), most of which happened under the Operation Flood programme of the white revolution and which continues even today. The population of indigenous varieties of cattle, which are low yielding, had drastically reduced over the past few decades in India.

4.5 Changes in Value of Agricultural Outputs in Real Terms

4.5.1 Changes in price of agricultural produce, milk prices

For many crops (cereals, pulses, a few oil seeds and sugarcane), there is government intervention in procurement which controls the market price of the produce. So, the prices are administered. For common paddy and coarse cereals, the minimum support price was Rs. 74/quintal in 1975-76 and Rs. 1310 / quintal in 2013-14. In the case of wheat, the MSP was Rs.105/quintal in 1975-76 and Rs. 1350/quintal in 2012-13. Gram had a minimum support price of Rs. 90/ quintal in 1975-76 and Rs.3000/quintal in 2012-13. The minimum support price of sugarcane increased from Rs. 13/quintal in 1980-81 to Rs. 210 / quintal in 213-14. Cotton had a minimum support price of Rs. 135/ quintal in the year 1975-76 and Rs. 4000/quintal in the year 2013-14. The MSP for groundnut went up from Rs.26/quintal in 1980-81 to Rs. 4000 /quintal in 2013-14. Black soya bean and yellow soya bean had minimum support prices as Rs. 183 and Rs. 198 per quintal respectively in the year 1980-81 and Rs. 2500 and Rs. 2560/quintal respectively in the year 2013-14. The sunflower seed had a MSP of Rs. 183/quintal in the year 1980-81 and Rs. 3700/quintal in the year 2013-14.Both rapeseed/mustard and sunflower had a minimum support price of Rs. 400 / quintal in the year 1985-86 and Rs. 3000/quintal and Rs. 2800/quintal respectively in the year 2012-13.

The real prices of agricultural commodities were computed from the values of consumer price index, for two reference years, i.e., 1965 and 1985. As per the estimates, the real price for paddy was Rs.22/quintal in 1975-76 which increased to Rs.26/quintal in 1995-96. It also went up marginally from R. 167/quintal in 2000-01 to Rs. 186/quintal in 2012-13. In the case of wheat, the real price decreased from Rs.31/ quintal to Rs. 28/quintal during 1975-76 and 1995-96. The price was almost stable during 2000-01 and 2012-13 (Table 3). For all oil seed crops (ground nut, rape seed mustard, sunflower and soya bean) the real price increased marginally during 1996-97 and 2012-13. The price rise was significant for pulses during the latter period, i.e., 1996-97 and 2012-13. For pigeon pea, the increase was to the tune of 46%--from Rs 393 to Rs.573 per quintal. For black gram, the increase was to the tune of 63%. These changes may be attributed to increasing demand owing to improvement in the purchasing power, and decline in domestic production.

Table 3: Real price for food grains (Rs/quintal)

Year	Paddy Common	Coarse Cereals	Wheat	**Gram**	Pigeon pea	Green gram	Black gram
1975-76	22	22	31	26	0	0	0
1980-81	27	27	33	0	48	51	51
1985-86	26	24	30	48	55	55	55
1990-91	27	24	30	60	64	64	64
1995-96	26	22	28	51	58	58	58
2000-01	167	146	200	361	393	393	393
2005-06	161	149	184	407	397	431	431
2010-11	177	156	207	372	621	651	603
2012-13	186	175	201	446	573	655	640

Please note that from 1975-76 to 1995-96, Base 1960-61 = 100 and
From 1996-97 to 2012-13, Base 1986-87 = 100

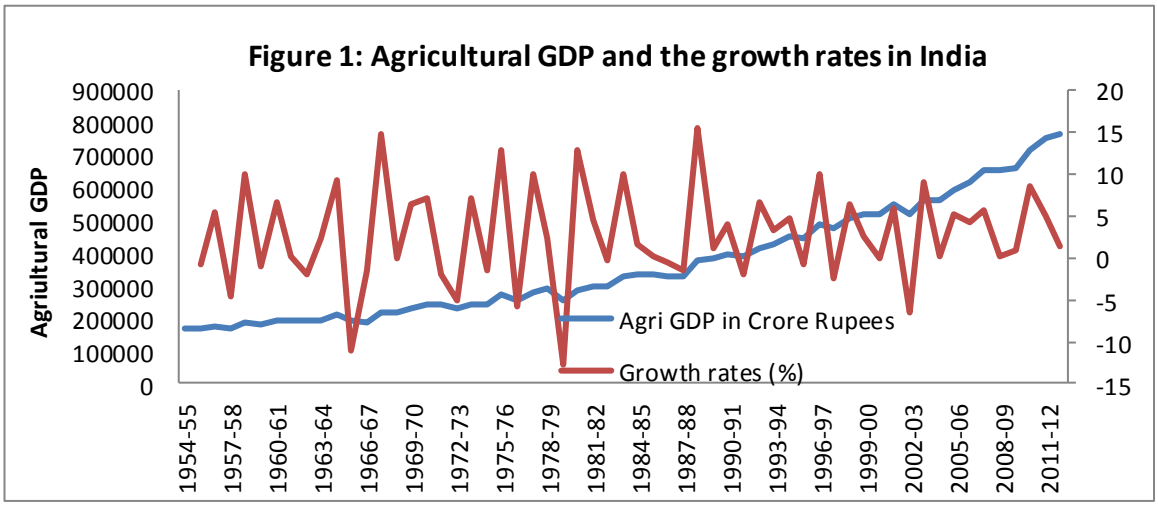
4.5.2 Growth in agricultural GDP

In spite of the fact that the performance of agriculture in the country is still subject to the vagaries of monsoon, overall, the agriculture sector recorded an impressive growth during the past 58 years, with the value of the agricultural output (agricultural GDP) jumping from Rs 168361 crore in 1954-55 to Rs 7,64510 crore in 2012-13, at 2004-05 prices. The growth came from the following: moderate expansion in area under crops; increase in livestock holding; improvement in crop and milk yield; increase in other livestock products, particularly meat; increase in production of fish; the improvement in the price of agricultural produce.

The long term annual compounded growth rate is 2.65%. However, what is notable is the erratic nature of growth. During the years of severe droughts, the growth rate was negative whereas the years following them recorded very high growth rates. For instance, the growth rate during 1965-66 was -11.04% and that during 1972-73 was -5.02%. During 1987-88, the growth rate was -1.59%. Interestingly, the growth rate during 1988-89, which was an abnormally wet year, was 15.64%. It is found that the value addition in Indian agriculture recent years have come mainly from crop diversification, with addition of high value fruits and vegetables, livestock products.

As a matter of fact, during the last decade (2000-01 to 2010-11), the share of sugarcane, condiments and spices, fruits & vegetables, oilseeds, tea, coffee and fibre in the GCA had increased when compared to 1950-51 levels (MoA, 2013). Contribution of dairy to agricultural outputs in value terms has also increased substantially from 20% to 25% in just 19 years, from 1990-91 to 2009-10. Contribution of horticulture has gone up from 16% to 20% during the same period. Fish production has increased remarkably over the years with higher growth in inland fisheries. As a result, the share of fisheries in agricultural GDP has been consistently rising from nearly 2% in in 19501-52 to around 5% in 2010-11. This sub-sector has been consistently performing better than crop sector, with negative growth observed only in six years, against 19 years in the overall agricultural sector (source: authors' own analysis based on MoA, 2012).

The long term growth rates have improved after 1991-92, with the annual compounded



growth rate during 1991-92 and 2012-13 touching 3.25%, going up from 2.3% during 1954-55 and 1991-92. The erratic growth rates in agricultural GDP indicate that estimates of short term growth rates cannot be used to assess the impact of adoption of technologies, institutions and policy interventions in the sectors on sector performance, but instead would only be indicative of the performance of the monsoon during the starting and ending years.

5 Objectives of the Study

The study will address the following key research questions:

- To what extent physical factors such as resource depletion and degradation primary productivity of land and changing weather patterns, have contributed to the current agrarian crisis in India?

- To what extent socio-economic factors such as increasing employment opportunities in the non-farm sector in the rural as well as urban areas, and outward movement of people from rural areas to urban areas as a result of better education and declining size of operational holdings and better wages have contributed to the crisis?

- To what extent, the institutional and policy factors such as reduction in input subsidies, globalization of agriculture and creation of non-farm employment through legislative measures and crop insurance have precipitated or reduced the crisis?

- To what extent, the nature of crisis in agriculture change from region to region?

6 Methodology

6.1 The Approach

The study involved a longitudinal analysis involving time series data of farm inputs, outputs and throughputs at the level of individual farms to understand the changes in agricultural production situation from the point of view of farming as an economic enterprise. The study comprised four distinct regions, each one characterized by a unique 'agro climatic and socio-economic setting', to enable the influence of these factors on the nature and magnitude of the crisis. The time frame considered was thirty five years, beginning 1980. The time series data were obtained from the farm households using recall method. From each region, a total of five villages were chosen for the field investigation. A total of 526 households were chosen for the survey. The five villages from each location were selected in such a way that they together represent the unique characteristics of the region by capturing the variations in agro climate, geo-hydrology and land holdings and overall socio-economic conditions.

A range of analytical procedures were used to estimate the changes in net income from farming at the farm level over time, changes in opportunity cost of engaging in farming operations for the farm households, changes in size of operational holdings of farmers over time, and changes in risk involved in farming. The study assessed the magnitude of the crisis and the physical, socio-economic, institutional and policy factors causing it. Based on the identification of these factors, the institutional and policy measures were suggested for each region.

6.2 Methods and analytical tools

A questionnaire was designed to collect data from sample households on the following: a] extent of use of farm inputs, and farm outputs; b] market price of inputs; c] farm gate price of farm outputs; d] time series data on historical changes in use of inputs and volume of outputs produced for crops and livestock; and, e] time series data on historical changes in the price of inputs, farm gate price of produce and wage rates for farm labourers. A separate questionnaire was also designed to collect data at the village level for sample villages on the following: a] total

number of operational holdings in at present; b] total number of farmers; c] land holding pattern (number of farmers under each holding category); d] total number of wage labourers engaged in farming operations; e] wage rates in non-farm sector; f] market price of agricultural land in the village, and, f] time series data on historical changes in all of the above.

Secondary data was collected from each region on the overall physical environment (rainfall and weather patterns), socio-economic conditions including agricultural scenario, migration, non-farm employment, wage rates in farm sector and non-farm sector, education, market dynamics in agriculture, and government interventions in agriculture sector.

Net income from farming at any given point of time was estimated by considering the following: i] the net return from each crop per household; and ii] the per centage area under each crop considering all the crops grown during the year. Further, revenue from dairying was separately estimated using; i] the milk yield from each category of livestock per livestock unit and its selling rate; and, ii] the number of animals under each livestock type. All the income figures will be adjusted to real prices (2013-14 prices) using Consumer Price Index for comparison.

Farming risk were assessed considering the physical factors (such as resource scarcity, variable climate) and socio-economic factors (such as declining per capita landholding, migration to urban areas, low availability of farm labour) causing crisis in the agriculture sector in the selected regions. Impact of institutional and policy factors on reduction in input cost (through subsidies), improvement in infrastructure for procurement and marketing, and creation of non-farm employment through legislative measures are also analysed.

7 Profile of the Study Regions

7.1 Demographic summary

The study was conducted in four distinct agro-climatic regions in India. The regions include: Coastal Andhra, Gangetic Plains in West Bengal, North Gujarat, and Vidarbha in Maharashtra (Figure 2). Coastal Andhra is spread over a geographical area of 92.9 thousand sq. km and comprise of 9 districts namely: East Godavari, Guntur, Krishna, Nellore, Prakasam, Srikakulam, Visakhapatnam, Vizianagaram and West Godavari. As per Census 2011, the overall population in the region is 3.4 crore with a density of about 368 person per sq. km.

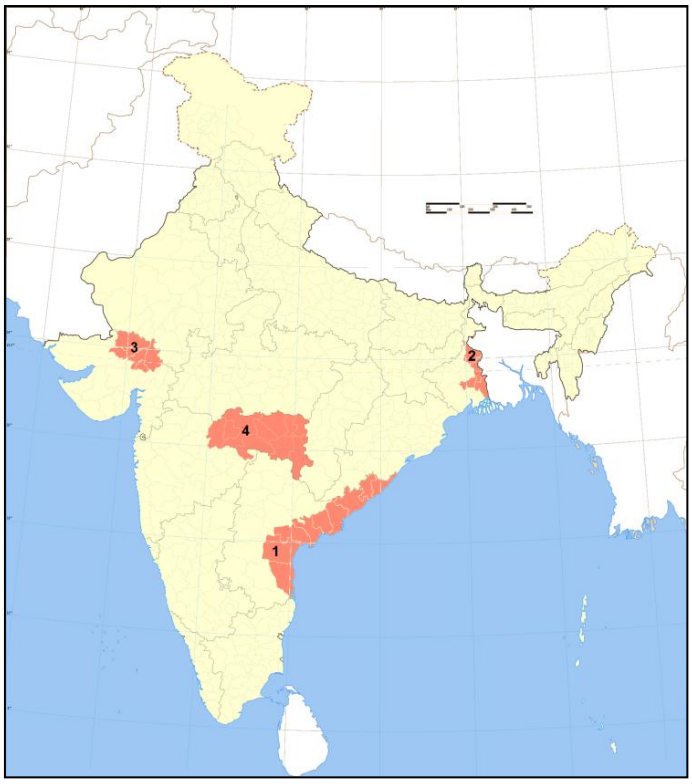


Figure 2: India map showing location of selected regions- 1] Coastal Andhra; 2] Gangetic Plains, West Bengal; 3] North Gujarat; and 4] Vidarbha
(Source: Map used from Wikipedia)

Gangetic Plains in the West Bengal is about 355 km wide area along the Bay of Bengal and covered by the network of streams forming the mouths of the Ganga and Brahmaputra rivers.

The districts included in this region are Murshidabad, Nadia, North 24 Parganas and Hoogly. Sundarban coastal region is also a part of this region. The total population in the region is 2.8 crore with a density of about 1690 person per sq. km. It is among the most fertile regions in the world and the major crops that are grown include jute, tea and rice.

North Gujarat covers a geographical area of 29.2 thousand sq. km and includes districts of Gandhinagar, Banaskantha, Sabarkantha, Mehasana and Patan. The total population in the region is 1.03 crore with a density of about 353 person per sq. km. North Gujarat has a dominant dairy industry and farmers predominately grow cash crops like tobacco, papaya, pomegranate and castor. It is one of the regions in India with a high adoption of micro-irrigation technology (mainly drip system).

Vidarbha lies in the eastern part of the State of Maharashtra, covering a geographical area of 96.3 thousand sq. km and comprising divisions of Nagpur and Amravati. It has 11 districts namely, Amravati, Akola, Bhandara, Buldana, Chandrapur, Gadchiroli, Gondia, Nagpur, Wardha, Washim and Yavatmal. As per Census 2011, the overall population in the region is 2.3 crore with a density of about 239 person per sq. km. The major cash crops of the region include cotton, oranges and soya bean. However, the region is infamous for frequent droughts and large number of farmers' suicides.

From these four regions, five districts were selected for undertaking a household survey for collecting socio-economic and agricultural details. Chosen districts along with the summary of their demographic details are presented in table 4. Among selected districts, the highest geographical area (in sq. km) is of district Banaskantha (12,703) followed by Chandrapur (10,695), West Godavari (7,742), North 24 Parganas (4,094) and Hoogly (3,149). Whereas, districts of North 24 Parganas (2463) and Hoogly (1753) both have a high population density (no of people per sq. km). The probable reason can be the availability of fertile land in these areas. Low population density was observed in Banaskantha and Chandrapur. While the former is semi-arid and naturally water scarce region, the latter is dry and physical water scarce region. However, Banaskantha has registered the highest decadal (from 2001 to 2011) population growth rate (19.6%) among the selected districts.

Table 4: Population in the selected districts from the regions covered under the study

Sr. No.	Region covered	District selected	Population (selected district)			
			2001 (in lac)	% to region's overall	2011 (in lac)	% to region's overall
1	Coastal Andhra	West Godavari	38.03	12.00	39.35	11.51
2	Gangetic Plains (West Bengal)	Hoogly	50.42	20.62	55.20	19.80
		North 24 Parganas	89.34	36.54	100.83	36.17
3	North Gujarat	Banaskantha	25.04	28.01	31.16	30.25
4	Vidarbha (Maharashtra)	Chandrapur	20.71	10.04	21.94	9.54

(Source: authors own analysis based on Census of India, 2011)

7.2 Agro climate

Coastal Andhra, with an average annual rainfall that varies from 996 mm towards south and 1128 mm in north, has semi-arid to dry sub-humid climate. Major soils include deltaic alluvium, coastal alluvium, red loamy, and red sandy types. Thickness of alluvium is several hundred metres near the mouths of the major rivers, like Cauvery and Krishna, and it decreases inland to a few metres where crystalline rocks occur (CGWB, 2014). Geological map of the region is presented in figure 3. Ground water occurs under semi-confined conditions in the recent

alluvium and under confined conditions in the underlying Rajahmundry/Gondwana sandstones. The water levels are shallow but groundwater development is limited and is confined only to certain fresh water zones. As a result, the stage of groundwater development is only 47%. Most of the deltaic area is under surface water irrigation projects. Major crops in the region include rice, cotton, jowar, bajra, tobacco, groundnut, ragi and sesame.

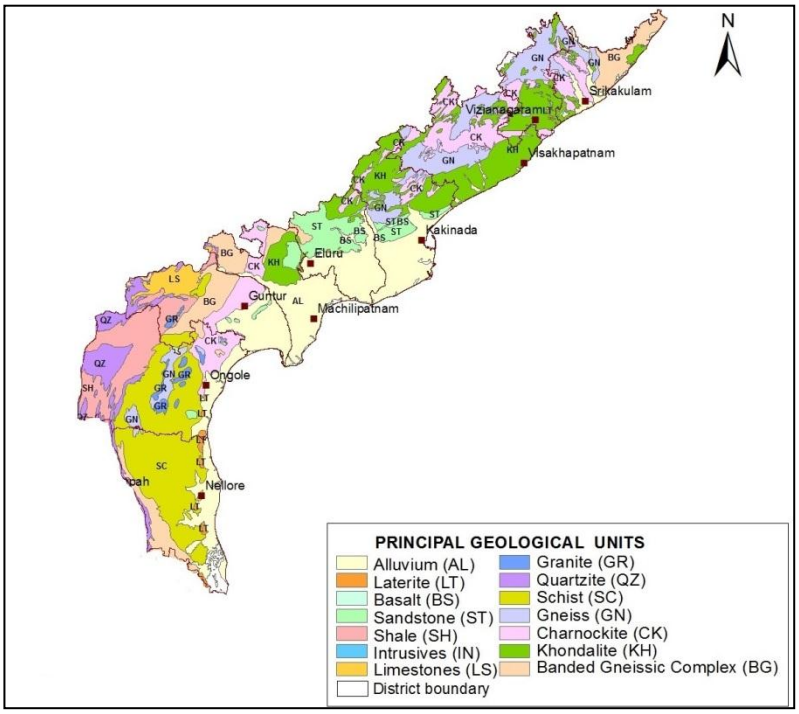


Figure 3: Geological map of Coastal Andhra
(Source: Andhra Pradesh State Development Planning Society)

North Gujarat is semi-arid to arid with an average annual rainfall of about 735 mm. The region lies in alluvial plains and has sandy loam to sandy soils. Geological map of the region is presented in figure 4. The region is endowed with high yielding alluvial aquifers where groundwater occurs under unconfined, semi-confined, confined and free flowing artesian conditions (Figure 4). However, due to over exploitation of groundwater in the region (stage of groundwater development is 101%) both unconfined and confined aquifers have shown decline in water levels at alarming rates of 3 to 5 meters per year. The tube well yields have also considerably reduced from 35 lps to 15 lps. As a result, many farmers in the region have adopted drip irrigation system and mainly grow cash crops such as castor, pomegranate and papaya, in order to make judicious use of scarce water resources and have high returns from agriculture. Bajra, cotton, jowar and wheat are the other major crops grown in the region.

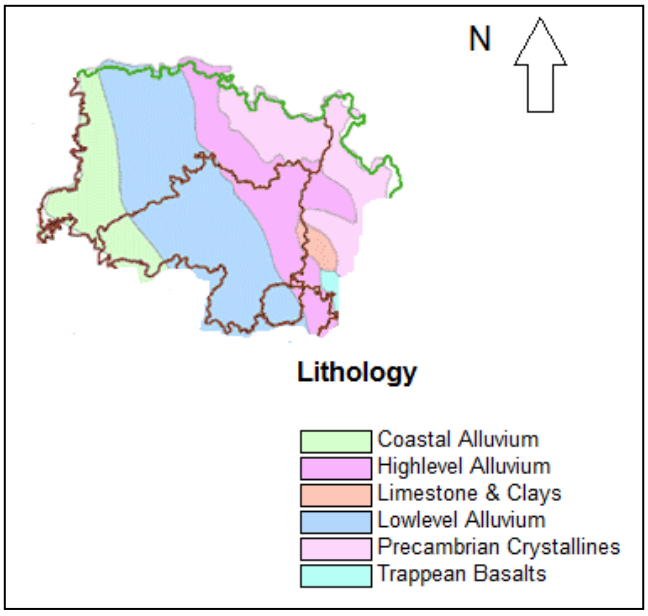


Figure 4: Geological map of North Gujarat
(Source: Gujarat Ecology Commission)

Gangetic plains in West Bengal are dry sub-humid to moist sub-humid with an average annual rainfall of about 1400 mm in central alluvial plains and 1600 mm in alluvial coastal saline plains. Major soils are red and yellow deltaic alluvium and red loamy types. In the coastal tract of the region, alluvium of Recent to Pleistocene ages and the Tertiary sediments form the principal aquifers. The aquifers in the porous alluvial formations in the region are characterised by a high groundwater potential with an average water yield of about 50-150 m^3/hr. However, high salinity

in groundwater occurs along the coastal tract. The stage of groundwater development is 73% and groundwater irrigation is mainly through use of shallow tube wells. Major crops that are grown include rice, rapeseed, and jute.

Vidarbha, with an average annual rainfall of about 1400mm, has a dry sub-humid to moist sub-humid climate. However, rainfall is erratic with average no. of annual rainy days varying from 44 in western part to 65 in eastern part of the region (Figure 5). The soils are red sandy, red and yellow type. As most of the region is underlain by hard rocks (mainly basalt) which are characterised by poor primary porosity, groundwater yield is very low. Therefore in spite of safe stage of groundwater development (39%), water availability from wells is severely limited especially during summer months. Major crops that are grown include rice, wheat, jowar, cotton, orange, grams and chilli.

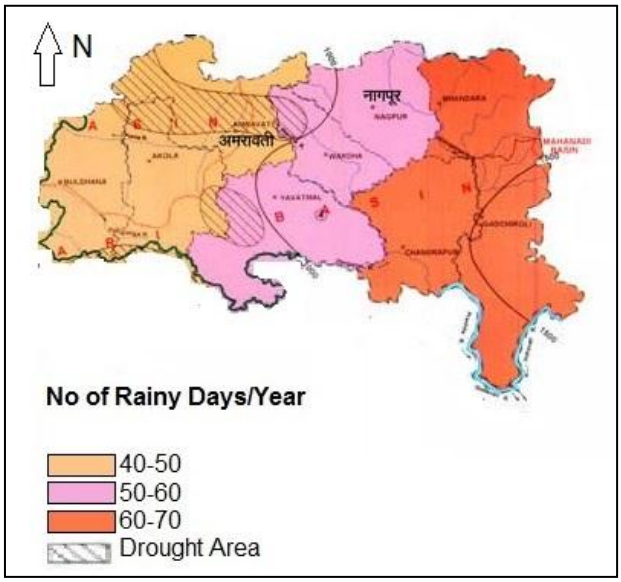


Figure 5: Map showing spatial variation in number of rainy days in Vidarbha
(Source: Central Ground Water Board, Nagpur Region)

8 Snapshot of the Surveyed Households

Demographic details of surveyed households are presented in Table 8. Households in North Gujarat support more number of people as indicated by its high family size among households in other regions. Further, North Gujarat has highest proportion of households belonging to other backward castes. Only Vidarbha was found to have substantial households with tribal population who are mainly engaged in rainfed agriculture. Interestingly Coastal Andhra, which has higher per capita agricultural income than Gangetic plains and Vidarbha, was found to have a highest proportion of households below poverty line.

Table 5: Demographic details of the surveyed households (HH)

Region	Selected districts	No. of HH surveyed	HH size (no./HH)	Proportion of HHs under different caste category				Proportion of HHs with BPL card
				General	SC	ST	OBC	
Coastal Andhra	West Godavari	135	3.83	39	13	1	47	74
Gangetic Plains	Hoogly and North 24 Parganas	150	4.55	81	12	-	7	37
North Gujarat	Banaskantha	150	5.62	2	1	-	97	0
Vidarbha	Chandrapur	91	4.10	4	5	49	41	15

Compared to other regions, a high proportion of adult family members in surveyed households in North Gujarat were engaged in agriculture (including dairy) as their major

livelihood activity (Table 9). In Coastal Andhra and Vidarbha, more than 75% of female adult members were reported to be handling household works exclusively. However, our field survey suggests that in Vidarbha a large proportion of such adult female members take up farm or non-farm labour work. Gangetic plains were having a highest proportion of unemployed people. Further, except for Vidarbha, a high proportion of children in the surveyed households were enrolled in schools (Table 9). Low registration of children in schools in Vidarbha may be due to their involvement in household work as a high proportion of adult female members in the region are engaged in farm and non-farm labour work.

Table 6: Major occupation of the surveyed households

Sr. No.	Region	Selected districts	Major occupation of adult members (% to total)				Proportion of children studying
			Agriculture & Dairying	Farm labour	Non-farm labour	Unemployed	
1.	Coastal Andhra	West Godavari	34	-	-	3	90
2.	Gangetic Plains	Hoogly and North 24 Parganas	54	1	6	7	84
3.	North Gujarat	Banaskantha	82	1	2	-	100
4.	Vidarbha	Chandrapur	59	-	1	2	64

Nevertheless, as presented in Table 11, major household expenditure continues to be on food items and for purchasing agricultural inputs. However, in Chandrapur, proportion of total expenditure on agri-inputs has increased substantially between 1980-81 and 2013-14. As a result household are spending lesser amount on food items and thus compromising on their food security. Nevertheless, in all the districts there were an increase in the proportion of total income been spend on children education. Thus, indicating their desire for child's better future.

8.1 Changes in landholding

Between 1980-81 and 2013-14, average landholding with households in districts of Hooghly and North 24 Parganas has reduced by almost half. Since these districts have high population density, any growth in population ultimately leads to more land fragmentation and hence smaller land holdings. There was no change in average landholding per household in the districts of Banaskantha and Chandrapur during the same time period. Though, it has reduced a little in West Godavari district. Households in Banaskantha, an agricultural prosperous region, have a significantly high average landholding in comparison to households in other surveyed districts.

Table 7: Landholdings details of surveyed HHs

Sr. No.	Selected districts	Average area of operational landholding (acre/HH)				
		1980-81	1990-91	2000-01	2010-11	2013-14
1	West Godavari	3.07	3.05	3.01	2.91	2.91
2	Hooghly & North 24 Parganas	1.70	1.58	1.22	0.94	0.89
3	Banaskantha	4.84	4.84	4.84	4.84	4.84
4	Chandrapur	0.65	0.65	0.65	0.65	0.65

8.2 Changes in cropped and irrigated area

Cropped area in Hooghly and North 24 Parganas has almost decreased by half between 1980-81 and 2013-14 (Table 13). There can be several factors for that including changing rainfall magnitude and pattern; limited access to irrigation; low land productivity; crop failure; low returns form; low availability of farm labourers etc. Some of these are discussed further in the subsequent sections. However, cropped area in Banaskantha and Chandrapur has increased. Except for Banaskantha, a high proportion of cropped area in all the districts was under irrigation (Table 13). However, most of the surveyed households in Chandrapur provide only 1-2 supplementary irrigation during monsoon and not more than 2-3 irrigations during winter season as groundwater which is the major resource for irrigation is severely limited. Whereas, in Banaskantha, annual groundwater abstraction has gone beyond its annual natural recharge limits and thus there is no scope for bringing more land under irrigation. However, large farmers have adopted micro-irrigation technologies to make efficient use of the available water and to bring more cropped area under irrigation.

Table 8: Cropped and irrigated area of the surveyed households

Selected districts	Gross cropped area (acres)					Irrigated area as % of cropped area (acres)				
	1980-81	1990-91	2000-01	2010-11	2013-14	1980-81	1990-91	2000-01	2010-11	2013-14
West Godavari	700	726	666	641	615	98	98	98	98	98
Hooghly & North 24 Parganas	554	544	435	336	291	65	75	85	94	95
Banaskantha	1083	1091	1043	1219	1145	53	96	60	55	55
Chandrapur	365	361	361	405	591	99	100	100	96	87

9 Major changes in agricultural landscape in West Godavari, Coastal Andhra Pradesh

9.1 Physiography

The District consists of three very dissimilar natural divisions, viz., 1) Delta, 2) Upland, and 3) the Eastern Ghats. The upland area which is an undulating plain broken by low ranges, cover parts of Chintalapudi, Kovvur, Eluru and Tadepalligudem Mandals This portion lies between the delta and the agency areas. Polavarm agency is traversed by the Eastern Ghats broken by the Papikonda range of hills. This area is covered by scattered hills and spurs rising from the lower uplands. The highest peak in the area is Peddakonda and it rises to a height of 1364 metres above the sea level. The map showing west Godavari district in Andhra Pradesh is provided in Figure 6.

9.2 Demography

The District occupies an area of 7,742 sq. km. with a density of 508 per sq.km. It accounts 2.81 % of the total area of the State. There are as many as 883 Revenue villages exist in the district, of which 845 villages are inhabited while the balance 38 villages are uninhabited. The Physical characteristics, natural resources and potentialities of the mandals in the District are not homogeneous. As per 2011 census, the total population of the District is 3936966. It accounts for

4.65 % of the total population of the State. The female population of the District is 1972048 and this forms 50.09 % of the District and 4.68 % of the State Female Population. (Source: census of India).

The decennial growth of population in the District from 2001 census to 2011 census was 3.5 %. The density of population according 2011 census is 508 per Sq.km, whereas it was 308 per Sq.kms. for the State. The Literacy rate of the District is 74.32% which is higher than the State literacy rate of 67.66%. The sex ratio of the District is 986 females per 1,000 males as against 978 of the State. The number of workers as arrived at in 2011 census is 15,34,166 forming 38.97% of total population of the District and 3.37% of the State population.(source : Government of AP)

9.3 Changing Land Use

The total geographical area of the district is 7.79 lakh ha and the land utilization particulars are given in Table 9.The net sown area forms 56.6% of the geographical area. About 14.92% of the land is put to non-agricultural purposes in the district. Current and other fallows have very limited area under them. Due to good irrigation coverage, nearly 59% of the total sown area is put under a second crop. Hardly 10% of the area is under forests.

Table 9: Land Utilisation particulars for 2012-13 of west Godavari district

Sr.no	CATEGORY	Area in Ha
1	Total geographical area	774200
2	Forests	81166
3	Barren & uncultivable land	37642
4	Land put to non-agricultural Uses	115477
5	Cultivable waste	13352
6	Permanent pastures and other Lands	13355
7	Land misc. tree crops and groves	7872
8	Other fallow lands	7900
9	Current fallows	24471
10	Net Area Sown (11-12)	425943
11	Total Cropped Area	694812
12	Area Sown More than Once	268802
13	Fish & Prawn Culture	47021

Source: District Census Handbook West Godavari

9.4 Changes in Operational Holding

Table 10: Land Utilisation particulars for 2012-13 of west Godavari district

Sr. No.	Region	Total no. of land holdings (in 000')		Total area of land holdings (in 000' ha)	
		2000-01	2010-11	2000-01	2010-11
1	Coastal Andhra	4771	5152	4629	4600

(Source: authors own analysis based on Agricultural Census of India, 2000-01 and 2010-11)

The cultivable land in the district is mostly under the ownership of small and marginal farmers. The category wise number and area of operational holdings in the district are presented in Table 11. While the marginal farms dominate the land holdings in terms of number, medium

size holdings account for a major part of the land owned in Coastal Andhra. The number of holdings in the marginal holding category, as a proportion of the total number of operational holdings, has increased over a decade from 2000-01 to 2010-11, while that under small, medium, semi medium, medium and large holding categories has reduced.

Table 11: Size class-wise details of the operational landholdings in the Coastal Andhra

Sr. No.	Land holding size class	Particulars	Coastal Andhra	
			2000-01	2010-11
1	Marginal	% to total no. of land holdings	70.6	72.7
		% to total area	30.1	33.4
		Avg. size (ha)	0.4	0.4
2	Small	% to total no. of land holdings	17.8	17.3
		% to total area	25.7	27.0
		Avg. size (ha)	1.4	1.4
3	Semi-medium	% to total no. of land holdings	8.6	7.6
		% to total area	23.9	22.7
		Avg. size (ha)	2.7	2.7
4	Medium	% to total no. of land holdings	2.8	2.2
		% to total area	16.0	13.7
		Avg. size (ha)	5.6	5.5
5	Large	% to total no. of land holdings	0.3	0.2
		% to total area	4.3	3.2
		Avg. size (ha)	16.8	15.7

(Source: authors own analysis based on Agricultural Census of India, 2000-01 and 2010-11)

9.5 Agricultural Situation

9.5.1 Cropped Area and Irrigated Area

In coastal Andhra Pradesh, 60 per cent of the gross cropped area is irrigated and nearly 68 per cent of the irrigation is from surface water, especially canal water (Table 12).

Table 12: Cropped and irrigated area in Coastal Andhra

Sr. No.	Region	Gross Cropped Area (lakh ha)	Gross Irrigated Area (GIA) as % of GCA	Groundwater Irrigated area as % of GIA
1	Coastal Andhra	54.42	60	32

(Source: authors own analysis based on Agricultural Census of India, 2000-01 and 2010-11)

9.5.2 Income and Expenditure

West Godavari is one of the districts in the state with high agricultural potential. The economy of the district is primarily agrarian. Nearly 70% of the population in the district depends on agriculture for their livelihood. While the average annual household income (at current prices) increased from Rs. 17,548 to Rs. 59,667 consistently during the period from 1980-81 to 20013-14, the percentage income from agriculture declined consistently from 65 to 40. The expenditure as percentage of annual income increased from 33 to 166. The reported annual expenditure during 2010-11 and 2013-14 are more than the annual income (Table 13).

Table 13: Income and expenditure (in current prices) pattern of surveyed households

Sr. No.	Time period	Particulars (Average per HH)	Districts covered
			West Godavari
1	1980-81	Average annual Income (Rs/HH)	17,548
		% agricultural income	65
		% expenditure	33
2	1990-91	Average annual income (Rs/HH)	22,778
		% agricultural income	58
		% expenditure	53
3	2000-01	Average annual income (Rs/HH)	35,681
		% agricultural income	41
		% expenditure	72
4	2010-11	Average annual income (Rs/HH)	50,178
		% agricultural income	34
		% expenditure	111
5	2013-14	Average annual income (Rs/HH)	59,667
		% agricultural income	40
		% expenditure	166

(Source: authors own analysis based on Agricultural Census of India, 2000-01 and 2010-11)

As presented in Table 14, the major household expenditure is on household items and durable good and expenditure on food items and agri-inputs have decreased over time.

Table 14: Expenditure (current prices) on major items by surveyed households

Sr. No.	Particulars	Time period	Average expenditure per household (% to total)
			West Godavari
1	Food items	1980-81	29
		1990-91	27
		2000-01	17
		2010-11	15
		2013-14	18
2	Agri-inputs	1980-81	40
		1990-91	28
		2000-01	23
		2010-11	14
		2013-14	19
3	Children education	1980-81	0
		1990-91	4
		2000-01	14
		2010-11	19
		2013-14	15
4	Health care	1980-81	15
		1990-91	18
		2000-01	12
		2010-11	8
		2013-14	11
5	HH items and	1980-81	7

	durable goods	1990-91	5
		2000-01	23
		2010-11	40
		2013-14	29

9.5.3 Changes in cropping and irrigation pattern

Paddy is the main crop for the surveyed households in the West Godavari district of coastal Andhra (Table 15). Between 1980-81 and 2013-14, proportion of total cropped area under paddy has remained almost same with majority of crop being grown in monsoon and winter seasons. About 1/6th of the cropped area is under perennial crops such as banana, casuarina, coconut, lemon, and mango and it has increased only marginally between 1980-81 and 2013-14. Almost entire paddy crop is irrigated.

Table 15: Cropping and irrigation pattern of surveyed households, West Godavari

Season	Crops	Proportion of cropped area under different crops (%)					Proportion of cropped area which is irrigated (%)				
		1980-81	1990-91	2000-01	2010-11	2013-14	1980-81	1990-91	2000-01	2010-11	2013-14
Monsoon	Paddy	45	46	42	43	41	97	98	98	98	97
Winter	Paddy	42	41	40	38	39	97	97	98	97	98
Summer	Paddy	0.4	0.4	0.3	0.3	0.3	100	100	100	100	100
Perennials	Banana	1	1	1	1	1	100	100	100	100	100
	Casuarina	2	2	2	2	2	100	100	85	90	100
	Coconut	10	10	13	14	15	100	100	100	100	100
	Lemon	0.0	0.0	0.0	0.5	1.0	-	-	-	100	100
	Mango	0.4	0.4	0.8	0.8	0.8	100	100	100	100	100
	Overall	13	13	17	18	19	100	100	98	99	100

9.5.4 Changes in agricultural inputs

The households provided details of agri-inputs for only paddy which occupy the major proportion of total copped area which are presented in Table 16. Between 1980-81 and 2013-14, input cost (adjusted to 2013-14 prices) per acre has actually decreased for paddy grown during monsoon season, whereas for winter paddy it has increased. However, in comparison to 2000-01, input cost for winter paddy has also reduced. The reduction in input cost, though both irrigation (mainly groundwater) and fertiliser application has increased, indicates that the price of fertiliser and irrigation has actually not increased as per the market inflation rate. In fact, electricity for farm use is supplied at a highly subsidized rate in the whole region which lowers the cost associated with irrigation. Nevertheless, the average irrigation hours increased from 32 to 175 hours per acre during monsoon and 52 to 265 hours per acre during winter season, whereas fertilizer application was more than doubled from 24 to 53 kg per acre during monsoon and from 31 to 73 kg per acre during winter season.

Table 16: Agri-input cost at real prices (2013-14) for the surveyed households, West Godavari

Crop	Season	Input cost (Rs/acre)				
		1980	1990-91	2000-01	2010-11	2013-14

		-81				
Paddy	Monsoon	13995	15954	9519	9580	11551
	Winter	17195	16117	29282	17159	20280

9.5.5 Changes in crop yield and returns

As presented in Table 17, average yield for both monsoon and winter paddy got almost doubled between 1980-81 and 2013-14. This can be attributed to increased application of fertilizer and irrigation. Accordingly, average net returns (adjusted to 2013-14 prices) have also gone up substantially for the paddy grown in both monsoon and winter seasons (Table 18). While farmers were making a loss in monsoon paddy during 1980's, they are now getting close to Rs 4000 per acre. For winter paddy, net returns have increased to almost three times.

Table 17: Crop yield for the surveyed households, West Godavari

Crop	Season	Crop yield (kg/acre)				
		1980-81	1990-91	2000-01	2010-11	2013-14
Paddy	Monsoon	481	738	703	878	849
	Winter	824	856	1108	1212	1484

Table 18: Net return from various crops at real prices (2013-2014) for the surveyed households, West Godavari

Crop	Season	Net return (Rs/acre)				
		1980-81	1990-91	2000-01	2010-11	2013-14
Paddy	Monsoon	-73	5324	1347	1234	3935
	Winter	2518	3229	15522	4801	7165

9.5.6 Changes in livestock holding and milk yield

There is a significant growth in livestock keeping in district of West Godavari (Table 19). While, there was a substantial increase in the total number of milch animals between 1980 and 2013, number of non-milch animals has reduced during the same time period. However, annual production of milk per milch animal has come down. This is primarily due to the fact that most of the milch animals owned by the households were low milk yielding indigenous cattle. As a result, amount of milk sold per household has also decreased substantially. This has led to significant reduction in average household earnings (adjusted to 2013-14 prices) from selling milk.

Table 19: No of animals and milk yield of households owning livestock, West Godavari

Sr. No.	Particulars	Animal type	Year				
			1980	1990	2000	2010	2013
1	No. of milch animals	Indigenous cow	89	94	64	198	194
		Buffalo	151	143	126	261	258
2	No. of non-milch animal	Indigenous cow	1	1	4	1	2
		Buffalo	0	0	2	8	9
		Bullock	22	14	22	6	6
3	Milk yield (lit/annum)	Indigenous cow	1190	1061	957	843	806

	per milch animal	Buffalo	1699	1595	1225	1039	1017
4	Average amount of milk sold (lit/day/HH)		16.27	15.65	11.92	8.50	7.51
5	Revenue from selling milk (Rs/day/HH) at real prices (2013-14)		1260	840	480	312	275

10 Major changes in agricultural landscape in Hooghly and North 24 Parganas, Gangetic Plains, West Bengal

10.1 Physiography

The State is divided into three distinct physiographic units as: Extra –Peninsular Region of the north, comprising mainly Himalayan Foot Hills, falling in Darjeeling, Jalpaiguri and Coochbehar districts; peninsular mass of the south – west forming a Fringe of Western Plateau, covering the entire district of Purulia, western part of the districts of Barddhaman, Paschim Medinipur and Birbhum and the northern part of Bankura districts; and Alluvial and Deltaic plains of the south and east, comprising the deltaic zone falling in Sundarban area of the district of South 24 Parganas and in a small part of North 24 Parganas district and plain flat terrain falling in the remaining areas of the State. The topographical map of North 24 Parganas and Hooghly is provided in Figure 7 and Figure 8. (Source: Government of North 24-Parganas and NIC Hooghly).

10.2 Demographic Summary

Gangetic Plains in the West Bengal is about 355 km wide area along the Bay of Bengal and covered by the network of streams forming the mouths of the Ganga and Brahmaputra rivers. The districts included in this region are Murshidabad, Nadia, North 24 Parganas and Hoogly. Sundarban coastal region is also a part of this region. The total population in the region is 2.8 crore with a density of about 1690 person per sq. km. It is among the most fertile regions in the world and the major crops that are grown include jute, tea and rice.

Table 20: Demographic details of Gangetic plains

Sr. No.	Region covered	District selected	Population (selected district)			
			2001 (in lac)	% to region's overall	2011 (in lac)	% to region's overall
1	Gangetic Plains (West Bengal)	Hoogly	50.42	20.62	55.20	19.80
		North 24 Parganas	89.34	36.54	100.83	36.17

(Source: authors own analysis based on Census of India, 2011)

10.3 Changing Land Use

10.3.1 Land Use of Hooghly District

The district has a territory of 3149 sq.km, which is about 3.55 per cent of total geographical area of the State. In 2005, the reported area under land utilization statistics of the district was 312.22 sq. km. 71 per cent of which was under net sown area and 27 per cent under non-agricultural use. Forest area is negligible(less than one per cent). The land utilization statistics of the district thus offer enough scopes for both agricultural and non-agricultural activities.

Table 21: Land Utilization Statistics of Hooghly District (in '000 ha.)

1	Reporting Area	312.22
2	Forest Area	0.53
3	Area under Non-Agricultural use	84.65
4	Barren and Uncultivable Land	0.61
5	Permanent pasture and other grazing land	0.06
6	Land under Miscellaneous Tree Groves not included in Net Sown Area	3.18
7	Cultivable Waste Land	1.83
8	Fallow Land other than Current Fallow	0.55
9	Current Fallow	1.08
10	Net Sown Area	219.73

Source: District Human Development Report Hooghly, 2011

10.3.2 Land Use of North 24 Parganas District

Agriculture is still a major source of livelihood in rural North 24 Parganas. The net cropped area of the district is 2605373 ha with current fallow of 1334 ha and land under miscellaneous tree groves of 4317 ha. Nearly 25 per cent of total landmass of the district is now under non-agricultural use (Table 22). The reduction in agricultural land is to be explained mainly by the fact that increased utilisation of land for non-agricultural purposes, particularly in the areas adjacent to Kolkata, changed the land use pattern of the district radically.

Table 22: Land Utilization Statistics of North 24 Parganas District (in '000 ha.)

1	Reporting Area	386.52
2	Forest Area	---
3	Area under Non-Agricultural use	119.7
4	Barren and Uncultivable Land	---
5	Permanent pasture and other grazing land	---
6	Land under Miscellaneous Tree Groves not included in Net Sown Area	4.44
7	Cultivable Waste Land	0.17
8	Fallow Land other than Current Fallow	0.55
9	Current Fallow	1.82
10	Net Sown Area	219.73

Source: District Human Development Report North 24 Parganas District, 2010

10.4 Changes in Operational Holding

Though there is an increase in number of land holdings between 2000-01 and 2010-11, its total area has decreased and the average size of land holding was found to be lowest in Gangetic Plains (0.7 ha) which is a water rich region.

Table 23: Agricultural landholdings in Gangetic Plains

Sr. No.	Region	Total no. of land holdings (in 000')	Total area of land holdings (in 000' ha)

		2000-01	2010-11	2000-01	2010-11
1	Gangetic Plains	1748	1814	1293	1286

Agriculture in the Gangetic plains is small-farmer centric with 97 per cent of the cultivators being small and marginal farmers. Marginal operational land holding accounts for 84.0 per cent of the total operational holdings (Table 24). Whereas the number of operational holders belonging to medium sized category, as a proportion of the total number of operational holdings, is insignificant (0.2 per cent). There are no large farmers in the region. Like in AP, the proportion of operational holdings belonging to marginal category has increased and that belonging to other categories (small, semi medium and medium) has reduced over the reporting period.

Table 24: Size class-wise details of the operational landholdings Gangetic Plains of West Bengal

Sr. No.	Land holding size class	Particulars	Gangetic Plains	
			2000-01	2010-11
1	Marginal	% to total no. of land holdings	81.1	84.0
		% to total area	52.9	58.3
		Avg. size (ha)	0.5	0.5
2	Small	% to total no. of land holdings	15.1	13.3
		% to total area	32.2	30.5
		Avg. size (ha)	1.6	1.6
3	Semi-medium	% to total no. of land holdings	3.4	2.6
		% to total area	12.4	10.0
		Avg. size (ha)	2.7	2.7
4	Medium	% to total no. of land holdings	0.4	0.2
		% to total area	2.4	1.1
		Avg. size (ha)	4.9	4.9
5	Large	% to total no. of land holdings	0.0	0.0
		% to total area	0.1	0.1
		Avg. size (ha)	25.7	16.0

10.5 Agricultural Situation

10.5.1 Cropped Area and Irrigated Area

The gross cropped area of Gangetic plains is 26.12 lakh hectares with 35 per cent of it is irrigated, and the ground water irrigated area is 52 per cent to that of the gross irrigated area.

10.5.2 Income and Expenditure

In the districts viz., Hooghly and North 24 Parganas, average household expenditure during 1980's and 1990's was more than the income as agricultural productivity in the region was low due to lack of access to irrigation facilities. As a result, households have to depend on private loans or government aids for their survival. However with the increase in access to irrigation, improvement in crop productivity and emergence of employment opportunity outside farm in the subsequent years, households were able to take care of their financial needs. Table 25 shows the changes in average annual household income, the proportion of income from agriculture and annual expenditure as a percentage of the annual income over time (from 1980-81 to 2013-14).

While the average annual household income (at current prices) has increased consistently (from Rs. 28463 to Rs.144996), the percentage of income from agriculture reduced (from 98 to 74 per cent), and the expenditure as a percentage of the income consistently reduced.

Table 25: Income and expenditure (in current prices) pattern of surveyed households

Sr. No.	Time period	Particulars (Average per HH)	Districts covered
			Hoogly & North 24 Parganas
1	1980-81	Average annual Income (Rs/HH)	28,463
		% agricultural income	98
		% expenditure	113
2	1990-91	Average annual income (Rs/HH)	52,449
		% agricultural income	95
		% expenditure	105
3	2000-01	Average annual income (Rs/HH)	96,356
		% agricultural income	87
		% expenditure	89
4	2010-11	Average annual income (Rs/HH)	144,390
		% agricultural income	75
		% expenditure	79
5	2013-14	Average annual income (Rs/HH)	144,996
		% agricultural income	76
		% expenditure	83

Nevertheless, as presented in Table 26, major household expenditure continues to be on food items and for purchasing agricultural inputs. The expenditure on health care started to decrease from the year 2000 to 2014.

Table 26: Expenditure (current prices) on major items by surveyed households

Sr. No.	Particulars	Time period	Average expenditure per household (% to total)
			Hooghly & North 24 Parganas
1	Food items	1980-81	24
		1990-91	21
		2000-01	18
		2010-11	18
		2013-14	21
2	Agri inputs	1980-81	55
		1990-91	53
		2000-01	43
		2010-11	39
		2013-14	44
3	Children education	1980-81	2
		1990-91	11
		2000-01	12
		2010-11	9
		2013-14	11
4	Health care	1980-81	14

		1990-91	15
		2000-01	11
		2010-11	8
		2013-14	9
5	HH items and durable goods	1980-81	8
		1990-91	6
		2000-01	20
		2010-11	23
		2013-14	8

10.5.3 Changes in cropping and irrigation pattern

Cropping and irrigation pattern of surveyed households in Hooghly and North 24 Parganas is presented in Table 27. Between 1980-81 and 2013-14, the proportion of cropped area under monsoon crops has remained unchanged. However, it has increased for winter crops, while for summer crops there is a significant decline as proportion of area under summer paddy has reduced substantially. From 2000 onwards, new crops such as mustard, red lentil and coriander were introduced in the winter season.

Table 27: Cropping and irrigation pattern of surveyed households, Gangetic Plains of West Bengal

Season	Crops	Proportion of cropped area under different crops (%)					Proportion of cropped area which is irrigated (%)				
		1980-81	1990-91	2000-01	2010-11	2013-14	1980-81	1990-91	2000-01	2010-11	2013-14
Monsoon	Paddy	37	37	34	35	38	13	35	59	86	91
	Vegetables	2	2	2	2	2	28	72	100	100	93
	Overall	39	39	37	37	40	13	37	61	91	90
Winter	Potato	26	24	25	25	26	100	99	100	100	100
	Vegetables	2	2	2	2	3	92	94	100	100	100
	Mustard	0	0	1	1	2	0	0	100	100	100
	Red Lentil	0	0	1	1	1	0	0	0	0	8
	Coriander	0	0	1	1	1	0	0	100	100	100
	Overall	28	27	29	30	34	99	98	100	100	96
Summer	Vegetables	7	7	8	8	9	95	100	100	100	100
	Jute	3	3	3	2	2	94	100	100	100	100
	Sesame	11	11	11	13	14	94	100	100	100	100
	Paddy	13	14	12	9	8	100	100	100	100	100
	Overall	33	35	34	32	25	96	100	100	100	100

Almost entire cropped area during winter and summer seasons is irrigated. There was also substantial improvement in area being irrigated during monsoon season as post 2000 almost entire area under vegetables was irrigated. Also, irrigated area for monsoon paddy has increased by almost seven times between 1980-81 and 2013-14. However, most of this increase is due to 1-2 supplementary irrigation being provided to the paddy crop during monsoon.

10.5.4 Changes in agricultural inputs

As presented in Table 28, between 1980-81 and 2013-14, cost (adjusted to 2013-14 prices) of agricultural inputs for all the crops except vegetables have gone up. For summer paddy, input cost increased to almost three times. One of the major reasons for the increase in input cost is the substantial increase in expenditure on fertilisers. The average expenditure on fertiliser (adjusted to 2013-14 prices) has increased from Rs 5,563/acre in 1990-91 to Rs 7,417/acre in 2013-14. Further, as the average land holding size of farmers in the region is low, they mostly depend on rental pumps to lift water for irrigation. Both the pump rent and cost of diesel have increased slightly from the 1980's level which has led to increase in average cost (adjusted to 2013-14 prices) of irrigation from Rs 1,879/acre in 1980-81 to about Rs 2,700/acre in 2013-14.

Table 28: Agri-input cost at real prices (2013-14) for the surveyed households, Gangetic Plains of West Bengal

Season	Crops	Input cost (Rs/acre)				
		1980-81	1990-91	2000-01	2010-11	2013-14
Monsoon	Paddy	19273	16135	24560	24787	26061
	Vegetables	113624	67622	54600	59995	62905
Winter	Potato	60874	83255	93159	98201	95527
	Vegetables	140309	86247	73337	68626	70679
	Mustard	-	-	9155	13434	14519
	Red Lentil	-	-	11531	12803	15425
	Coriander	-	-	7094	8044	11911
Summer	Vegetables	89801	56100	52517	52902	61017
	Jute	88633	89164	81799	95022	95342
	Sesame	10704	13964	12728	11702	12803
	Paddy	12218	11490	18425	28720	30924

However, average input cost for vegetables has come down substantially. For vegetables grown in monsoon and winter seasons it has reduced by almost half. One of the main reasons is the reduction in the expenditure (adjusted to 2103-14 prices) on pesticides and insecticides which have come down to almost one half, i.e. from average of Rs 4,267/acre in 1980-81 to Rs 2,237/acre in 2013-14.

10.5.5 Changes in crop yield and net return

Overall yield of all the crops increased from 1980-81 to 2013-14 (Table 29). Average yield of monsoon paddy has doubled while that of summer paddy has increased to five times. Yield for potato and vegetables have also gone up substantially. This is mainly due to increased application of fertilizer and irrigation. However, average net return from paddy, which is the main staple crop in the region, has declined (Table 30). Reduction is more substantial during monsoon season where farmers have even incurred losses in 2013-14. Nevertheless, farmers still go for monsoon paddy, in spite of low profitability, as this is the only crop they can grow during that season because of heavy rains. Also, the fodder which they obtain from paddy is fed to the animals.

There is also decline of income from jute crop. This can be attributed to the high expenditure on purchasing agri-inputs for these crops. Further, despite of reduction in input cost for vegetables during summer season, the net returns have declined. The probable reason can be damage to vegetable produce, a highly perishable item, during summer season which is characterised usually by very warm and dry weather. For rest of the crops, net returns have

increased between 1980-81 and 2013-14. Farmers were also able to get substantial earnings from mustard, red lentil and coriander which were introduced only in early 2000.

Table 29: Crop yield for the surveyed households, Gangetic Plains of West Bengal

Season	Crops	Crop yield (kg/acre)				
		1980-81	1990-91	2000-01	2010-11	2013-14
Monsoon	Paddy	903	959	1400	2276	1913
	Vegetables	8664	8843	10084	12974	15822
Winter	Potato	5219	5879	7499	14011	15745
	Vegetables	10188	10847	12435	14515	14571
	Mustard	-	-	588	1019	810
	Red Lentil	-	-	840	1138	965
	Coriander	-	-	519	730	845
Summer	Vegetables	7858	7739	9337	12538	13078
	Jute	1961	1889	2287	3178	2933
	Sesame	576	489	731	848	887
	Paddy	584	752	1203	2071	2600

Table 30: Net return from various crops at real prices (2013-2014) for the surveyed households, Gangetic Plains of West Bengal

Season	Crops	Net return (Rs/acre)				
		1980-81	1990-91	2000-01	2010-11	2013-14
Monsoon	Paddy	45911	19838	3630	1764	-1293
	Vegetables	-	65822	32222	56952	73119
Winter	Potato	75447	13226	13394	63938	85199
	Vegetables	-	-	87262	67345	64733
	Mustard	-	-	5619	15630	9788
	Red Lentil	-	-	18423	28551	23189
	Coriander	-	-	33800	28840	38794
Summer	Vegetables	70967	59982	38975	60549	54989
	Jute	67819	52600	30605	21137	6188
	Sesame	-	21344	25260	17151	26001
	Paddy	14503	12091	6836	3494	7821

10.5.6 Changes in livestock holding and milk yield

As presented in Table 31, total number of livestock with surveyed households has reduced over the years. Number of indigenous cattle has reduced to nil. However, there was a significant increase in the number of crossbred cattle which indicates household interest in dairy. Since 1980's, average milk yield per milch animal has also increased before coming down slightly in 2013. Average amount of milk sold by households has also shown the same trend. However, revenue from selling milk has reduced by almost half over the years. This may be due to the fact that the milk prices are determined by the fat content which is generally low in cow's milk. As a result, per litre milk price being offered to farmers work out to be below the procurement prices in other regions. Also, in absence of any formal arrangement for milk collection and distribution at the local level, prices offered to farmers are below than the market price.

Table 31: No of animals and milk yield of households owning livestock, Gangetic Plains of West Bengal

Sr. No.	Particulars	Animal type	Year				
			1980	1990	2000	2010	2013
1	No. of milch animals	Indigenous cow	53	52	7	2	0
		Crossbred cow	92	180	159	129	101
2	No. of non-milch animal	Indigenous cow	40	38	2	0	0
		Crossbred cow	40	83	39	26	43
3	Milk yield (lit/annum) per milch animal	Indigenous cow	427	427	495	360	-
		Crossbred cow	2226	2208	2165	2334	2094
4	Average amount of milk sold (lit/day/HH)		5.55	6.76	7.64	7.29	7.22
5	Revenue from selling milk (Rs/day/HH) at real prices (2013-14)		343	283	230	167	155

11 Major changes in agricultural landscape in Banaskantha, North Gujarat

11.1 Physiography

Banaskantha District is situated in North port of Gujarat. The district is encompassed by 23.03 to 24.45 North Latitude and 71.21 to 73.02 Longitudes. The district is surrounded by Rajasthan state in East-North, Mehsana in South and Patan and Kutch district in West. The Geographical area of the Banaskantha district is 1270300 Hect. The district divided into 12 talukas. The district is rich in respect of minerals resources. The important minerals in the district are like marble Block, Rubble, Lime stone, Granite Block, Granit rubble, Quartzite, ordinary sand etc. The map of Banaskantha district is shown in Figure 9.

11.2 Demography

Demographic details of Banaskantha district are given in Table 32. Among selected districts, the highest geographical area (in sq. km) is of district Banaskantha (12,703) and the lowest population density was observed in Banaskantha and Chandrapur districts. However, Banaskantha has registered the highest decadal (from 2001 to 2011) population growth rate (19.6%) among the selected districts.

Table 32: showing the demography details of Banaskantha district

Sr. No.	Region covered	District selected	Population (selected district)			
			2001 (in lac)	% to region's overall	2011 (in lac)	% to region's overall
1	North Gujarat	Banaskantha	25.04	28.01	31.16	30.25

The initial provisional data released by census India 2011, shows that density of Banaskantha district for 2011 is 290 people per sq. km. In 2001, Banaskantha district density was at 233 people per sq. km. Banaskantha district administers 10,743 square kilometres of areas. Out of the total Banaskantha population for 2011 census, 13.30 per cent lives in urban regions of district. In total 414,915 people lives in urban areas of which males are 216,638 and females are

198,277. Sex Ratio in urban region of Banaskantha district is 915 as per 2011 census data. As per 2011 census, 86.70 % population of Banaskantha districts lives in rural areas of villages. The total Banaskantha district population living in rural areas is 2,705,591 of which males and females are 1,393,741 and 1,311,850 respectively. In rural areas of Banaskantha district, sex ratio is 941 females per 1000 males.

11.3 Changing Land Use

The land use details of Banaskantha district are presented in Table 33. Total geographical area of the state is about 1044.4 ('000ha). It can be seen that the total cultivable area (including cultivable waste) is 83.0 per cent of the total area and forest covers 11 per cent of the total geographical area The gross cropped area is 1033.4 with cropping intensity 138.8 and 75 per cent of irrigated area depends on bore wells.

Table 33: Land Use Pattern of Banaskantha Area in '000 Hectares

Sr.no	CATEGORY	Area ('000 ha)
1	Total geographical area	1044.4
2	Forests	110.6
3	Barren & uncultivable land	30.9
4	Land put to non-agricultural Uses	52.9
5	Cultivable waste	17.5
6	Permanent pastures and other Lands	65.1
7	Land misc. tree crops and groves	----
8	Other fallow lands	----
9	Current fallows	23.4
13	Net sown area	744.0
14	Gross cropped area	1033.4

11.4 Changes in Operational Holding

The details of land holdings in north Gujarat are given in Table 34. The details of changes in land holding pattern in north Gujarat are given in Table 35. In Gujarat, households with small and marginal ownership holdings account for 69.2 per cent of all households and cover 88.8 per cent of all area owned. Semi-medium ownership accounts for 20.5 per cent of land holdings with total area of 30.4 per cent which is larger than other land holdings.

Table 34: Landholdings in Banaskantha, North Gujarat

Sr. No.	Region	Total no. of land holdings (in 000')		Total area of land holdings (in 000' ha)	
		2000-01	2010-11	2000-01	2010-11
1	North Gujarat	942	1101	2059	2071

Table 35: Size class-wise details of the operational landholding in North Gujarat

Sr. No	Landholding Size Class	Particulars	North Gujarat	
			2000-01	2010-11
1	Marginal	% to total no. of land holdings	34.2	41.5
		% to total area	8.3	10.7
		Avg. size (ha)	0.5	0.5

2	Small	% to total no. of land holdings	28.5	27.7
		% to total area	18.9	21.3
		Avg. size (ha)	1.4	1.4
3	Semi Medium	% to total no. of land holdings	23.4	20.5
		% to total area	30.0	30.4
		Avg. size (ha)	2.8	2.8
4	Medium	% to total no. of land holdings	12.8	9.6
		% to total area	33.5	28.7
		Avg. size (ha)	5.7	5.6
5	Large	% to total no. of land holdings	1.2	0.7
		% to total area	9.3	8.9
		Avg. size (ha)	17.2	23.0

11.5 Agricultural Situation

11.5.1 Cropped Area and Irrigated Area

The gross cropped area is 28.19 lakh hectares of which 51 per cent of area is gross irrigated and the percentage of gross irrigated area depending on ground water is 92 per cent. The major sources of contributors are Bore wells (75.3%) and open wells (22.7 %) respectively.

11.5.2 Income and Expenditure

The details of average annual household income, percentage income from agriculture and the average annual expenditure as a percentage of annual income are given for north Gujarat region for the period from 1980-81 to 2013-14 are given in Table 36. The average annual income of households from 1980-81 to 2013-14 has increased from 22,120 to 225,693 Rs/HH while the agricultural income is proportionately decreasing from 69 per cent to 49 per cent. The expenditure as a percentage of the annual household income increased consistently from 45 to 88.

The details of household expenditure for the same period are given in Table 37. The expenditure on food as a percentage of the total household expenditure decreased from 21 to 16, whereas that on agri inputs increased from 21 to 23, though not consistent with time.

Table 36: Income and Expenditure in North Gujarat region

Sr. No.	Time period	Particulars (Average per HH)	Districts covered
			Banaskantha
1	1980-81	Average annual Income (Rs/HH)	22,120
		% agricultural income	69
		% expenditure	45
2	1990-91	Average annual income (Rs/HH)	46,633
		% agricultural income	69
		% expenditure	64
3	2000-01	Average annual income (Rs/HH)	75,313
		% agricultural income	60
		% expenditure	70
4	2010-11	Average annual income (Rs/HH)	164,067
		% agricultural income	58

		% expenditure	65
5	2013-14	Average annual income (Rs/HH)	225,693
		% agricultural income	49
		% expenditure	88

Table 37: Expenditure (current prices) on major items by surveyed households

Sr. No.	Particulars	Time period	Average expenditure per household (% to total)
			Banaskantha
1	Food items	1980-81	21
		1990-91	13
		2000-01	14
		2010-11	16
		2013-14	16
2	Agri inputs	1980-81	21
		1990-91	25
		2000-01	25
		2010-11	21
		2013-14	23
3	Children education	1980-81	10
		1990-91	8
		2000-01	5
		2010-11	10
		2013-14	9
4	Health care	1980-81	9
		1990-91	14
		2000-01	12
		2010-11	5
		2013-14	9
5	HH items and durable goods	1980-81	15
		1990-91	18
		2000-01	23
		2010-11	29
		2013-14	25

11.5.3 Changes in cropping pattern and irrigated area

In Banaskantha, a comparatively large number of crops are grown during kharif season. Between 1980-81 and 2013-14, the proportion of total cropped area during monsoon season has increased substantially. Major increase was in area under castor and fennel crop which fetch high market price. However, proportion of cropped area under winter crops has come down substantially especially in case of mustard. Further, a high proportion of cropped area under castor and fennel, which are important cash crops, was found to be under irrigation. Also, all the winter and summer crops are fully irrigated (Table 38).

Table 38: Cropping and irrigation pattern of surveyed households, North Gujarat

Season	Crops	Proportion of cropped area under different crops (%)					Proportion of cropped area which is irrigated (%)				
		1980-81	1990-91	2000-01	2010-11	2013-14	1980-81	1990-91	2000-01	2010-11	2013-14
Monsoon	Castor	17	16	23	22	24	74	72	76	65	76
	Fennel	5	10	13	10	11	100	100	100	100	100
	Cluster Bean	22	21	17	22	22	0	100	0	0	0
	Sorghum	9	9	7	-	-	0	100	0	-	-
	Pearl Millet	14	11	12	17	19	9	100	11	7	7
	Overall	66	66	72	70	76	28	100	44	35	41
Winter	Mustard	14	9	9	10	5	100	100	100	100	100
	Wheat	8	8	6	6	8	100	100	100	100	100
	Rajgaro	-	3	2	3	-	-	100	100	100	-
	Overall	22	20	17	19	13	100	100	100	100	100
Summer	Pearl Millet	12	13	11	11	10	100	100	100	100	100

11.5.4 Changes in agricultural inputs

Between 1980-81 and 2013-14, average input cost for all crops has reduced substantially (Table 39). However, both application of irrigation and quantum of fertilizers have increased. Average irrigation hours increased from 20 per acre to 26 per acre, whereas, average fertilizer application increased from 48 kg/acre to 86 kg/acre. This indicates that growing subsidy for irrigation (mainly on energy use) and on fertiliser has reduced the input cost. In fact, between 1980-81 and 2013-14, average real cost of irrigation has reduced from Rs 72/hr to Rs 14/hr and fertilizer cost has reduced from Rs 29/kg to Rs 11/kg (adjusted to 2013-2104 prices). Thus it has offset the rise in input cost to a great extent.

Table 39: Agri-input cost at real prices (2013-14) for the surveyed households, North Gujarat

Season	Crops	Input cost (Rs/acre)				
		1980-81	1990-91	2000-01	2010-11	2013-14
Monsoon	Castor	10979	13387	8165	6242	4512
	Fennel	9632	12141	10198	5109	4810
	Cluster Bean	4587	3836	971	2176	1669
	Sorghum	10226	7001	7810	-	-
	Pearl Millet	-	-	3354	1475	655
Winter	Mustard	6998	10022	9341	8881	1865
	Wheat	27703	25273	11733	13911	8023
	Rajgaro	-	7390	8819	3257	-
Summer	Pearl Millet	7246	5023	6636	4256	2851

11.5.5 Changes in crop yield and returns

Average yield of all the crops, except for fennel and monsoon pearl millet, has increased between 1980-81 and 2013-14 (Table 40). In case of fennel and monsoon pearl millet, yields have reduced by almost half. This can have a significant bearing on the household earning.

Interestingly, even after low input cost and better yields, average net return per acre for all the crops have declined, except for sorghum, between 1980-81 and 2013-14 (Table 39). Net return from fennel has declined by almost 10 times. The main reason appears to be low farm gate prices for the crops being offered to the farmers. Between 1980-81 and 2013-14, real farm get prices (adjusted to 2013-2104 prices) have decreased from: Rs 67/kg to Rs 25/kg for castor; Rs 256/kg to Rs 70/kg for fennel; Rs 88/kg to Rs 43/kg for cluster bean; Rs 60/kg to Rs 20/kg for mustard; Rs 47/kg to Rs 17/kg; and Rs 29/kg to Rs 13/kg for summer pearl millet.

Table 40: Crop yield for the surveyed households, North Gujarat

Season	Crops	Crop yield (kg/acre)				
		1980-81	1990-91	2000-01	2010-11	2013-14
Monsoon	Castor	693	740	871	648	981
	Fennel	1480	524	525	525	703
	Cluster Bean	316	408	219	522	325
	Sorghum	419	488	546	-	-
	Pearl Millet	-	-	469	412	296
Winter	Mustard	623	656	963	851	926
	Wheat	1398	1302	1921	1912	1817
	Rajgaro	-	700	900	750	-
Summer	Pearl Millet	971	1299	938	1166	1080

Table 41: Net return from various crops in real prices (2013-2014) for the surveyed households, North Gujarat

Season	Crops	Net return (Rs/acre)				
		1980-81	1990-91	2000-01	2010-11	2013-14
Monsoon	Castor	35245	31747	51873	19768	19722
	Fennel	369131	67008	40566	27716	44402
	Cluster Bean	23247	12939	18961	32163	12437
	Sorghum	18702	22449	21717	-	-
	Pearl Millet	-	-	9323	5102	2309
Winter	Mustard	30197	21536	21789	9388	16606
	Wheat	37974	20009	37337	23029	23174
	Rajgaro	-	20802	68640	25666	-
Summer	Pearl Millet	21161	31727	8927	9997	11625

11.5.6 Changes in livestock holding and milk yield

Banaskantha is known for its cooperative dairy business. Between 1980 and 2013, the number of crossbred cow has increased by substantial proportion for the surveyed households, whereas number of buffaloes has decreased (Table 42). Nevertheless, there was an overall increase in the number of milch animals. Livestock holding for cattle in non-milch category also shows the similar trend. Average annual milk yield of crossbred cow has increased by almost 4

times which also explains households' preference for more number of such cattle. Accordingly amount of milk being sold by per household has increased by substantial proportion between 1980 and 2013.

Milk prices in the region are also revised from time to time to take care of the inflation and increasing input cost for livestock keeping. Due to the combined effect of high milk yield and increase in procurement prices, the average revenue earned per day by the households has also gone up to 4 times (Table 42).

Table 42: No of animals and milk yield of households owning livestock, North Gujarat

Sr. No.	Particulars	Animal type	Year				
			1980	1990	2000	2010	2013
1	No. of milch animals	Crossbred cow	42	172	394	349	506
		Buffalo	299	459	345	223	181
2	No. of non-milch animal	Crossbred cow	0	75	245	365	264
		Buffalo	435	395	260	136	226
		Goat	0	1101	1244	1073	0
3	Milk yield (lit/annum) per milch animal	Crossbred cow	3562	5170	10502	9552	12979
		Buffalo	3413	4176	4162	3924	3114
4	Average amount of milk sold (lit/day/HH)		6.43	16.76	23.65	21.94	27.03
5	Revenue from selling milk (Rs/day/HH) at real prices (2013-14)		222	534	540	622	778

12 Major changes in agricultural landscape in Chandrapur, Vidarbha

12.1 Physiography

Chandrapur is located in the eastern edge of Maharashtra in 'Vidarbha' region. It is located between 19.30' N to 20.45'N Latitude and 78.46'E longitude. The district is bounded by Nagpur, Bhandara and Wardha on the northern side, Yavatmal on the western side, Gadchiroli on the eastern side and Adilabad district of the Andhra Pradesh on the southern side. Physiographically, the district is situated within the Wainganga and Wardha river basins, respectively, flowing on the eastern and western boundaries of the district which are the tributaries of Godavari River. The map of Chandrapur District is given in Figure 10.

12.2 Demography

The demographic details of Chandrapur district are given in Table 43. In 2011, Chandrapur had population of 2,204,307 of which male and female were 1,123,834 and 1,080,473, respectively. In 2001 census, Chandrapur had a population of 2,071,101 of which males were 1,062,993 and remaining 1,008,108 were females.

Chandrapur District population constituted 1.96 per cent of total Maharashtra population. In 2001 census, this figure for Chandrapur District was at 2.14 per cent of Maharashtra population. There was change of 6.43 per cent in the population compared to population as per 2001. In the previous census of India 2001, Chandrapur District recorded increase of 16.88 per cent to its population compared to 1991.

Table 43 Demography Details of Chandrapur District

Description	2011	2001
Actual Population	2,204,307	2,071,101
Male	1,123,834	1,062,993
Female	1,080,473	1,008,108
Population Growth	6.43%	16.88%
Area Sq. Km	11,443	11,443
Density/km2	193	181
Proportion to Maharashtra Population	1.96%	2.14%

Source: Population Census 2011

12.3 Changing Land Use

Table 44 gives the details of land use pattern of Chandrapur district. The total geographical area of the district is 10,919 sq. km. Of the total area, the total cultivable land accounts for 51.45 per cent. The next highest area (33.44 per cent) is under forests. The land, which is either not available or suitable for cultivation amounts to 12.68 per cent and the area not used for cultivation, is about 5.56 per cent.

Table 44: Land Use Pattern of Chandrapur District 2010

Sr. No	CATEGORY	Area in Ha
1	Total geographical area	1092
2	Forests	388.2
3	Barren & uncultivable land	26.3
4	Land put to non-agricultural Uses	91.7
5	Cultivable waste	36.6
6	Permanent pastures and other Lands	56
7	Land misc. tree crops and groves	12
8	Other fallow lands	13.6
9	Current fallows	16
10	Cultivable Land	451.5

Source: Chandrapur district census handbook

12.4 Changes in Operational Holding

The economy of the district is mainly depending on agricultural. Cultivators and agricultural labourers together account 65.7 per cent workers in the district. Table 45 provides the details of land holdings in Chandrapur for the period 2000-01 and 2010-11.

Table 45: Land Holdings in Chandrapur District

Sr. No	Region	Total no. of land holdings (in 000')		Total area of land holdings (in 000' ha)	
		2000-01	2010-11	2000-01	2010-11
1	Vidarbha	2359	3024	5160	5172

Table 46 presents the landholding details as per different size classes in 2000-01 and 2010-11. In this region, the proportion of small and marginal holdings has increased during this

period. Small and marginal farmers are increasingly depending on small land holdings to earn their livelihoods.

Table 46: Size class-wise details of the Operational Landholding in Vidarbha

Sr. No.	Land holding size class	Particulars	Vidarbha	
			2000-01	2010-11
1	Marginal	% to total no. of land holdings	30.3	35.9
		% to total area	9.0	12.2
		Avg. size (ha)	0.6	0.6
2	Small	% to total no. of land holdings	35.6	37.1
		% to total area	25.4	30.8
		Avg. size (ha)	1.4	1.4
3	Semi-medium	% to total no. of land holdings	23.0	19.8
		% to total area	30.7	30.8
		Avg. size (ha)	2.7	2.7
4	Medium	% to total no. of land holdings	10.1	6.7
		% to total area	28.3	21.7
		Avg. size (ha)	5.7	5.6
5	Large	% to total no. of land holdings	1.0	0.5
		% to total area	6.7	4.6
		Avg. size (ha)	13.7	14.6

12.5 Agricultural Situation

12.5.1 Cropped Area and Irrigated Area

The gross cropped area in Vidharba region is 60.92 lakh hectares and the gross irrigated area is 18 per cent of gross cropped area, and groundwater accounts for 62 per cent of the irrigated area in Vidharba region.

12.5.2 Changes in income and expenditure

Table 47 gives details of the average annual income and expenditure of the households in the region for the period from 1980-81 to 2012-13. Unlike other regions, in Vidharba, the agricultural income still accounts for 100 per cent of the total family income of the surveyed households. The household expenditure as a percentage of the family expenditure however kept increasing like the sample households in the other three regions. As regards the break-up of the family expenditure (Table 48), the expenditure on food kept reducing consistently from 1980-81 to 2012-13, whereas that on agri inputs kept increasing during the same period, though not consistently.

Table 47: Income and Expenditure in North Chandrapur

Sr. No.	Time period	Particulars (Average per HH)	Districts covered
			Chandrapur
1	1980-81	Average annual Income (Rs/HH)	14,552
		% agricultural income	100
		% expenditure	41
2	1990-91	Average annual income (Rs/HH)	16,108

		% agricultural income	100
		% expenditure	48
3	2000-01	Average annual income (Rs/HH)	17,844
		% agricultural income	100
		% expenditure	51
4	2010-11	Average annual income (Rs/HH)	18,285
		% agricultural income	100
		% expenditure	53
5	2013-14	Average annual income (Rs/HH)	45,341
		% agricultural income	100
		% expenditure	67

Table 48: Expenditure (current prices) on major items by surveyed households

Sr. No.	Particulars	Time period	Average expenditure per household (% to total) in Chandrapur
1	Food items	1980-81	46
		1990-91	41
		2000-01	38
		2010-11	42
		2013-14	28
2	Agri inputs	1980-81	14
		1990-91	8
		2000-01	10
		2010-11	12
		2013-14	32
3	Children education	1980-81	1
		1990-91	6
		2000-01	10
		2010-11	7
		2013-14	8
4	Health care	1980-81	4
		1990-91	12
		2000-01	10
		2010-11	8
		2013-14	9
5	HH items and durable goods	1980-81	9
		1990-91	10
		2000-01	11
		2010-11	12
		2013-14	11

12.5.3 Changes in cropping pattern and irrigated area

As shown in Table 49, proportion of total cropped area is highest during monsoon season and no crop is taken during summer months. Further, between 1980-81 and 2013-14, area under cotton crop has increased by remarkable proportion. It is also observed that over the years, proportion of area under winter crops has declined. This is largely due to limited availability of water (groundwater being the major resource) for irrigation. As presented in Table 29, a large proportion of cropped area during monsoon season is irrigated. However, it has come down post 2010. Further, though whole of the winter crops are irrigated, the number of watering are less as the groundwater gets exhausted by the middle of winter season.

Table 49: Cropping and irrigation pattern of surveyed households, Chandrapur

Season	Crops	Proportion of cropped area under different crops (%)					Proportion of cropped area which is irrigated (%)				
		1980-81	1990-91	2000-01	2010-11	2013-14	1980-81	1990-91	2000-01	2010-11	2013-14
Monsoon	Cotton	28	29	29	34	45	100	100	100	92	81
	Soya bean	27	26	26	26	28	96	100	100	95	85
	Pulses	10	10	10	9	6	100	100	100	100	100
	Overall	65	65	65	69	78	98	100	100	94	84
Winter	Maize	2	2	2	2	1	100	100	100	100	100
	Sorghum	19	19	19	17	12	100	100	100	100	100
	Pearl Millet	14	14	14	13	9	100	100	100	100	100
	Overall	35	35	35	31	21	100	100	100	100	100

12.5.4 Changes in agricultural inputs

Table 50 presents the data on the agri input costs for the surveyed households over the time period from 1980-81 to 2012-13. In comparison to 1980-81, the input cost for all the crops have come down by 2013-14. The main reasons appear to be: reduction in number of irrigation hours per unit of land area; growing energy subsidies which further lowers the cost of irrigation using groundwater; and lower fertiliser cost. The expenditure might also have reduced due to lower returns which will be discussed in subsequent sub-sections.

Table 50: Agri-input cost at real prices (2013-14) for the surveyed households, Chandrapur

Season	Crops	Input cost (Rs/acre)				
		1980-81	1990-91	2000-01	2010-11	2013-14
Monsoon	Cotton	25262	44179	22722	13722	15773
	Pulses	33513	43666	22463	17485	14677
Winter	Maize	39678	25797	15798	7076	10316
	Sorghum	34832	24345	11573	8470	8874
	Pearl Millet	32559	25059	13952	9939	10378

12.5.5 Changes in crop yield and returns

As presented in Table 51, yield for all crops has grown substantially than those in 1980's. Most significant change was in cotton yield which increased by almost 10 times between 1980-81 and 2013-14. The major reason for this is the use of Bt cotton seed for sowing. Though this variety is resistant to many of the pest attacks, it is susceptible to damages during climate extremes.

The reduction in input cost and yield increase is not reflected in the net returns for the farmers. In fact, net returns from all crops except cotton have declined from 1980's to 2013-14 (Table 52). This implies that farmers were not able to give optimal inputs for the level of crop yields which can bring more income for them. Nevertheless, cotton has emerged as the major profit giving crop for the farmers. However, its production is totally dependent on the good monsoon and in case of droughts (which are experienced frequently in the region) entire produce is damaged.

Table 51: Crop Yield for the Surveyed Households, Chandrapur

Season	Crops	Crop yield (kg/acre)				
		1980-81	1990-91	2000-01	2010-11	2013-14
Monsoon	Cotton	76	492	652	579	716
	Pulses	315	692	742	763	748
Winter	Maize	641	591	783	852	810
	Sorghum	571	595	657	650	665
	Pearl Millet	559	569	940	759	664

Table 52: Net return from various crops at real prices (2013-2014) for the surveyed households, Chandrapur

Season	Crops	Net return (Rs/acre)				
		1980-81	1990-91	2000-01	2010-11	2013-14
Monsoon	Cotton	-13262	13515	22138	10619	8446
	Pulses	9870	14408	14381	2940	333
Winter	Maize	11163	15027	14099	7035	97
	Sorghum	46907	19598	16566	4851	2738
	Pearl Millet	18981	14838	21038	-1006	24

12.5.6 Changes in livestock holding and milk yield

As shown in Table 53, dairy in the area is not well developed. Most of the households have low milk yielding indigenous cattle and buffaloes. As the production is low, milk is mainly used for household own consumption and nothing is sold. Household also own a significant number of bullocks which might be in use for supporting agricultural operations.

Table 53: No of animals and milk yield of households owning livestock, Chandrapur

Sr. No	Particulars	Animal type	Year				
			1980	1990	2000	2010	2013
1	No. of milch animals	Indigenous cow	43	22	54	40	51
		Crossbred cow	0	10	29	0	0
		Buffalo	44	39	0	59	49

		Goat	17	0	13	10	0
		Sheep	0	0	16	0	0
2	No. of non-milch animal	Indigenous cow	47	61	48	36	51
		Crossbred cow	0	17	32	13	0
		Buffalo	45	28	0	61	48
		Goat	15	0	13	0	0
		Sheep	0	10	7	0	0
		Bullock	61	71	60	64	65
3	Milk yield (lit/annum) per milch animal	Buffalo	83	94	-	79	103

13 Comparative Analysis of Agricultural Performance across Regions

Since the farmers grow many crops and raise livestock, and allocate the inputs optimally to maximize the income from the whole farm rather than from individual plots and fields, analysis of the changes in income from individual crops alone has limited relevance. It is important to know how the farm as a whole has fared as an enterprise.

The average net returns at farm level (adjusted to 2013-14 prices) are presented in Table 54. It shows that average net returns at farm level for the surveyed households in Hoogly, North 24 Parganas (both in Gangetic Plains, West Bengal) and Banaskantha (North Gujarat) are substantially higher than that in West Godavari and Chandrapur. The average farm income from crop production is lowest in Chandrapur (Rs. 7330/HH per annum). One of the reasons is diversified cropping pattern in both Gangetic Plains and North Gujarat where farmers were found to be growing 10-11 different crops. In fact after registering a decline, net farm returns have increased post 2000 in Hooghly and North 24 Parganas owning to introduction of new crops (mustard, red lentil and coriander). Further, farmers are able to adjust to the resource scarcity (water scarcity in North Gujarat and land scarcity in Gangetic Plains, West Bengal) by increasing the cropping and irrigation intensity.

However, farmers in Banaskantha, North Gujarat have experienced significant decline in their farm income which has reduced to one half in 2013-14 from the 1980-81 level. The main reason, as discussed in the previous sections, are the low farm gate prices being offered to farmers. Nevertheless, there was a substantial increase in household earnings during 2010-11 in comparison to previous time period (before again declining in the subsequent period), as 1999-2000 was a drought year. In 2000-01, farmers earning has also been affected in Hooghly and North 24 Parganas as the gross cropped area per household reduced substantially. Further in Chandrapur (Vidarbha), where the crop input (including irrigation) is suboptimal, earnings have reduced to about one third in 2013-14 from the 1980-81 level. In fact, groundwater which is the major source of irrigation in the region is not available from latter part of winter season leading to insufficient irrigation and hence reduced yields. Hence, crop yields are dependent mostly on the good monsoon. In West Godavari (Coastal Andhra) where paddy is the major crop, farm level earning have increased. This is mainly due to the availability of highly subsidised agri-inputs (mainly irrigation and fertilisers) and substantial increase in paddy yields.

Table 54: Farm level Net Return at Real Prices (2013-2014) for the Surveyed Households

Sr. No.	Selected district	Net return-Farm (Rs/HH)				
		1980-81	1990-91	2000-01	2010-11	2013-14
1	West Godavari	4,669	8,047	28,583	9,328	15,790

2	Hoogly & North 24 Parganas	196,024	87,527	47,979	66,989	80,217
3	Banaskantha	181,135	104,472	98,687	129,673	76,998
4	Chandrapur	29,950	25,448	31,665	9,112	7,330

Regarding development of dairy as a major livelihood activity in the selected regions, North Gujarat is clearly a leader. Presence of infrastructure facilities (milk collection centres) at village level and market adjusted procurement rate of milk has made farmers consider dairy as a serious livelihood activity (Table 55). Farmers in the region own high milk yielding cattle and a result revenue from selling milk has increased substantially over the years. As a result, farmers overall income is much higher than other selected regions.

In West Godavari, though there was an increase in number of milch animals and milk price, most of them are low yielding indigenous cattle and thus dairying no longer seem to be a profitable activity (Please refer to Table 19). Similarly, household revenue from dairy in the Gangetic Plains of West Bengal has declined as the current milk procurement prices are comparatively low and there is no formal collection and marketing infrastructure (Table 53). In Vidarbha, dairy as an enterprise is a non-starter as only a few of the surveyed households have cattle and all the milk is used for household own consumption.

Table 55: Milk Prices in the Selected Study Regions

Sr. No.	Selected district	Average milk price (Rs/lit)				
		1980-81	1990-91	2000-01	2010-11	2013-14
1	West Godavari	7.57	10.66	16.36	27.61	36.65
2	Hoogly & North 24 Parganas	6.04	8.32	12.25	17.21	21.43
3	Banaskantha	3.37	6.33	9.29	21.33	28.8
4	Chandrapur	-	-	-	-	-

14 Findings

14.1 Where is the crisis most severe?

Both the nature and severity of agrarian crisis change across regions. Among all the four regions, not only the farm level income is lowest in Vidarbha but the degree of reduction in income over time is also the highest here. There is absolutely no doubt that the crisis is most severe in Vidharbha region. This corroborates with the widely studied other manifestations of the agrarian crisis in the region in terms of farmer suicides, and large scale migration of farm workers to the urban areas.

In West Godavari, there is a minimal crop diversification and farmers entirely depend on paddy for their livelihoods. This can have serious implications for their earnings during an extremely-wet or a dry year. During a year of below normal rainfall, irrigated area will reduce (as most of the irrigation is by canals which in turn depend on releases from the reservoir), whereas floods can damage the entire standing crop. Dependence on just one crop and rainfall variability might be responsible for decline of contribution of agriculture to household's total income and reduction in milk yield as availability of green fodder becomes an issue. Nevertheless, the district has been able to register a substantial increase in farm income over a period of 35 years but it still remains one of the lowest among the selected regions.

In Hoogly and North 24 Parganas, a water rich district of West Bengal, very small landholdings and difficulty in accessing irrigation water is having an impact on earnings of small

and marginal farmers. Starting from 1980-81, the net farm income per household had declined drastically till 2000-01, but picked thereafter. Though the farm level income is the highest among the selected regions, rising fertiliser cost is resulting in significant increase in input cost for rabi and summer crops. As a result, returns per unit cropped area have also started to decline. However, the reduction in net income per unit area is offset by the increase in cropping intensity, owing to expansion in irrigation. But, the non-existence of proper infrastructure for milk procurement and marketing affects income from dairy farming.

In Banaskantha, a water scarce district, returns from agriculture are seriously impacted due to low farm gate prices for most of the crops. However, dairy as an enterprise is booming and emerged as a major livelihood activity for the households. However, due to groundwater overexploitation in the region, farmers' expenditure on either deepening wells or arranging for the alternate source of water for irrigation will rise. Though the farmers have also adopted micro-irrigation technology (mainly drip systems), water use in agriculture has not reduced much as they bring more area under irrigation with the saved water.

In Chandrapur, most of the households depend on agriculture as the only source of income. However, farmers have to be content with growing crops in only two of the agricultural seasons. Water availability for irrigation during winter season is a major limiting factor for achieving higher crop yield. Availability of water in wells becomes a serious constraint during the droughts, which recur in the region. Large scale seasonal failure of agro-wells is also reported. Average household income is one of the lowest and agriculture is subsistence in nature. As the availability of water is an issue, most of the households do not own cattle.

14.2 What are the physical factors causing crisis in the agriculture sector?

In Coastal Andhra, as most of the groundwater is saline it is not used and canals are the major source of irrigation. However water availability from them depends on release from the reservoirs which is again dependent on the occurrence of rainfall during a hydrological year. Thus most of the irrigated agriculture in the region depends on monsoon.

In North Gujarat, low rainfall and high aridity are the most significant physical factors affecting water availability and hence leading to a sort of agrarian crisis. As the average water consumption for crop production far exceeds the average rainfall in the region owing to intensive cultivation of crops which are grown during non-rainy season, groundwater gets depleted. During drought years, groundwater replenishment drastically reduces, but overall water withdrawal for crop production increases. After droughts, farmers have to incur extra cost on well deepening. As per household survey, the average depth to water level has gone up from 24m in 1980-81 to 49m in 2013-14. As a result, farmers have to spend a substantial portion of their net income on deepening the existing wells. A large proportion of the wells, i.e. about 68%, are deepened every year. The average depth of well has gone up from 33.5m in 1980-81 to 69m in 2013-14. The receding ground water levels have also resulted in decline in average area irrigated per tube well from 17 acre in 1980-81 to about 13 acre 2013-14.

In Vidarbha, droughts resulting from monsoon failure are a major reason for farmers' distress. In combination with the regions geo-hydrology, it seriously affects the groundwater availability for irrigation. While during monsoon, water overflows from the large number of open wells tapping the un-weathered portion above the hard rock aquifers due to their limited storage potential. By late winters, most of the groundwater gets used up for irrigation or household consumption or flows out as base flows. Hence by summers, most of the wells become dry.

In Gangetic Plains of West Bengal, farmers have reported reduction in soil fertility. This is mainly due to high cropping intensity and increased use of fertilisers which deplete soil of its essential micro-nutrients. Also, in a number of areas groundwater is unusable as it is highly saline.

14.3 What are the socio-economic factors causing the crisis?

In Gangetic plains of West Bengal, declining land holding size is a major problem. One of the major consequences of this is on the gross cropped area per household which has declined from in 4.3 acre in 1980-81 to 2.3 acre in 2013-14. As a result, household's overall earning has declined. Further, the region has mainly marginal and small farmers and their dependence on rented diesel pumps to lift groundwater for irrigation is quite high. Erratic electricity supply makes it difficult for even those who own electric pumps. This social set up is leading to an agrarian crisis in the region which is further substantiated by the fact that close to 7% of the surveyed households has confirmed that there is increased migration to the cities in search of better employment opportunity.

In Vidarbha where farmers are engaged in subsistence agriculture which yield low returns and which is subject to vagaries of monsoon, easy availability of non-farm labour work under Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS) further make them disinterested in agriculture. Availability of wage labour for unskilled work in industries is also a deterrent for farmers to rely only on agriculture. Since no crops are taken during summer, farmers take up these works to supplement the household income. In the process, some even permanently migrate to nearby urban areas like Ballarpur (which is famous for paper industry) for better earning opportunities.

In North Gujarat, there are problems with the farm gate price offered to farmers for some of their produce. Though the region has a large number of milk cooperatives, with every village having one dairy at least and in some cases even two, there are no such influential cooperatives for selling agricultural crops, which can help farmer to get right rate of their produce.

A considerably large proportion of the children from the households surveyed from North Gujarat, Gangetic Plains of West Bengal and Coastal Andhra are studying in schools. A high proportion of households in these regions want their children to take up jobs and migrate to cities. This indicates that there would be a great reduction in number of people engaged in agriculture from these regions in the years to come.

14.4 What are the institutional and policy factors?

Subsidy on energy and fertiliser continue to play an important role in reducing expenditure on agricultural inputs for medium and large farmers in North Gujarat and Costal Andhra, whereas, they occupy a major proportion of the total input costs for small and marginal farmers in Gangetic Plains and Vidarbha. Nevertheless, electricity subsidy for agricultural pumping of groundwater is one of the factors responsible for decline in groundwater levels in North Gujarat, which, in turn, has adversely affected farmers' income by increasing the cost of irrigation and expenditure on well deepening. Further, in Coastal Andhra, where farmers are content with mono-cropping, the current cultivation practices are producing low returns in comparison to other regions and can also affect region's soil productivity in long run.

Marginal and small farmers in Gangetic Plains of West Bengal were found to be spending a high amount on fertilisers. As a result farm income has declined substantially. Considering that the region is one of the largest producers of vegetables, lack of policy initiatives to reduce input cost is detrimental for the sustainability of agriculture in the region.

In Vidarbha, which experiences frequent droughts, small farmers are unable to access a sustainable source of irrigation. The wells in this hard rock region are poor yielding and dry up much before summer. Therefore, farmers take less risk and apply agri-inputs at sub-optimal level. As a result, both crop yields and returns are low. This has created a vicious cycle in the region where farmer apply low inputs, gets low yields and returns and further reduces expenditure on crop inputs.

In dairy development, North Gujarat has a well-developed dairy structure which is supported by a professional milk marketing agency. However, lack of infrastructure for milk procurement in Coastal Andhra and Gangetic Plains of West Bengal is making farmers disinterested in dairy farming as it yields low returns. Also the milk prices offered to farmers in Gangetic plains are lower than in other States.

15 Conclusions and Policy Inferences

The findings of the study, which was undertaken in the four distinct agro-climatic regions of India, clearly show that the widespread perception about a growing agrarian crisis in India is largely true. However, the degree of crisis varies across regions--being highest in regions such as Chandrapur where natural endowment of water is poor; access to irrigation water is low; the farmers have poor land holdings; and the access to institutional credit and markets are also very poor. Also, the factors which act as drivers for this crisis vary from region to region. In the semi-arid, Coastal Andhra, North Gujarat and Vidarbha regions, physical factors, such as rainfall variability, overall scarcity of water, groundwater depletion, limited availability of groundwater, are causing stress on farming enterprise, whereas in West Bengal socio-economic factors, such as declining size of landholding, migration and poor market conditions are the key factors. Non-availability of labours to work in farms, owing to large-scale migration of rural wage labourers to urban areas and engagement of a large number of those who are left behind in public works under the rural employment guarantee scheme was also significant in Vidarbha region.

But, even within the same region, the crisis is not uniform across different segments of the farming community. The institutional and policy regimes governing the access to and use of water and distribution of input subsidies (electricity, diesel and fertilizer) ultimately decide how this crisis actually get played out across different socio-economic segments. The existing energy and fertilisers subsidies are providing more benefit to large farmers in North Gujarat and Coastal Andhra Pradesh. For instance, in north Gujarat, the large and medium farmers who own wells are able to access groundwater at considerably low costs, which do not reflect the social cost of resource depletion because of heavy electricity subsidies. Whereas small and marginal farmers who dominate agricultural sector in the Gangetic Plains of West Bengal and Vidarbha continue to incur high input costs. Further, apart from North Gujarat where a proper infrastructure for milk collection, its distribution, processing and marketing is in place, dairy is unable to take off in other regions due to either low milk yields or low milk procurement prices. In Vidarbha it is a complete non-starter. Therefore, a blanket policy across regions will not work in making agriculture a lucrative option especially for small and marginal farmers.

In naturally water scarce areas like North Gujarat where groundwater is the major source of irrigation, establishing system of water rights and efficient pricing of energy used for groundwater pumping would not only lead to resource (both water an energy) sustainability but will also reduce farmer's expenditure on well deepening. It will also help small and marginal farmers, who are now dependent on water purchase to secure water rights in the region (Kumar, 2005; Kumar *et al*., 2011). Further, establishing a proper post-harvest marketing system to give farmers fair return of their produce needs to be established. In areas which are largely under mono cropping, such as Coastal Andhra, incentives in the form of easy availability of seeds and proper market for produce should be given to promote adoption of other remunerative crops. This will help in increasing farmers' income and also restore soil fertility.

In areas where rainfall variability is high, and groundwater resources, which act as drought buffer, are extremely limited due to the hard rock geology, such as Vidarbha, an effective drought monitoring and prediction system needs to be established. It will help farmers in making judicious decision on crop choice based on the information on the water availability during a particular hydrological year and help them reduce their losses. Along with this, long term plans

for investment in surface irrigation systems also will have to be explored with reservoirs, canal systems and or lift irrigation from rivers/canals, provided they are economically viable. Only such measures can reduce the distress in the farming sector in such ecologically fragile regions.

In areas where water is abundant but land is scarce, such as Gangetic Plains of West Bengal, any policy intervention which is based on the strategy of intensifying land and water use will not work, unlike what some researchers have recently claimed, as land use intensity is already very high there. However, technological and institutional interventions to improve the economic access of small and marginal farmers to irrigation water can be explored such as introduction of micro diesel engines and targeted subsidies for poor farmers. Simultaneously, a new policy for agricultural growth, which is driven by the strategy of enhancing the productivity of land and water and which is built on the concept of multiple use systems, needs to be adopted (Kumar *et al*., 2014)[7]. Along with modification in farming systems, the markets for high value agricultural produce need to be strengthened, so as to encourage farmers to go for crop diversification. For dairy to become attractive in West Godavari and Gangetic Plains a proper infrastructure for milk procurement needs to be established.

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[7] As pointed out by Kumar *et al*. (2014), the region needs farming systems that suit its agro-ecosystem. The region has large areas under wetlands, including: i] areas that are under paddy grown under submerged conditions; ii] areas that are inundated due to floods and tides; and iii] numerous wetlands that have water year round. Within the second type of areas, there are large low-lying areas in the coastal region of West Bengal that are likely to get inundated during tides. In addition, there are floodplains that are likely to get flooded due to river flooding, mostly in north Bihar. These areas are suitable for extensive shrimp farming, with very little farm inputs. While the first category of areas, which get water from tidal exchange, would be suitable for salt-water shrimp, the second type of areas would be suitable for freshwater shrimp and numerous varieties of native fish, along with paddy

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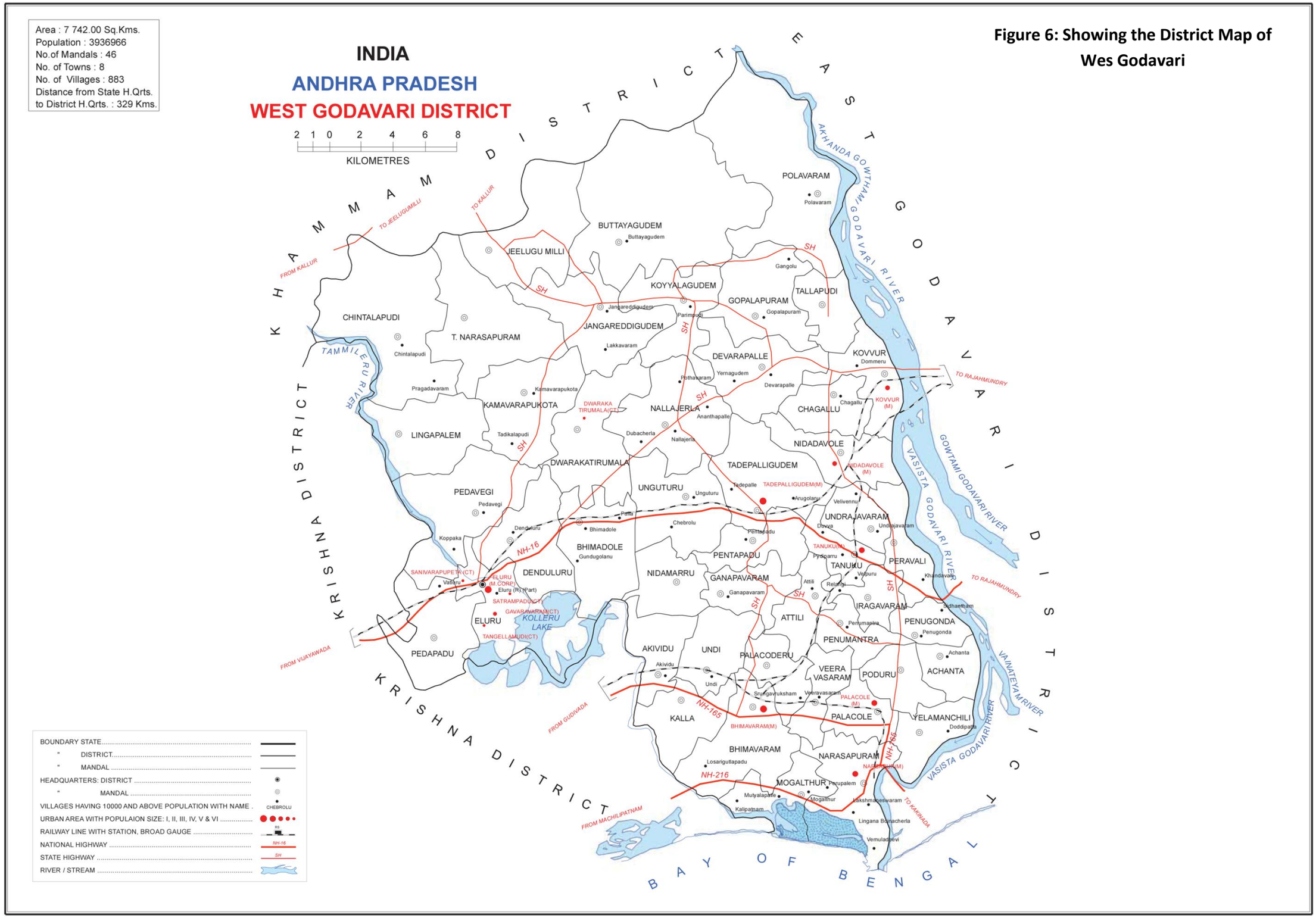
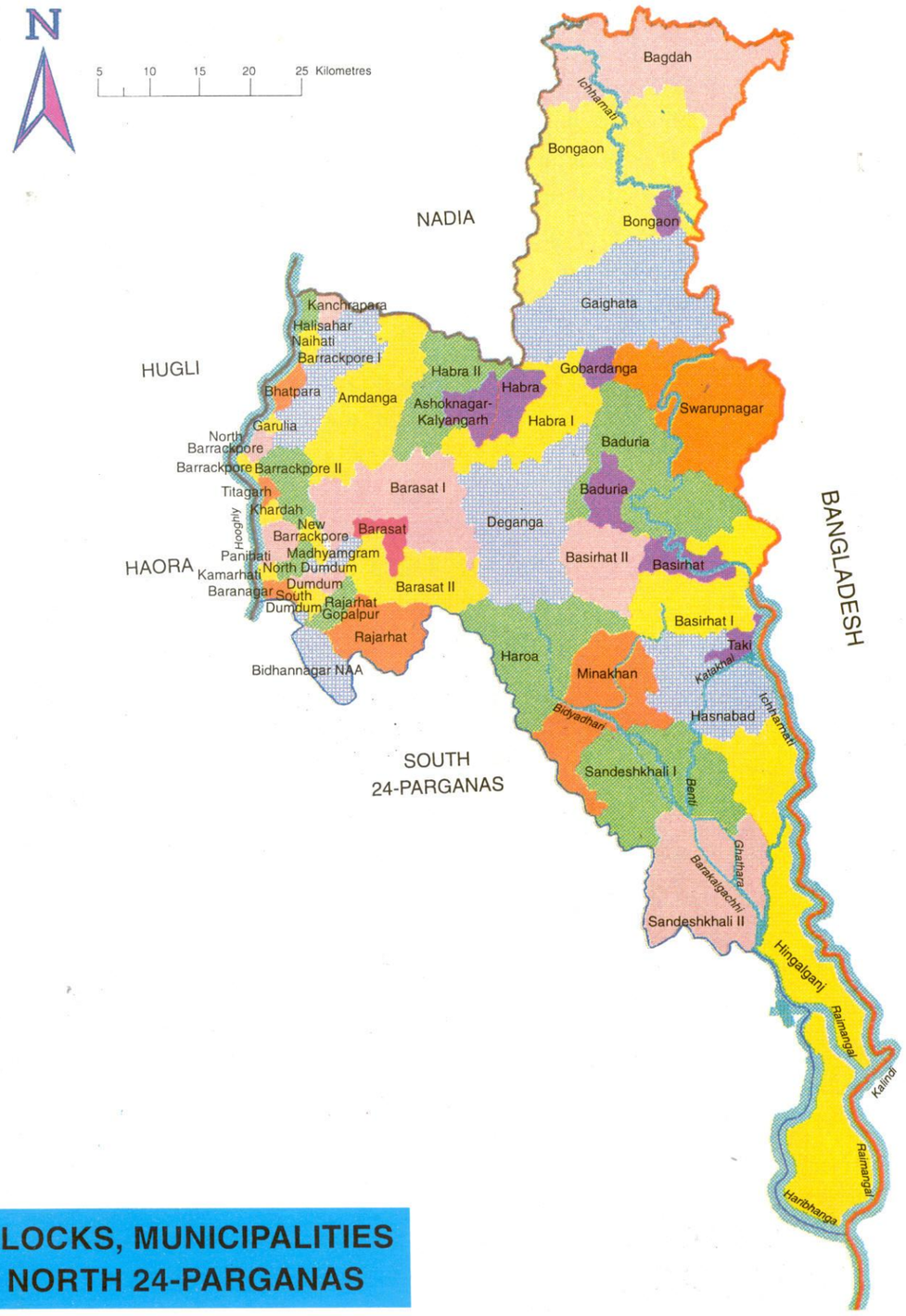


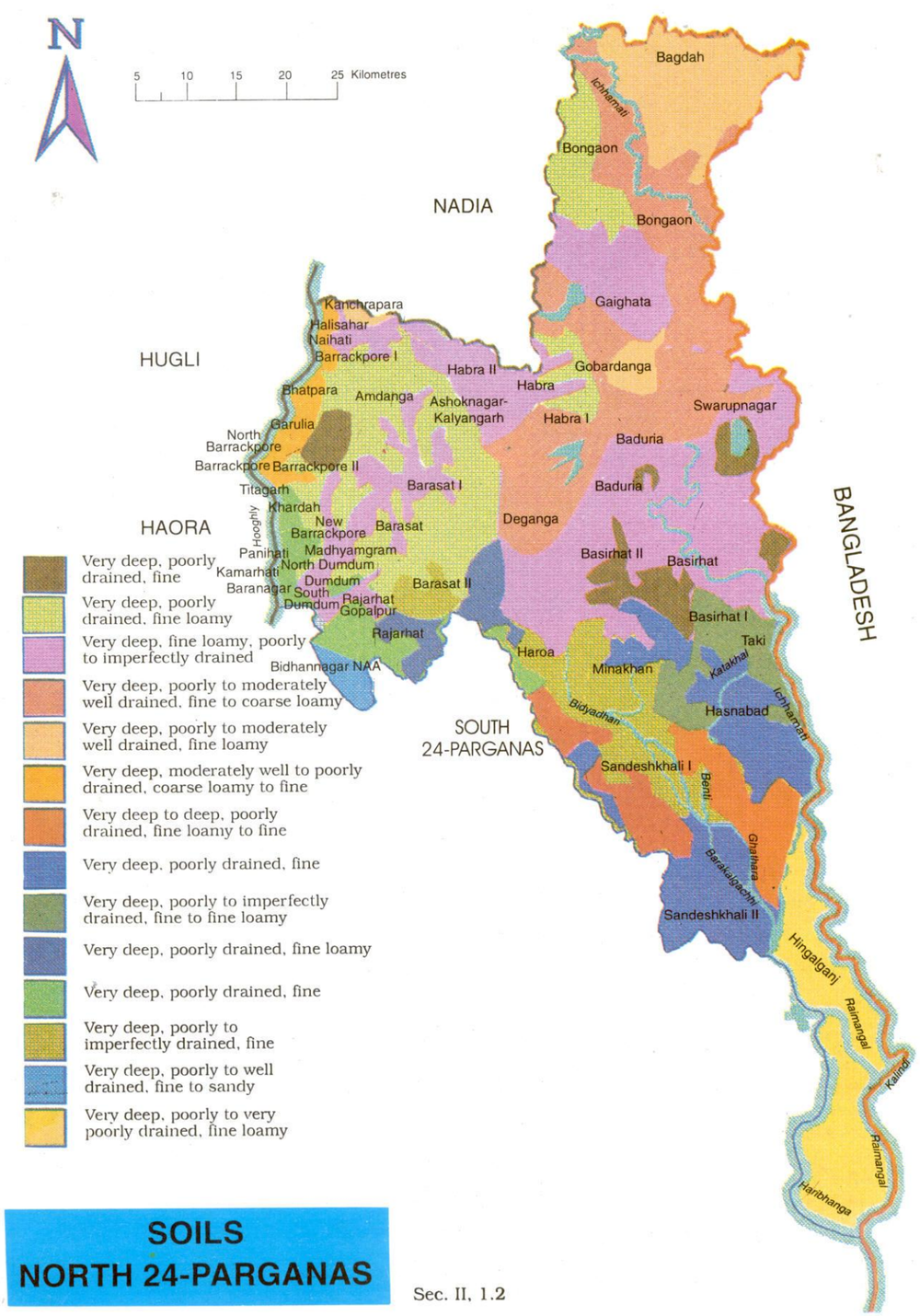
Figure 6: Showing the District Map of Wes Godavari

Source: DISTRICT CENSUS HANDBOOK WEST GODAVARI

Figure 7: MAPS SHOWING DISTRICT BLOCKS, MUNICIPALITIES AND SOILS OF NORTH 24 PARGANAS



BLOCKS, MUNICIPALITIES NORTH 24-PARGANAS



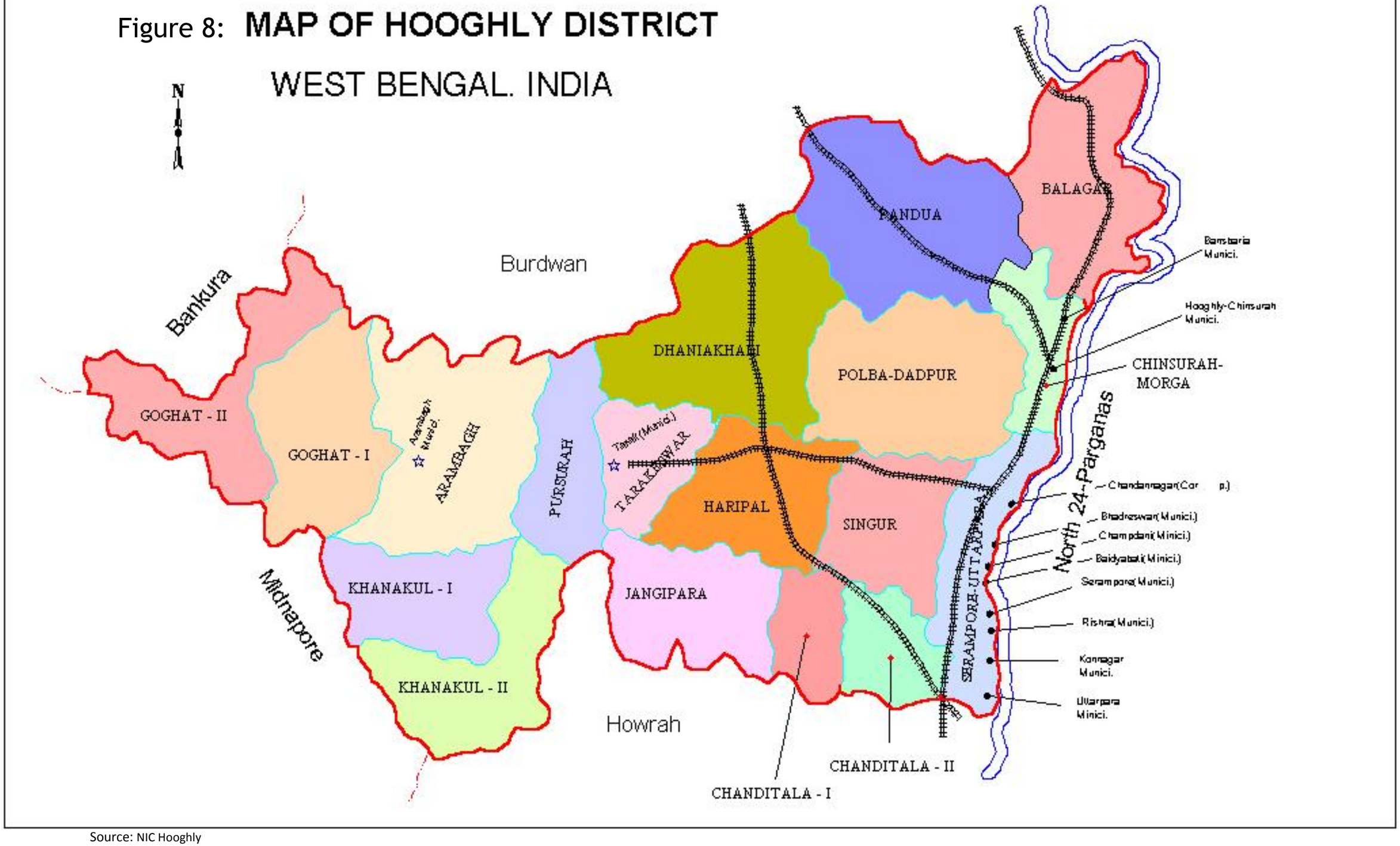
Very deep, poorly drained, fine
Very deep, poorly drained, fine loamy
Very deep, fine loamy, poorly to imperfectly drained
Very deep, poorly to moderately well drained, fine to coarse loamy
Very deep, poorly to moderately well drained, fine loamy
Very deep, moderately well to poorly drained, coarse loamy to fine
Very deep to deep, poorly drained, fine loamy to fine
Very deep, poorly drained, fine
Very deep, poorly to imperfectly drained, fine to fine loamy
Very deep, poorly drained, fine loamy
Very deep, poorly drained, fine
Very deep, poorly to imperfectly drained, fine
Very deep, poorly to well drained, fine to sandy
Very deep, poorly to very poorly drained, fine loamy

SOILS NORTH 24-PARGANAS

Sec. II, 1.2

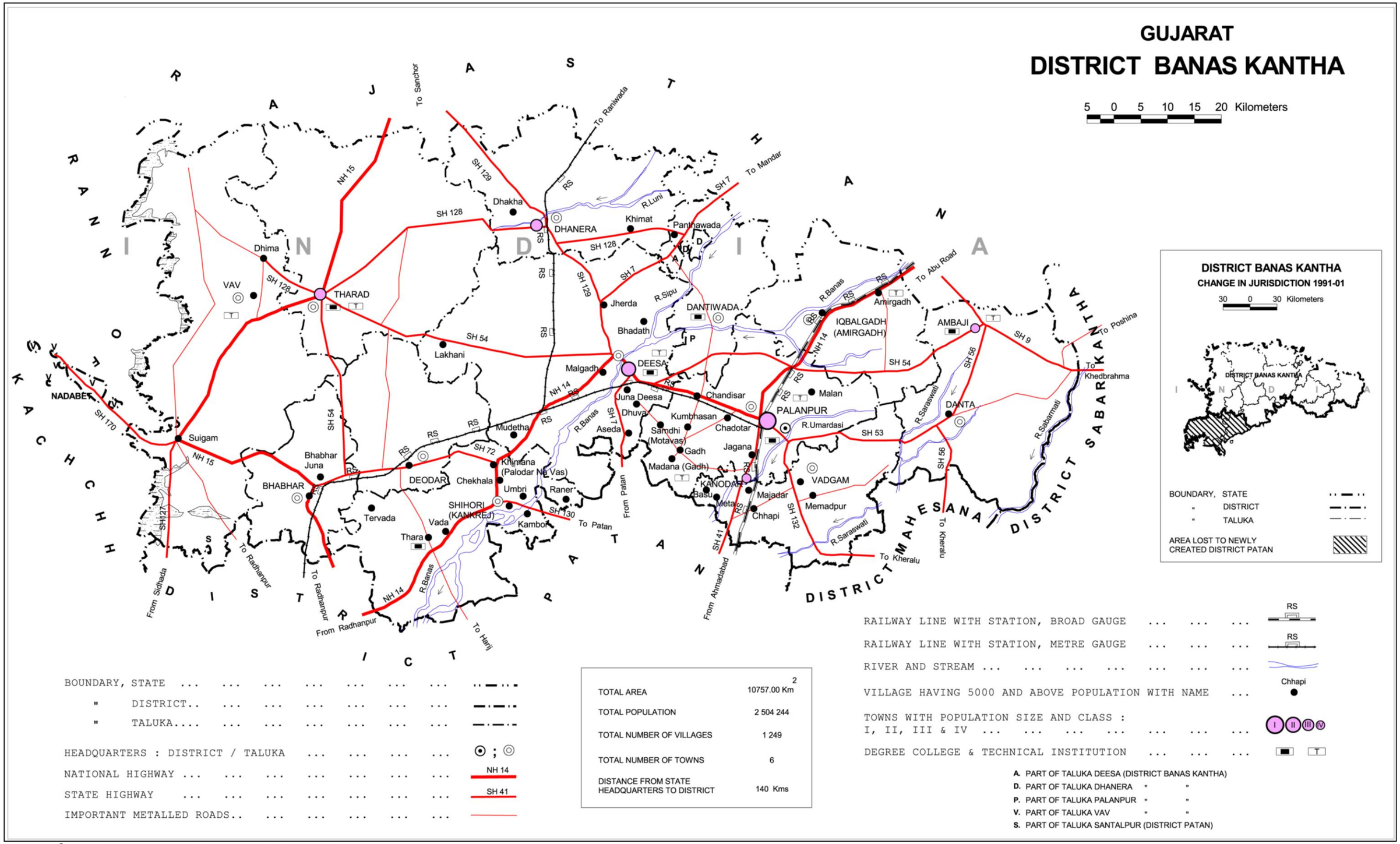
Source: Government of North 24-Parganas

Figure 8: **MAP OF HOOGHLY DISTRICT**



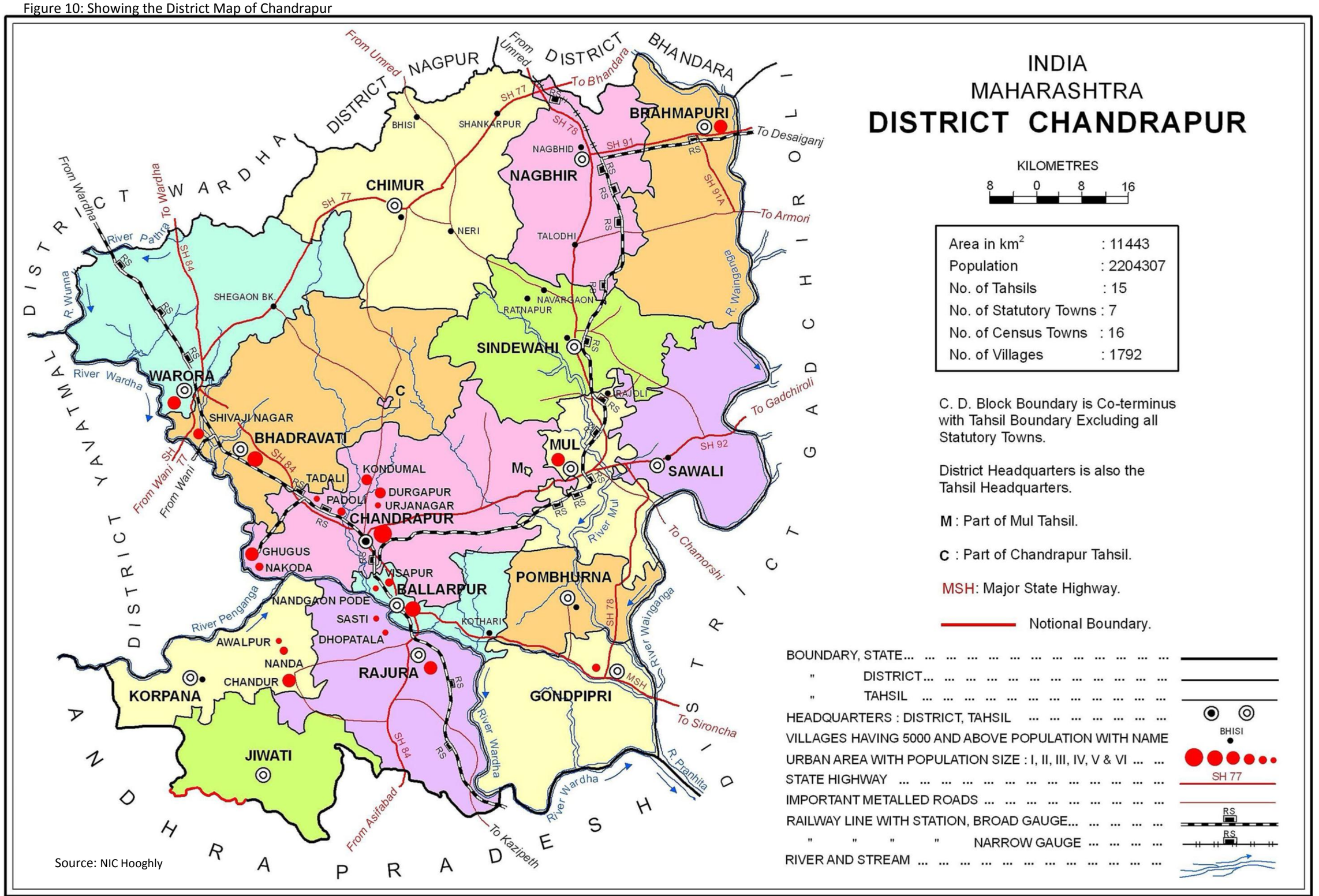
Source: NIC Hooghly

Figure 9: Showing the District Map of Banaskantha



Source: DISTRICT CENSUS HANDBOOK BANASKANTHA

Figure 10: Showing the District Map of Chandrapur



Source: NIC Hooghly

Source: DISTRICT CENSUS HANDBOOK CHANDRAPUR