Final Report on

Planning Commission Project

Growth of Indian Agriculture:

A District Level Study

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INTRODUCTION

The introduction of the Borlaug seed-fertiliser technology during the mid-sixties brought about significant increases in the levels and growth of agricultural output in India, but the gains of new technology were not spread evenly over various states and regions of the country. Our three earlier studies provided a detailed analysis of the impact of this new-seed fertiliser technology on regional patterns of levels and growth of agricultural output at the state and district levels in India during the period 1962-65 to 1990-93.

The purpose of the present study is to extend the period of analysis of the impact of new seed fertiliser technology from 1990-93 to 2003-06. This would, in the ordinary course, have been an easy mechanical exercise. But the study of this period assumes special significance since it follows the introduction of economic reforms in India in 1991 which brought about fundamental changes in macro-economic and trade policies completely altering the entire agricultural policy framework which had prevailed during the planning period prior to 1990's.

Planned Economy

During the period 1962-65 to the beginning of nineties before the initiation of economic reforms in 1991, agricultural policy operated within a planned economy framework. The strategy for agricultural development constituted part and parcel of overall planning of the Indian economy. The entire gamut of macro-economic policies, notably trade, fiscal and monetary policies, was designed to subserve the Plan objectives. The quantum of Plan outlay, methods and sources of financing Plan expenditure and targets set for the agricultural sector were all decided through the planning process at the State and Central levels. While taxation was employed to mobilize resources for current expenditure, public investment was financed through borrowings and monetary policy was geared to exercise a prior claim on bank deposits through appropriate changes in statutory cash and liquidity reserve ratios.

Of crucial importance among the Plan outlays for agriculture was the priority accorded to public investment in rural infrastructure in general, and in irrigation, in particular. From the very inception of planning, substantial resources were invested in large, medium and minor irrigation projects in both the Central and state plans.

An important breakthrough in agriculture during the mid-sixties was the introduction of Borlaug seed-fertiliser wheat technology in the north western states that resulted in significant increases in yield levels first of wheat and later rice.

Since the new technology held the promise of increasing agricultural and food production significantly, the policy makers took several measures to promote the spread of the new technology. The promotion of new technology was undertaken through a package approach which consisted of supply of HYV seeds, research and extension, supply of fertiliser and other inputs at subsidised rates and provision of credit to enable farmers to undertake necessary production expenditures. The policy makers gave special emphasis to investment in agricultural R & D and extension services. A number of agricultural universities were established up under the aegis of the Indian Council of Agricultural Research (ICAR) for combining the functions of education, research and extension. Several new institutions were set up to make available good quality seeds and other inputs to the cultivators.

Simultaneously, policies were instituted to provide cheap institutional credit and other subsidies to the farmers to encourage private investment in irrigation, including tanks, wells, pumpsets and irrigation structures. Large subsidies were also given for user charges for both irrigation and power and tariffs were kept much below the costs of their operation. The main thrust of this effort was to create an enabling economic environment for encouraging private investment by the farmers.

Trade policy under planning was highly restrictive and exchange rates were greatly overvalued. In the case of agriculture, except for a few traditional commercial crops, the rest of the agricultural sector was insulated from world agricultural markets through almost total control of exports and imports. The estimated surplus over domestic consumption requirements determined the marginal quantities to be exported and *vice versa* for imports. More importantly, foodgrains, sugar and edible oils were imported in times of scarcity to

prevent domestic prices of essential commodities from rising and to impart a measure of stability to domestic prices in the interest of both producers and consumers.

Agricultural price policy, another critical component of the Plan strategy, also aimed at subserving the main planning objective of keeping foodgrains prices low in the interest of food security. To begin with, in the context of all-pervading food shortages, the early 'fifties were characterised by a regime of rationing in urban areas and controls on stocks and the movement of foodgrains. With the advent of the new seed fertilizer technology during the mid-'sixties, price policy was also assigned the positive role of providing incentives to farmers to augment their production through the provision of remunerative prices along with the assurance of minimum support prices.

The provision of food security through augmenting domestic production constituted the central objective of agricultural policies in independent India. In addition to taking urgent steps to accelerate growth in food production, a comprehensive food management system of procurement, storage and public distribution of foodgrains was evolved with a view to providing food to consumers at reasonable prices. Sufficient food stocks were kept not only for the smooth running of the Public Distribution System (PDS) but also for stabilizing prices through open market operations.

Economic Liberalisation and Critique of Agricultural Policies in the Planning Period

Indian policy makers initiated the process of economic reforms in 1991 with the aim of liberalising the economy and integrating it with the world economy. The package of macro-economic and trade policy reforms introduced in 1991 consisted of macro-economic policy changes, changes in exchange and trade policy, devaluation of the currency, gradual dismantling of the industrial licensing system and controls, reduction of tariffs, reform of public enterprises and increasing privatisation.

Although no direct reference was made to agriculture, the new policy framework was expected to be highly beneficial to tradable agriculture through ending discrimination against it.

The liberalisers argued that the import substitution strategy of industrialisation under the planning regime followed by most developing countries in the post-war period was highly discriminatory against the agricultural sector. Their argument was that the inward-

looking import substitution development strategy aimed at rapid industrialisation under the planning regime followed by most of the developing countries including India, in the post-war period, shifted resources from tradable agriculture to industry by turning the terms of trade against agriculture, thereby discriminating against it.

The following specific points were made. *Firstly,* the overvaluation of the exchange rate, characteristic of most planned economies, introduced a bias against tradable agricultural production and exports (Manmohan Singh, 1995). *Secondly*, the high protection accorded to all sectors of the economy resulted in non-alignment of internal prices with border prices, thereby leading to inefficiency in resource use and a distorted cropping pattern. This policy framework also prevented producers from deriving the benefits of comparative advantage in highly labour intensive and tradable agriculture. *Thirdly,* the import substitution strategy of industrialization, which accorded high protection to industry, raised the relative prices of modern farm inputs, thereby implicitly taxing agriculture. *Finally,* numerous sector specific government interventions like low administered prices for foodgrains, ostensibly for food security reasons, also discriminated against agriculture. Product prices were kept so low that, despite large input subsidies on fertilizers, credit, irrigation, power etc, the agricultural sector remained net taxed (World Bank, 1986). Simultaneously, excessive input subsidies led to inefficiencies, resource misallocation, and contributed to environmental degradation. The adverse terms of trade for agriculture resulted in a lack of incentive to producers to invest in output raising technologies. In addition, a major proportion of the costs of inefficient functioning of para-statal organizations like the Food Corporation of India were borne by the farmers. Large subsidies given on agricultural inputs also led to resource misallocation and placed an unsustainable burden on state and central finances and reduced the capacity of government to undertake large investments. However, these subsidies failed to compensate the farmers for the negative impact of lower administered price paid on outputs, discrimination against agriculture due to overvalued currency, and higher input prices due to excessive protection given to industry. The net effect, it is argued was that agriculture had negative protection and was discriminated against (Gulati, A and A. Sharma, 1995).

It is agued by some scholars that the correction of the exchange rate combined with the abolition of controls and considerable reductions in tariffs on manufacturing (specially

capital goods) has tended to gradually end protection to industry. Hence, economic reforms have been instrumental in indirectly benefiting the agricultural sector and that the most important impact is a significant reduction in the anti-agriculture bias (Dholakia, 1997).

Another development was that in 1995, India became a founder member of the WTO with the expectation that the multilateral trade liberalisation envisaged by the WTO Agreement on Agriculture (AoA), would not only result in a significant increase in the quantum of international trade but also developing countries' share in it. India was expected to be a major beneficiary from increased trade in agriculture.

For several reasons and mainly because of the unwillingness of developed countries to reduce their massive support to agriculture, the Doha round could not be completed. In the meantime, many countries have tended to join one or more of the trading blocks to avail of better market access through these trading blocks. But this has dampened the efforts to go in for a multilateral trade agreement under the aegis of WTO. Lately there are signs that there may be a thaw in rigid positions taken by different country negotiators and Doha round negotiations may again resume on a positive note.

But despite the changes in the macro-economic policy framework and trade liberalisation, India’s agricultural sector did not experience any significant growth subsequent to the initiation of economic reforms in 1991. In fact, except for a short period 1991-92 to 1996-97, when because of a highly favourable international climate, agricultural exports rose sharply, the agricultural sector has not derived the expected benefits from trade liberalisation. Nor has the new macro-economic policy framework resulted in accelerating agricultural growth. In fact, when compared with the immediate pre-liberalisation period 1980-81 to 1990-91, agricultural growth in India recorded a visible deceleration during the post-liberalisation period 1990-93 to 2003-06.

Several studies have tried to study the impact of economic liberalisation on Indian agriculture (Bhalla, 1994, and Chand, 2002). But most of these deal with the impact of changes in policy framework like, reform of trade, exchange, monetary and industrial policy on Indian agriculture at the national level. Very few studies exist that have tried to study the impact of economic reforms at the state and district levels.

An attempt is made here for the first time to extend the period of analysis from 1990-93 to 2003-06 and analyse the impact of economic reforms on the levels and growth of agricultural output at the state and district levels.

Earlier District-level Studies

The regional pattern of agricultural development in India has been widely studied, mostly at the state level (Sen, 1969, Krishnaji, 1975, Dev, S. Mahendra, 1985). But recognising that the states are much too large a unit and generally contain areas with widely varying regional characteristics in term of resource endowments and climate, it was for the first time in 1975 that a joint Jawaharlal Nehru University-Planning Commission project was initiated to study at the disaggregated district level, the changes that had taken place in agriculture in India during the period 1962-65 to 1970-73 as a consequence of the introduction of new-seed fertiliser technology during the mid-sixties. The report of the study was subsequently published (Bhalla & Alagh, 1979).

The 1979 study brought out some interesting conclusions. *Firstly*, it was found that consequent to the introduction of new seed-fertilizer technology, many districts in the irrigated north-western region of Punjab, Haryana and western U.P. recorded a significant increase in the yield and output of wheat. It was noted also that in addition to wheat, a beginning had also been made in these areas in the matter of the introduction of HYV rice by the early seventies. The *second* conclusion was that the benefits in terms of higher yields and growth of output were confined to the irrigated north western states, while there was no significant growth in the non-green revolution eastern, central and southern regions where output levels continued to be determined by the vagaries of monsoons. Since the weight of wheat was relatively low in total foodgrains, the rapid growth of wheat in the north western region did not lead to any appreciable increase in the growth rate of foodgrains at the all-India level.

Coming to the district level analysis, it was found that during 1962-65 as many as 106 out of 281 districts with 39.54 per cent share of GCA and 23.46 per cent share in value of output belonged to low productivity category (Yield < Rs. 700/ha at 1970-73 prices). By 1970-73, the number of low productivity districts had declined to 85 and their share in total area declined from 39.54 percent to 31.36. There was sharper decline

in their share of value of output from 23.46 percent to 15.49 percent. The number of mid productivity districts (Yield between Rs 700 –Rs 1300/ha) remained almost constant having declined from 135 in 1962-65 to 134 in 1970-73. Interestingly the mid-productivity districts accounted for nearly half of the total GCA and half of total value of output during both the periods 1962-65 as well as 1970-73. The number of high productivity districts (Yield. Rs. 1300/ha) increased from 48 during 1962-65 to 70 during 1970-73 and their share in GCA increased from 12.61 percent to 20.27 percent and that in total value output from 25.81 percent to 36.03 percent. *Thirdly*, since only a small proportion of districts had recorded significant increases in output, the disparities in yield levels continued to be quit high.

The second study (Bhalla & Tyagi, 1989), which extended the period from 1970-73 to 1980-83 also brought out some interesting conclusions.

Firstly, it was found that with the passage of time, the new technology had spread to new areas during the eighties. One of the important developments was the introduction of High Yielding Varieties (HYV) rice, mainly IR8, not only in the assured irrigation areas of the north-western states as a second crop but also for the first time in the southern state of Andhra Pradesh and to some extent in coastal areas of Tamil Nadu.

Secondly, the study confirmed that the growth performance of rainfed areas was characterised by the persistence of very large inter year and inter-period disparities. The rainfed areas which had shown poor performance during the first period 1962-65 to 1970-73, recorded very high growth during 1970-73 to 1980-83 as a result of good monsoons. But the states in the eastern region continued to experience low growth even during this period.

Third, the district level analysis also confirmed that with the passage of time the new technology spread to newer areas and encompassed more districts thereby leading to higher output growth rates. The growth of output enabled many low productivity districts to graduate to mid-productivity level and many mid-productivity districts to move to the high productivity category. Thus whereas the number and weight in terms of share in GCA and share in value of output of low productivity districts went down that of high productivity districts went up.

In this context, two points are worth noting. *First*, both the 1979 and 1989 studies used constant 1970-73 prices to obtain value of output of individual crops as well as aggregated value of all crops.

Second, the definition of low, medium and high productivity districts underwent some changes in the second (1989) study as compared with the first (1979) study. The new classification for districts in the (1989) study was:

Low productivity = Productivity < Rs 750/ ha (instead of <Rs. 700/ha in the 1979 study)

Mid-productivity = productivity between Rs. 750 to Rs 1250/ha (instead of Rs 700-Rs1300/ha in the 1979 study)

High productivity = > Rs 1250/ha (instead of > Rs. 1300/ha in the 1979 study)

Our analysis brought out that whereas the number of low productivity districts declined from 141 during 1962-65 to 116 during 1970-73 and further to 84 during 1980-83. The percentage of area under low productivity districts declined from 54.56 percent in 1962-65 to 43.74 percent in 1970-73 and further to 36.50 percent during 1980-83. In the mean time, the share of low productivity districts in total value of output declined from 36.50 percent in 1962-65 to only 16.61 percent during 1980-83.

On the other hand, the number of high productivity districts (in terms of Bhalla & Tyagi, 1989 study classification) increased from 33 during 1962-65 to 55 during 1970-73 and to 89 during 1980-83. In the meantime, their share in area increased form 7.82 percent during 1962-65 to 27.82 percent by 1980-83 and their share in the value of output increased from 15.53 percent to 45.49 per cent. Thus by 1980-83 almost half the total output was being produced by 89 high productivity districts. The number and percentage share in area and output of mid-productivity districts (productivity between Rs. 750/hect to Rs. 1250/Hect) did not undergo any significant changes during 190-3 to 180-83.

Fourth, it was found that, as in the earlier period, there existed a positive correlation between levels of productivity and the use of modern inputs like fertilizers, irrigation, tractors and tubewells.

Finally, unlike the first period 1962-65 to 1970-73, when the level of inter-district disparities in land yield was very high, there was a visible decline in disparities in land productivity during 1970-73 to 1980-83. The coefficient of variation declined from 50

per cent during 1970-73 to 42 percent by 1980-83. However, there was evidence of increases in disparities in (male) agricultural worker productivity over this period.

The third (Bhalla & Gurmail Singh, 2001) study further extended the period from 1980-83 to 1990-93. It may be noted that the (2001) study used constant 1990-93 prices instead of the constant 1970-73 prices used by both the (1979) and (1989) studies. The state and district level data for 1962-65, 1970-73 and 1980-83 which was based on 1970-73 prices was reworked at 1990-93 prices to make it comparable with the data for 1990-93. Based on the new price series, the 2001 study brought out some interesting results.

The 2001 study found *firstly* that because of the maturing of new technology, its extension to more crops and its wider regional spread, there was a marked acceleration in the growth of agricultural output at the all India level and for most of the states during the period 1980-83 to 1990-93 as compared with the earlier period 1962-65 to 1980-83. Many more districts also recorded higher growth during this period.

During this period, the green revolution extended from the north western to the eastern region and the central region and there was a revival of growth in the southern region, but a slight slow down in growth in the north-western region.

Secondly, in addition to its extension to newer areas, another important development during this period was a distinct change in cropping patterns away from coarse cereals towards oil-seeds and other commercial crops particularly in the central region but to a lesser extent, in the southern region. In addition to the availability of better technology in oilseeds, the relative prices between coarse cereals and oilseeds decisively tilted the comparative advantage in favour of oilseeds. Contrary to the central region where there was a shift from coarse cereals to oilseeds, there was a shift from coarse cereals to wheat and rice in the north-western and the eastern regions.

Third, in terms of district level analysis, although the number of low productivity districts had been going down continuously since the adoption of new technology in the mid-sixties, the decline became much more marked during 1980-83 to 1990-93. Thus the number of low productivity districts which had declined from 222 in 1962-65 to 147 by 1980-83 further declined to 94 only by 1990-93. Again, the share of area under low yield districts (yield below Rs. 5000 per hectare) which had declined from 82.6 percent during 1962-65 to 56.0 percent by 1980-83, further declined to 36.9 percent by 1990-93. The

share of low productivity districts in the total value of output declined from 69.1 percent during the sixties to only 19.8 percent by 1990-93. But, it is significant to note that despite considerable progress, even during1990-93; low productivity districts accounted for more than one third of the total cultivated area and almost one fifth the total value of output. Most of the low yield districts were concentrated in M. P, Rajasthan, Maharashtra and Gujarat in the central region, in Bihar and Orissa in the eastern region and Uttar Pradesh in the north western region. The fact that many of these districts continued to have abysmally low yields since 1962-65 brings out that policy interventions in these areas have failed to yield the expected results.

The *fourth* important development was that the introduction of new technology was instrumental in raising per male agricultural workers productivity (M AWP)[1].

Thus during 1980-83 to 1990-93, there took place a significant increase in the productivity of male agricultural workers across all the states and regions of India. To begin with during 1962-65, MAW productivity was woefully low in most states except Punjab, Kerala and Haryana. During 1980-83 to 1990-93, in all states except Bihar and Gujarat, the growth of output far exceeded the growth of male agricultural workers thereby resulting in rapid growth in productivity per male agricultural worker. One of the important consequences was that agricultural workers in large parts of India witnessed higher wage levels and incomes. But despite this, the productivity per male worker continued to be quite low in the states located in the eastern and central region.

Fifth, the 2001 study also confirmed that the extent of regional variations in terms of yield per hectare which increased during 1962-65 to 1970-73, the early years of the green revolution, continuously came down afterwards. The coefficient of variation at the district level which had increased from 49.9 percent during both 1962-65 to 56.0 percent during 1970-73 declined sharply to 51.2 percent during 1980-83 and further to 50.2 percent by 1990-93. The Gini coefficient shows a similar trend.

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1. MAWP = Value of Agricultural Output/ number of Male Agricultural Workers. In the 2001study, we had used male agricultural workers rather than total agricultural workers because of frequent changes in the definition of workers because of which the data on the number of female workers in agriculture is not comparable over various censuses, in particular for 1971. In the present (2010) study, we have decided to take total agricultural workers based on censuses of 1961, 1981 and 2001 and ignore the data for 1971 census because of its non-comparability with other censuses.

The success of new technology in raising yields is very much related with the use of modern inputs. Both the tabular analysis as well as the regression analysis undertaken in the 2001 study clearly brought out that there exists a very high and significant relationship between the use of modern inputs and levels of yields across districts. The regression analysis also showed that there existed a strong relationship between growth rates and the use of modern inputs.

The regression results on levels of male agricultural workers productivity at the district level brought out that, in addition to land availability, the levels of male agricultural worker productivity were significantly related to the use of modern inputs, at the region, state and district levels.

Objectives of the Present (2010) Study

The present study which is a continuation of our earlier studies on regional patterns of agricultural growth in India aims to extend the period of analysis of the impact of new technology on regional pattern of levels and growth of agricultural output at the state, regional and disaggregated district level from 1990-93 to 2003-06. The detailed objectives of the study are:

(a) To analyse the regional patterns of levels and growth of agricultural output at the district, state and regional levels during the post reform period 1990-93 to 2003-06 and to compare it with the output levels and growth during the pre-reform period periods 1980-83 to 1990-93 as well as the period 1962-65 to 1980-83. The growth rates for the intervening period 1962-65 to 1970-73 and 1970-73 to 1980-83 have also been tabulated but not discussed in detail.

(b) To analyse the regional patterns of levels and growth of productivity per agricultural worker at the district, state and regional levels in the post-reform period 1990-93 to 2003-06 as compared with those during the immediate pre-reform period 1980-83 to 1990-93 as well as with the period 1962-65 to 1980-83.

(c) To analyse the association between levels and growth of agricultural output and per agricultural worker productivity with the use of modern inputs like irrigation, new seeds, fertilizer, tractors etc. with a view to identifying the factors that explain inter-

district/inter- state variations in the levels and growth of agricultural output as also in labour productivity and the degree of labour absorption.

(d) To examine whether the degree of regional disparities in levels and growth of agricultural output as well as levels and growth of agricultural worker productivity have increased or declined.

The available data brings out that as compared with the pre-reform period 1980-83 to 19990-93, the growth rates of agricultural output have recorded a notable deceleration during the post-reform period 1990-93 to 2003-06. Consequently, many policy initiatives will be needed to reverse the deceleration of output growth rate experienced during the post- reform period and to accelerate it to 4 to 5 percent per annum as envisaged in the Eleventh Plan.

Coverage of the present 2010 study

States and Districts Covered

This present study is based on the analysis of state wise data from 17 major states and 281 composite districts units formed out of 523 districts in 2001. The states covered are Andhra Pradesh, Assam, Bihar, Gujarat, Haryana, Himachal Pradesh, Jammu & Kashmir, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Orissa, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh and West Bengal during 2003-06. The newly created states of Chhattisgarh, Jarkhand and Uttarakhand have not been included as separate states since area and output data for these states and their respective districts are not available prior to 1990-93. Again, the remaining small states and union territories have not been included because of non-availability of comparable data. The study also excludes suburban Bombay, Madras, Bangalore (urban) and Calcutta metropolitan districts since crop wise data for area and output for these metropoles are not available.

In India, the number of districts has increased rapidly over time. During 1970-73, there were 334 districts in the 17 states included in the study. However, their number increased to 424 by 1990-93 and to 523 by 2003 mainly by carving out new districts out of the existing districts. Generally speaking, when a new district is formed, no attempt is made to generate data series for the new entities for the earlier period and this data gap persists over time. This creates a major problem for any longitudinal study of comparable

units. The only practical solution is to merge the newly created districts with their original constituent district(s) in order to study the trends in the level and growth of agricultural development at the district level.

All the districts of Himachal Pradesh have been treated as one composite district due to the non-availability of comparable data separately for individual districts. Similarly, due to the non-availability of district wise data, all the districts of Jammu and Kashmir have been grouped into three notional districts namely Jammu, Kashmir Valley and the Ladakh region. Consequently we have constituted 288 composite district units by combining 420 districts during 1990-93 in order to make them comparable with the 'sixties, the 'seventies and the 'eighties. Appendix 1.1 gives details about the formation of the 288 district units.

It may be noted that for the analysis of relationship between inputs and outputs, 7 districts, namely North Cachar Hills (Assam), Himachal Pradesh (H.P.), Ladakh (J & K), Non-Reporting Areas (M.P.), Nilgiris (T.N.), Hill Districts (U.P.) and Darjeeling (W.B.), have been excluded because of the non-availability of data on inputs.

Thus, in the present study as in the original Bhalla-Alagh study (Sterling, 1979), Bhalla-Tyagi (ISID, 1989) and Bhalla –Singh study (Sage, 2001), the number of composite districts has remained 281.

Crops Covered

The index of agricultural production, compiled by the Directorate of Economics and Statistics (DES) of the Ministry of Agriculture, Government of India is normally used for analysing the growth of agricultural output in the country. This index is based on the output of 46 crops. The weights assigned to different crops in the construction of the index are the percentage share of each crop in the total value of output in the base period at fixed prices. The Ministry of Agriculture also compiles time series information on area, production and yield for these 46 crops for all-India and the states.

At the state level, the present study has covered 44 crops as compared with 46 crops covered by the DES. The only crops left out are garlic and onion. During 2003-06, our coverage of the area of 44 crops constituted nearly 99.58 per cent of the area of 46 crops covered by the DES.

While the time series information on area, production and yield of the 46 crops at the all-India and state level is available from published sources, the information on area and output of various crops at the district level is not brought out in any regular publication, but is published in various issues of the *Agricultural Situation in India*. For the early sixties, the Ministry of Agriculture published district wise area and production estimates for 23 crops only, though recently it has also started publishing estimates for some additional crops. Nevertheless, information on area and output for some of the remaining crops (other than the 23 crops) is available from some other sources like the *Season and Crops Reports* and *Statistical Abstracts* published by the respective state governments, statistics published by various Commodity Boards like the Tea Board, the Coffee Board, the Rubber Board and the Cashewnut Board.

In the present study while data on area and output for 23 crops were obtained from the Directorate of Economics and Statistics (DES), Ministry of Agriculture and Co-operation, that for 12 additional crops were obtained from the sources mentioned above. Unlike the 1979 and 1989 studies, which covered only 19 major crops at the district level, the present study like the present 2010 study covers 44 crops at the state and 35 crops at the district level.

Extending the crop coverage from 19 to 35 crops at the district level required a major effort at data collection. In the 1979 and 1989 studies, for many analytical exercises the district wise data collected for only 19 major crops had to be inflated by using the average state wise ratio between the area under all the crops and that under the 19 crops as the inflation factor. This introduced a bias since the inflation factor was based on the assumption that the left out area in each district had the same average yield of the remaining (other than 19) crops as the state as a whole. The present study is a major improvement over the earlier studies since it does not make any such assumption and the analysis is based on actual data of area and output of 35 crops.

To sum up, in terms of regional coverage, the present study covers 281 composite districts in 17 major states of India while, in terms of crops, it covers 44 crops at the state level and 35 crops at the district level (Appendix 1.2).

During 2003-06, these 35 crops in 281 combined districts in 17 major states covered as much as 94.00 per cent of the all-India area 94 as reported by the Directorate

of Economics and Statistics (DES), Ministry of Agriculture and Cooperation. Table 1.1 details the crop wise coverage of all-India area and output by the districts included in the study for various triennia. Our study has left out a few territorial units and some crops. This notwithstanding, even at the district level, the coverage of the present study is quite comprehensive both in terms of area and output of the 46 principal crops covered by the Directorate of Economics and Statistics (DES).

Data Limitations

Some important data limitations in terms of territorial coverage and crop coverage have already been discussed above. To recapitulate, a few territorial units like the hill districts and districts in small states have been excluded from the study. We have formed 281 composite districts by combining the new districts into old units. In addition, we have covered only 35 out of 46 reported crops.

In addition, the data suffers from a few other limitations. The first of these pertains to mixed crops. In general, the reported data refers to area and output of crops sown singly (pure crops) in a field. Some serious difficulties are encountered in the estimation of area and output of a few crops that are grown as mixed crops. For example, in Uttar Pradesh some oilseeds like rapeseed/mustard, sesamum and castorseed apart from being sown as pure crops, are also grown as mixed crops along with cereals. The State level estimate of area under mixed crops, rather than being allocated proportionately between the constituent crops, is actually counted in the area and output of both the (mixed) crops. This leads to double counting. Consequently, the sum of area under all the 44 crops in Uttar Pradesh exceeds the total (gross) cropped area of the state.

Table 1.1

Crop-wise Coverage of All-India Area and Production of 35 Crops in the Study

S No	**Crop**	**Ar60**	**AR70**	**AR80**	**AR90**	**AR2003**	**VO60**	**VO70**	**VO80**	**VO90**	**VO2003**
1	Rice	97.39	95.28	95.67	96.32	97.55	97.48	95.64	95.18	96.61	97.27
2	Wheat	95.96	93.53	96.3	97.22	99.8	96.06	94.58	97.45	96.61	99.91
3	Jowar	99.88	98.49	97.79	99.78	99.9	99.96	97.3	98.91	95.22	99.83
4	Maize	93.83	93.3	92	90.8	97.9	91.6	90.76	88.9	89.43	98.26
5	Bajra	99.91	99.66	99.37	99.82	99.95	99.91	99.48	99.14	99.19	99.9
6	Ragi	92.8	88.03	91.15	94.48	99.6	93.02	86.25	96.2	96.72	99.71
7	Barley	97.31	96.2	96.35	93.29	99.03	97.63	95.57	96.03	94.03	99.22
8	Gram	99.55	99.84	98.2	99.32	99.97	99.38	98.73	97.05	98.3	99.97
9	Tur (arhar)	99.7	97.23	98.63	99.7	99.7	99.82	93.65	98.87	97.78	99.61
10	Groundnut	99.94	97.85	98.89	99.89	99.87	99.94	95.67	95.96	99.93	99.82
11	Sasamum	99.24	99.27	99.29	99.97	99.32	99.74	98.76	94.41	99.95	98.85
12	Rseed-Mustard	98.03	96.3	96.16	98.94	99	97	92.54	97.8	98.81	99.25
13	Linseed	99.44	93.75	97.97	97.79	98.38	99.99	99.1	99.57	97.06	97.14
14	Castor	99.89	95.38	96.88	99.65	100	99.9	95.95	99.99	99.64	100
15	Jute	97.47	97.45	97.85	98.37	99.08	97.61	96.4	94.49	87.21	99.52
16	Mesta	96.62	94.86	97.96	96.04	95.95	96.02	94.77	94.66	93.82	96.59
17	Cotton	99.7	99.64	99.96	94.31	99.99	92.74	94.23	99.15	95.05	99.99
18	Sugarcane	99.28	99.57	99.43	99.59	99.94	99.99	99.42	98.87	99.12	99.98
19	Tobacco	98.12	95.97	97.79	98.1	99.8	98.51	96	98.62	98.17	99.5
20	Other Pulses	99.73	99.55	99.07	100	99.38	99.66	100	100	100	99.28
21	Coconut	93.4	94.87	93.71	95.94	96.9	91.78	94.82	91.04	92.35	97.73
22	Tea	81.03	82.28	83.26	82.05	97.27	88.06	85.99	87.49	84.21	98.43
23	Coffee	98.33	99.82	95.49	99.96	100	97.82	98.07	99.59	99.71	100
24	Rubber	98.01	96.8	89.44	90.87	92.15	91.5	90.63	98.82	86.76	97.32
25	Black Pepper	99.39	99.81	99.96	96.84	98.8	98.22	97.51	99.05	94.36	98.78
26	Dry Chillies	99.23	97.81	95.75	90.76	97.92	99.28	94.55	95.83	97.51	97.72
27	Dry Ginger	87.66	81.76	70.5	72.56	69.98	90.74	90.24	60.84	56.02	54.88
28	Turmeric	95.94	95.99	94.52	92.5	96.74	99.15	97.92	92.48	92.06	95.62
29	Arecanut	88.51	93.31	91.53	91.46	93.83	95.96	97.64	92.09	89.69	92.16
30	Cardamom	99.94	99.97	90.02	83.89	71.88	93.81	99.01	67.68	49.85	65.91
31	Potato	89.46	91.49	91.56	93.21	96.26	93.49	92.9	95.18	93.96	97.99
32	Topioca	99.65	98.4	99.9	99.56	97.32	97.6	98.17	99.14	99.57	99.21
33	Cashewnut	90.07	97.23	96.56	87.43	93.28	91.78	86.02	46.44	78.85	94.85
34	Sunflower			93.39	99.71	99.94			98.17	98.3	99.83
35	Soyabeans			97.64	99.61	99.48			98.32	99.45	99.36
	35 Crops*	**98.23**		**96.68**	**97.84**	**94**	**97.59**	**95.77**	**96.34**	**96.72**	**94.83**

Note: Ar is percentage share of the crop-wise area in the included districts to the total all-India area under the crop; VO is percentage share of the crop-wise value output in the included districts to the total all-India value of output of that crop. VO for each crop has been estimated using crop wise production estimates of the DES and crop wise prices at 1990-93 constant prices provided in Appendix 1.2.

* VO is the proportion of output covered by the 35 crops taken together in 281 district units to the value output of 46 crops covered by the DES.

Source Calculated from Government of India, *Area and Production of Principal Crops in India* (various years).

For mixed crops a similar estimation problems exists at the district level. This has introduced some error. However, since area under mixed crops is not very large and is shrinking over time consequent to the adoption of new technology, the magnitude for error is not very large. Further, the estimates of area and output are often subjected to checks and undergo revisions before finalisation. While the state level revised estimates are published by the Ministry of Agriculture quickly, the district level revised estimates of area and output in some cases are not published regularly. Consequently, district totals do not add up to the state figures in all cases.

The statistical reliability of the area and output estimates at the district level is also problematic. Whereas estimates of area under different crops at the district level are obtained from the revenue records, production estimates for each crop are derived by using estimates from the crop cutting experiments. The crop cutting estimates are based on yields obtained from a sample of fields. This sample is primarily designed to give statistically reliable estimates at the state-level and may be too small a sample to provide a good base for reliable estimates at the district level. Although, to some extent, a three year average figure of yield for each crop has tended to increase the confidence limit of these estimates, the estimates are nevertheless likely to lack statistical validity.

There are some problems with input data also. For quite a few districts, particularly for hilly regions, data on inputs are not reported whereas data for a few inputs like tractors and pumpsets become available with a considerable time lag.

All these data limitations ought to be kept in mind while interpreting the results of the present study.

Choice of Years

To study the changing patterns of agricultural development and growth at the district level, triennium averages of area and output of crops have been taken for the early sixties, early seventies, early eighties, and early nineties. While the first triennium of 1962-65 represents the picture prevailing before the introduction of the green revolution technology during the second half of the sixties, the second triennium 1970-73 represents the period that attempts to capture the initial impact of new technology in Punjab, Haryana and Western Uttar Pradesh. The third triennium, 1980-83, represents further

extension of new technology to rice and its spread` from the North-Western region to the southern region. The triennium of 1990-93 captures the results of maturing of green revolution. It was during the eighties that the new technology not only got consolidated in rice and wheat, it also encompassed new crops like oilseeds and coarse cereals. Furthermore, it was during the eighties that the new technology spread to hitherto left out areas in the eastern and central regions.

The last triennium 2003-06 has tried to capture the impact of economic reforms on Indian agriculture at the state and distinct levels. This period saw a slow down in public investment in agriculture and increasing evidence of input use inefficiency. Yields recorded a notable rise, but input use rose even faster. The period also saw a deepening stress on water resources and rapid environmental degradation. The silver lining was the introduction of high yielding Bt cotton and cropping shifts to 'remaining crops' that included high value fruits and vegetables in some areas.

Prices

In most of the analysis of the growth performance of Indian agriculture, the basic data sources are the indices of agricultural production constructed by the Directorate of Economics and Statistics, Ministry of Agriculture and Cooperation. The current series of index numbers is at constant prices for triennium ending 1980-81. While constructing the index numbers at the all-India level, weights are assigned to each crop in proportion to their share in the value output of all crops in the base year. Therefore, to study the growth performance of agriculture (by the index number approach) at the state and district levels , similar weights are required to be determined separately for each crop for all the 17 states and 281 districts separately. This is necessary because the shares of different crops in the total value of output in different states and also in different districts are not the same. For this study it has been possible to undertake this exercise.

In the present study, the district wise value of output has been estimated for each crop at constant 1990-93 prices (see Appendix 1.2). The value of output for all the 35 crops has been obtained by aggregating at the districts level, the value of output of all the 35 crops (43 crops at the state level). It is this aggregate value of output that has been used in conjunction with other relevant data for estimating levels of yield, growth of

output, over time changes in inter-district disparities, concentration of agricultural development and the level and growth of agricultural worker productivity.

Plan of the Study

The main focus of the present study is to analyse the changes in the regional patterns of levels and growth of agricultural output at the dis-aggregated state and district level in the post-reform period 1990-93 to 2003-06 as compared with those during the immediate pre-reform period 1980-83 to 1990-93 as well as with the initial period of green revolution 1962-65 to 1980-83. Wherever necessary, growth patterns have also been studied for the intervening periods 1962-65 to 1970-73 and 1970-73 and 1980-83.

After the introduction in Chapter I, Chapter II is devoted to an analysis of the spatial pattern of changes in Indian agriculture at the state level during 1962-65 to 1970-73 and 1970-73 to 1980-83, 1980-83 to 1990-93 and 1990-93 to 2003-06. A brief analysis of growth in cropped area, output and yield of major crops is first undertaken along with a discussion of the changes in the cropping patterns at the all-India and state levels. This is followed by a detailed analysis of the spatial pattern of the performance of the total crop sector at the state and regional levels. State level figures for all the 44 crops have been directly calculated from the various issues of 'Area & Production of Principal Crops in India' published by the Directorate of Economics & Statistics.

Chapter III is then devoted to an analysis of yield levels of all the crops taken together at the disaggregated district level. For this study, the analysis of district level data is based on actual area and output of 35 crops. An attempt is made to study the problem of spatial variation in agricultural productivity and to examine the association, if any, between the levels of productivity and use of modern farm inputs at the district level.

This is followed by a district level analysis of spatial patterns of growth of output in Chapter IV. Growth rates of output and productivity have been analysed for the overall period 1962-65 to 2003-06 and between various sub-periods therein. Since the main focus is to compare the agricultural performance in the post-reform period with that during the pre-reform period, the growth rates in the post-reform period 1990-93 to 2003-06 are compared with the immediate pre-reform period 1980-83 to 1990-93 as well as with the period 1962-65 to 1980-83. A comparative data for the intervening periods

1962-65 to 1970-73 and 1970-73 to 1980-83 has also been provided. An attempt is also made to analyse the association, if any, between growth rates of output and intensity of use of modern farm inputs.

Chapter V is devoted to an analysis of the levels and growth of agricultural workers productivity at the district level during the respective periods. Besides analysing the spatial pattern of levels and growth, an attempt is also made to analyse the nature of association between levels and growth of agricultural workers productivity and the use of modern inputs. Finally, Chapter VI gives a brief summary and conclusions of the study.

Detailed data for 281 districts on area and value of output of 35 crops along with the levels of inputs used during 1962-65, 1970-73, 1980-83 and 1990-93 are given in Annexure 1(a) to 1(e).

Chapter - II
Economic Liberalisation and Indian Agriculture
A State wise Analysis[1]

Introduction

The main objectives of the present study, the methodology used, the data sources for this study the formation of districts units, choice of prices etc was discussed in detail in the Introduction in Chapter 1. The Introduction also contained brief discussion on the changes in macro-economic policy framework for agriculture as a consequence of initiation of economic reforms in India in 1990-91.

This Chapter is to devoted to a discussion of the impact of new seed fertiliser technology introduced during the mid-sixties on regional patterns of levels and growth of agricultural output at the state (and regional) levels in India during 1962-65 to 2003-06 and during its various sub-periods 1962-65 to 1980-83 (the initial period of green revolution), 1980-83 to 1990-93 (the maturing of green revolution) and 1990-93 to 2003-06 (the post-reform period). The focus of the study is to compare agricultural performance at the state level during the pos-reform period with the immediate pre-reform period 1980-83 to 1990-93.

Crop wise data on area and output of 44[2] reporting crops for 17 major states have been obtained from the Government of India (GOI) publication, *Area and Production of Principal Crops in India*, brought out by the Directorate of Economics and Statistics (DES)), Ministry of Agriculture and Cooperation.

For all the crops, triennium averages of area and output have been worked out for all the states for 1962-65, 1970-73, 1980-83, 1990-93 and 2003-06. The value of crop output has been obtained by using all-India prices for the triennium ending 1993. Land yields or land productivity has been obtained by the value of crop output as obtained above by area under 44 crops. Intensity of cultivation is defined as gross cropped re divided by net sown area. Growth rates are annual compound growth rates.

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1 This Chapter is based on our article entitled " Economic Liberalisation and Indian Agriculture-
A State wise Analysis" published in the Economic and Political Weekly, December 26, 2009, Vol xliv no 52.

[2] In this study the statistics for Cottonseed have been subsumed under cotton (Kapas). Hence, the total numbers of crops covered in terms of ESAs list are 44. The index of agricultural production, compiled by the Directorate of Economics and Statistics (DES) of the Ministry of Agriculture and Cooperation, Government of India is based on the output of 46 crops. The only two crops that are left out in the present study are onions and garlic.

For analysis, all the states have been clubbed into the following four regions:

North Western Region	comprising Haryana, Himachel Pradesh (H P), Jammu and Kashmir (J & K), Punjab and Uttar Pradesh (U P);
Eastern Region	comprising Assam, Bihar, Orissa and West Bengal (W B);
Central Region	comprising Gujarat, Madhya Pradesh (MP), Maharashtra and Rajasthan;
Southern Region	comprising Andhra Pradesh (AP), Karnataka, Kerala Tamil Nadu (TN).

The main components of output growth being yield increases, area increases and cropping pattern changes, an attempt is also made to study the contribution to agricultural growth in various regions made by these components.

The organisation of the Chapter is as follows. After the introduction, growth of agricultural output is discussed at the state and regional levels during the different periods. This is followed by a discussion of the regional patterns of levels and growth of yields and of gross cropped area, (under 43 major crops) respectively. A brief discussion of association between the yield levels and growth of output with the level of use of modern agricultural inputs is followed by an analysis of the changes in cropping patterns and changes in relative crop shares in output over the study period. And finally, an attempt is made to summarise the analysis undertaken in the Chapter and draw some policy suggestions.

Part 2

Growth Rate of Crop Output

The new Borlaug seed-fertiliser technology introduced in the mid-sixties made a major impact on raising yield and output levels of some crops and of aggregate crop output in India. In the beginning, the new technology was confined to wheat in the irrigated north-western region of India. But over time, it covered rice and some other crops and its geographical coverage extended from the north-western region to many other parts of the country. By 2003-06, despite considerable inter-state variation, most states in India were able to share in the gains of the new technology. The deepening and extension of new technology led to significant growth of agricultural output.

Taking the entire period 1962-65 to 2003-06, total agricultural output (value of 44 crops at 1990-93 constant prices) increased at an annual growth rate of 2.36 per cent (Table 2.1). During this period, the highest output growth rate, 2.85 per cent per annum, was recorded by the north-western region followed by the central and the southern regions and the lowest growth rate of only 1.76 percent per annum was registered by the highly populated eastern region.

Table 2.1

State and Region wise Level and Growth of Value Output during 1962-65, 1970-73, 1980-83, 1990-93 and 2003-06

(44 Crops)

Sl No	State	Average Value of Output (in Rs. Million)					Annual Compound Growth Rate (%)			
		1962-65	1970-73	1980-83	1990-93	2003-06	1980-83 / 1962-65	1990-93/ 1980-83	2003-06/ 1990-93	2003-06/ 1962-65
1	Haryana	16303	23445	31556	51576	69278	3.74	5.04	2.30	3.59
2	Himachal Pradesh	2488	3233	3557	4663	5315	2.01	2.74	1.01	1.87
3	Jammu & Kashmir	2428	3690	5192	5278	5772	4.31	0.17	0.69	2.13
4	Punjab	22079	36898	58654	88635	109510	5.58	4.22	1.64	3.98
5	Uttar Pradesh	93628	114461	150373	203292	243514	2.67	3.06	1.40	2.36
	North-West Region	**136926**	**181727**	**249331**	**353444**	**433389**	**3.39**	**3.55**	**1.58**	**2.85**
6	Assam	15039	17419	22964	29154	31798	2.38	2.42	0.67	1.84
7	Bihar	39332	42993	41276	50648	52413	0.27	2.07	0.26	0.70
8	Orissa	24391	26389	34268	45436	41660	1.91	2.86	-0.67	1.31
9	West Bengal	32536	39230	41980	75035	102047	1.43	5.98	2.39	2.83
	Eastern Region	**111298**	**126032**	**140488**	**200274**	**227919**	**1.30**	**3.61**	**1.00**	**1.76**
10	Gujarat	33174	38209	51959	56842	111692	2.52	0.90	5.33	3.01
11	Madhya Pradesh	48073	56214	63846	99386	137294	1.59	4.52	2.52	2.59
12	Maharashtra	52069	38698	73149	88453	116293	1.91	1.92	2.13	1.98
13	Rajasthan	24153	33788	38276	68932	103960	2.59	6.06	3.21	3.62
	Central Region	**157469**	**166909**	**227231**	**313613**	**469240**	**2.06**	**3.27**	**3.15**	**2.70**
14	Andhra Pradesh	49878	53718	76565	106962	134279	2.41	3.40	1.76	2.44
15	Karanataka	33176	40854	51372	73573	83424	2.46	3.66	0.97	2.27
16	Kerala	25169	34678	31651	37736	33978	1.28	1.77	-0.80	0.73
17	Tamil Nadu	47007	58441	55208	82184	67869	0.90	4.06	-1.46	0.90
	Southern Region	**155230**	**187691**	**214796**	**300455**	**319549**	**1.82**	**3.41**	**0.48**	**1.78**
	All India	**565643**	**666706**	**843474**	**1174471**	**1469719**	**2.24**	**3.37**	**1.74**	**2.36**
	Coefficient of Variations (%)						**54.19**	**51.07**	**118.59**	**43.95**

Source: Calculated from Government of India, *Area and Production of Principal Crops in India* (various issues), Ministry of Agriculture and Cooperation, New Delhi

The initial period of green revolution-1962-65 to 1980-83

The new seed-fertiliser technology, introduced in the irrigated states in the north-west during the mid sixties, gradually spread to new areas. During 1962-65 to 1980-83, all the states in the north-western region, in particular Punjab and Haryana, registered high growth rates of agricultural output. In the eastern region, except for Assam, the growth performance of other states was rather modest with Bihar recording a very low growth rate of 0.27 per cent per annum. Crop output in the dry rainfed states in the central region was hardly influenced by new technology and agricultural production in that region was characterised by sharp weather induced year to year fluctuations (Table 2.1). In the southern region, all states except for Tamil Nadu were able to register medium growth rates of output.

Maturing of green revolution- 1980-83 to 1990-93

The period 1980-83 to 1990-93 marks a turning point in India's agricultural development. At the all-India level, the growth rate of crop output accelerated from 2.24 per cent per annum during 1962-65 to 1980-83 to 3.37 per cent per annum during 1980-83 to 1990-93. An interesting feature of the eighties was that agricultural growth permeated to all regions in India. In the north western region, while there took place a slight slow down of growth in Punjab, during the period 1980-83 to 1990-93, as compared with the earlier period, there was a significant acceleration in the growth rate of output in Haryana and in Uttar Pradesh.

An important development was the acceleration of growth in the eastern region. In West Bengal the growth rate increased to 5.98 per cent per annum during 1980-83 to 1990-93 compared with a growth rate of 1.43 per cent per annum during 1962-65 to 1980-83. Bihar and Orissa also recorded acceleration in their output growth rates during this period, but there was only a marginal increase in output growth rate in Assam.

The acceleration of the growth in the highly populated but hitherto agriculturally stagnant states of eastern India was a development of major significance because rapid agricultural growth in this region is likely to benefit to large workforce dependent on agriculture, thereby making a significant dent on rural poverty.

The central region also recorded accelerated growth during this period although, for individual states there was a mixed picture. While growth rate

accelerated significantly in Rajasthan and Madhya Pradesh, growth rates recorded a sharp deceleration in Gujarat primarily as a result of persistent drought during the late eighties.

Among the southern states, the growth rate accelerated significantly during this period. But the most interesting development was the unprecedented rate of growth of 4.06 per cent recorded by Tamil Nadu during 1980-83 to 1990-93 compared with a paltry growth rate of 0.90 per cent per annum registered during 1962-65 to 1980-83. Whereas Andhra Pradesh and Karnataka recorded significant acceleration in their growth rates during 1980-83 to 1990-93 compared with the earlier period 1962-65 to 1980-83, Kerala registered only a slight acceleration in its growth rate.

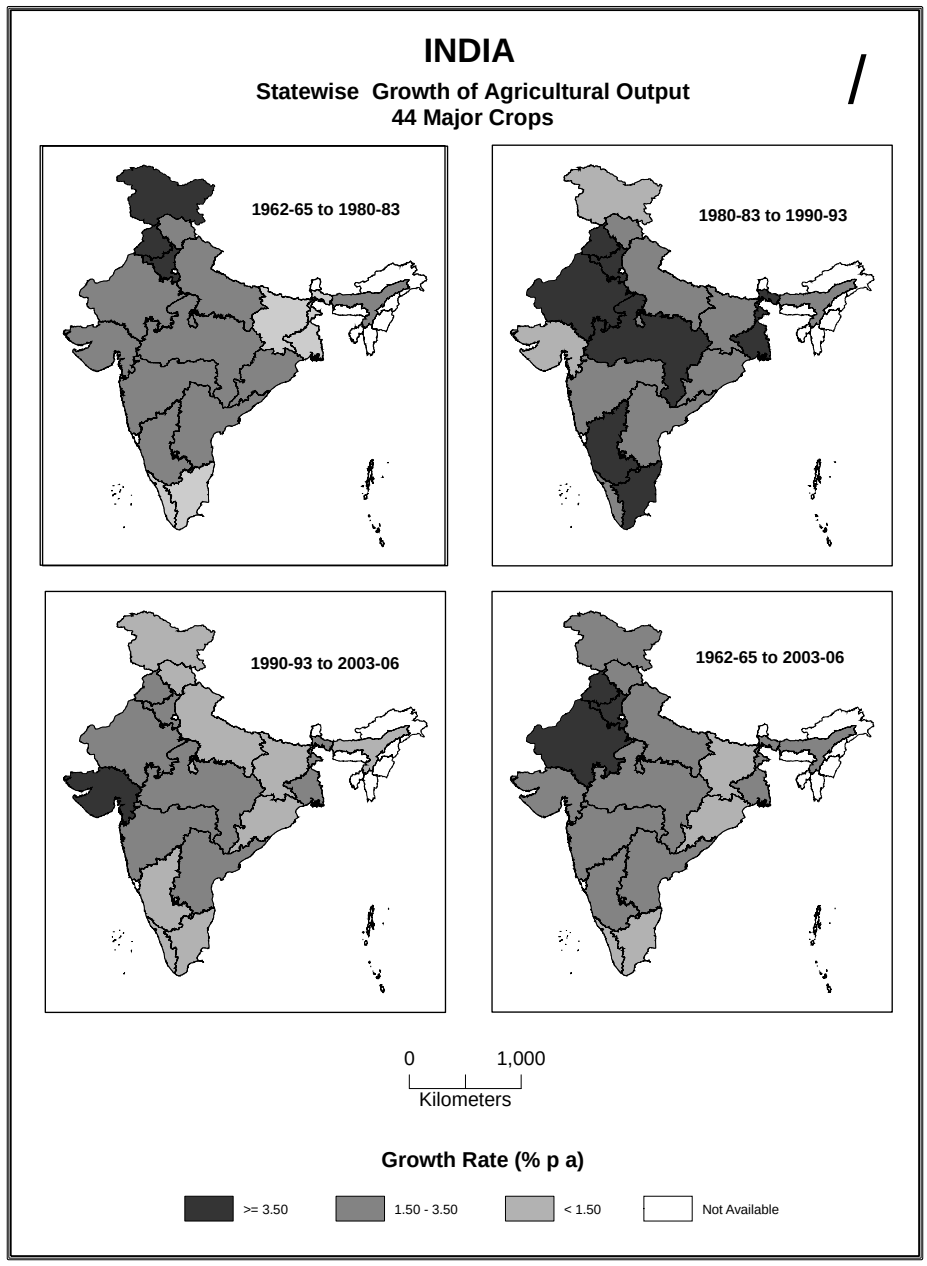
Post-Liberalisation period- 1990-93 to 2003-06

Agricultural growth during 1990-93 to 2003-06 reflects the impact of economic reforms on agricultural performance. The most important feature of this period is that agricultural growth decelerated sharply at the all India level and in all regions. At the all-India level, output growth decelerated to 1.74 per cent per annum during 1990-93 to 2003-06 compared with a growth rate of 3.37 per cent per annum during 1980-83 to 1990-93. At the regional level during the same period, the growth rate of agricultural output decelerated from 3.55 per cent to 1.58 per cent per annum in the north-western region, from 3.61 to 1.00 per cent per annum in the eastern region, from 3.27 to 3.15 per cent per annum in the central region and from 3.41 to only 0.48 per cent per annum in the southern region.

All states except Gujarat and to some extent Maharashtra registered a sharp decline in their output growth rates in the post-reform period. Gujarat was an exception because this state registered a very high output growth rate of 5.33 per cent per annum during the post reform period compared with a growth rate of only 0.90 per cent per annum during the immediate pre-reform period. This remarkable performance was primarily because of the very rapid spread of Bt cotton in the state during the last triennium.

The main reason for the deceleration of growth during the post-reform period was a visible deceleration in investment in irrigation and other rural infrastructure.

Map 2.1



Part 3

Changes in Land Yields: 1962-65 to 1980-83

One of the key contributions to output growth in recent years has been increases in levels and growth of crop yields. However, during the period 1962-65, prior to the advent of the green revolution at the all-India level, the average yield levels were quite low although there were large regional variations. (Map. 2).

Since the levels and growth rates of yields were low, area growth was the major source of growth of output in India during the pre-green revolution period. For example, during 1949-50 to 1964-65, the contribution of area growth to output

growth was 50.16 per cent while that of yield growth was only 38.41 per cent (DES, 2008). The introduction of new technology during the mid-sixties resulted in raising the yield levels of major crops, particularly wheat and rice thereby making yield growth the dominant source of growth of output. Thus during 1962 to 2003-06, yield growth accounted for 85.2 per cent of growth of output while the contribution of area growth was only 14.41 per cent.

During 1962-65 to 1980-83, the north-western states that had pioneered the green revolution registered significant increases in the yield levels and growth (Table 2.2). As compared with a yield growth rate of 1.73 per cent per annum at the all India level, the north-western region recorded a growth rate of 2.53 per cent per annum. The growth of yield was 1.91 per cent in the southern region, 1.49 per cent in the central and only 0.73 per cent per annum in the eastern region.

It is also clear that since yield growth rates were the main source of output growth, yield growth rates in various states were highly associated with their output growth rates in all periods (Table 2.1 and Table 2.2).

1980-83 to 1990-93

Along with agricultural output, the growth rates of yields accelerated significantly during 1980-83 to 1990-93 as compared with the period 1962-65 to 1980-83 not only at the all-India level but in most states and regions.

In particular, the eastern region recorded a very high yield growth rate of 3.38 per cent compared with only 0.57 per cent per annum achieved during the earlier period. West Bengal achieved an unprecedented yield growth rate of 4.81 per cent per annum during 1980-83 to 1990-93. Similarly, during 1980-83 to 1990-93, all the states in the southern region and all the states in the central region, with the exception of Gujarat, recorded acceleration in their yield growth rates.

Post-liberalisation period: 1990-93 to 2003-06

During the post-liberalisation period 1990-93 to 2003-06, the growth rates of both agricultural output and of land yields slowed down as compared with the pre-liberalisation period 1980-83 to 1990-93. At the all-India level, while the output growth rate of decelerated to 1.74 per cent per annum from 3.37 per cent per annum, the yield growth rate decelerated to 1.52 per cent per annum from 3.17 per cent per annum in the earlier period.

All regions recorded a deceleration in their yield growth rates of during 1990-93 to 2003-06 compared with 1980-83 to 1990-93 (Table 2.2). Most of the states also recorded a deceleration in their yield growth rates the only exception being Gujarat which recorded a high yield growth rate of 4.55 % during 1990-93 to 2003-06 compared with a yield growth of 1.55 % recorded by it during the previous period. As noted earlier, this was primarily because of the introduction and rapid spread of high value Bt cotton in the state. Gujarat seems to have reaped the benefits of a cotton revolution in the post-reform period.

Since yield growth rates are now the predominant source of growth of agricultural output, a steep deceleration in the growth rates of yields in most parts of India should be matter of great concern for the policy makers. A major reason seems to be decline in public investment in irrigation and non-availability of yield raising cost reducing new technology.

The coefficient of variation (CV) of yield levels brings out that over the period 1962-65 to 2003-06, there has been a tendency for regional disparity in yield levels to come down (Table 2.3). But despite this decline, it is important to underline that the disparities continue to be very high and are a product of more rigid climatic, structural and institutional factors like variations in rainfall and irrigation, and those in the level of infrastructural and technological investments in various regions.

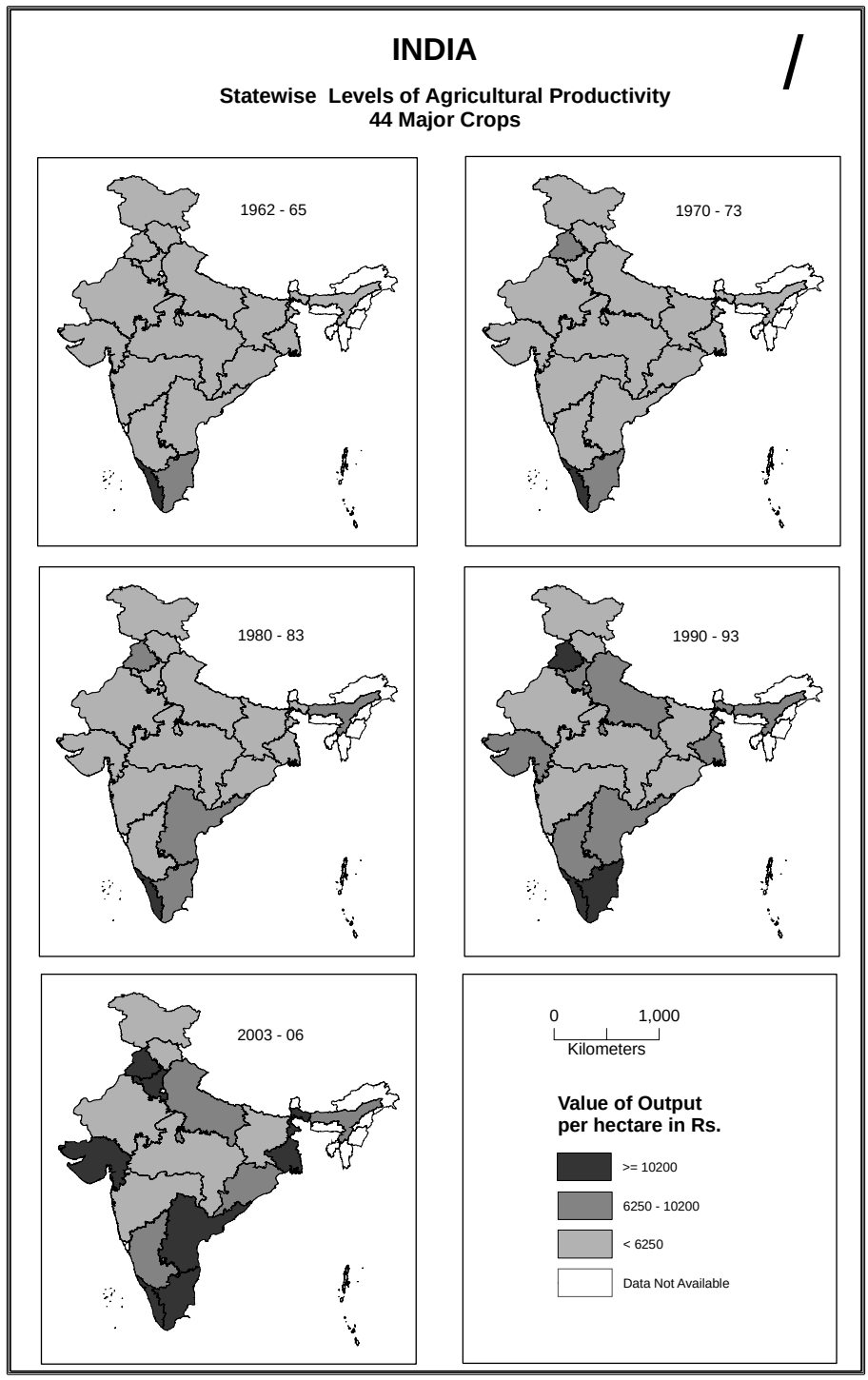
Table 2.2

State and Region wise Level and Growth of Crop Yield during 1962-65, 1970-73, 1980-83, 1990-93 and 2003-06

Sl No	State	Value output Rs. Per hectare of GCA					Annual Compound Growth Rate (%)			
		1962-65	1970-73	1980-83	1990-93	2003-06	1980-83 / 1962-65	1990-93/ 1980-83	2003-06/ 1990-93	2003-06/ 1962-65
1	Haryana	3927	5090	6229	9682	11569	2.60	4.51	1.38	2.67
2	Himachal Pradesh	3048	3734	3918	5187	6176	1.40	2.85	1.35	1.74
3	Jammu & Kashmir	2987	4481	5759	5432	5985	3.71	-0.58	0.75	1.71
4	Punjab	5396	7476	9708	13215	15373	3.32	3.13	1.17	2.59
5	Uttar Pradesh	3970	4590	5805	8355	9894	2.13	3.71	1.31	2.25
	North-West Region	**4093**	**5025**	**6423**	**9244**	**10958**	**2.53**	**3.71**	**1.32**	**2.43**
6	Assam	5728	6241	6907	7998	8989	1.05	1.48	0.90	1.11
7	Bihar	3680	4010	4049	5278	5670	0.53	2.69	0.55	1.06
8	Orissa	4114	4073	4375	5740	6690	0.34	2.75	1.19	1.19
9	West Bengal	5075	5615	5944	9507	12142	0.88	4.81	1.90	2.15
	Eastern Region	**4338**	**4671**	**4944**	**6894**	**8314**	**0.73**	**3.38**	**1.45**	**1.60**
10	Gujarat	3673	4327	5693	6640	11836	2.47	1.55	4.55	2.90
11	Madhya Pradesh	2603	2836	3070	4406	5640	0.92	3.68	1.92	1.90
12	Maharashtra	2899	2344	3795	4490	5960	1.51	1.70	2.20	1.77
13	Rajasthan	1740	2217	2335	3809	5095	1.65	5.02	2.26	2.65
	Central Region	**2654**	**2763**	**3464**	**4551**	**6367**	**1.49**	**2.77**	**2.62**	**2.16**
14	Andhra Pradesh	4065	4363	6276	8728	11537	2.44	3.35	2.17	2.58
15	Karanataka	3208	4267	4990	6342	6994	2.49	2.43	0.76	1.92
16	Kerala	11376	12958	12334	14655	13858	0.45	1.74	-0.43	0.48
17	Tamil Nadu	6690	7900	8756	13037	13117	1.51	4.06	0.05	1.66
	Southern Region	**4873**	**5873**	**6848**	**9178**	**10244**	**1.91**	**2.97**	**0.85**	**1.83**
	All India	**3738**	**4257**	**5090**	**6957**	**8460**	**1.73**	**3.17**	**1.52**	**2.01**
	Coefficient of Variations (%)	**50.13**	**50.19**	**42.75**	**42.59**	**36.98**	**57..93**	**49..87**	**78..28**	**35.41**

Source: As in Table- 2.1

Map 2.2


INDIA
Statewise Levels of Agricultural Productivity
44 Major Crops
1962 - 65
1970 - 73
1980 - 83
1990 - 93
2003 - 06
0
1,000
Kilometers
Value of Output
per hectare in Rs.
>= 10200
6250 - 10200
< 6250
Data Not Available

Part 4

Levels and Growth of Net Sown Area and Gross Cropped Area (Area under 44 Crops)

Net Sown Area

In India, there are competing demands on area available for cultivation from increase in rural habitations, forestation, urbanisation and industrialisation. Consequently, net sown area in the country has registered rapid deceleration in its growth over time.

Table 2.3
State and Region wise Level and Growth of Net Sown Area during 1962-65 to 1980-83, 1980-83 to 1990-93 and 1990-93 to 2003-06

(44 Crops)

Sl. No	State	Average Net Sown Area 000 Hectares					Annual Compound Growth Rate (%)			
		1962-65	1970-73	1980-83	1990-93	2003-06	1980-83/ 1962-65	1990-93/ 1980-83	2003-06/ 1990-93	2003-06/ 1962-65
1	Haryana	3484	3550	3619	3519	3542	0.21	-0.28	0.05	0.04
2	Himachal Pradesh	536	551	572	577	542	0.37	0.08	-0.48	0.03
3	Jammu & Kashmir	684	586	718	734	750	0.28	0.22	0.17	0.23
4	Punjab	3861	4072	4201	4191	4228	0.47	-0.02	0.07	0.22
5	Uttar Pradesh	17296	17272	17245	17286	17454	-0.02	0.02	0.07	0.02
	North-West Region	**25860**	**26031**	**26356**	**26306**	**26516**	**0.11**	**-0.02**	**0.06**	**0.06**
6	Assam	2120	2327	2703	2706	2756	1.36	0.01	0.14	0.64
7	Bihar	8478	8261	7902	7526	7382	-0.39	-0.49	-0.15	-0.34
8	Orissa	5938	5663	6117	6315	5758	0.17	0.32	-0.71	-0.08
9	West Bengal	5505	5437	5565	5387	5366	0.06	-0.32	-0.03	-0.06
	Eastern Region	**22041**	**21687**	**22287**	**21935**	**21262**	**0.06**	**-0.16**	**-0.24**	**-0.09**
10	Gujarat	9531	9692	9610	9449	9852	0.05	-0.17	0.32	0.08
11	Madhya Pradesh	16536	18436	18857	19526	19735	0.73	0.35	0.08	0.43
12	Maharashtra	18148	16921	17950	17906	17465	-0.06	-0.02	-0.19	-0.09
13	Rajasthan	13923	15100	15502	16268	16926	0.60	0.48	0.31	0.48
	Central Region	**58139**	**60150**	**61918**	**63149**	**63978**	**0.35**	**0.20**	**0.10**	**0.23**
14	Andhra Pradesh	11511	11361	11032	10843	10397	-0.24	-0.17	-0.32	-0.25
15	Karanataka	10426	10129	10215	10626	10285	-0.11	0.39	-0.25	-0.03
16	Kerala	2023	2185	2177	2248	2159	0.41	0.32	-0.31	0.16
17	Tamil Nadu	6060	6283	5453	5706	5010	-0.58	0.46	-1.00	-0.46
	Southern Region	**30021**	**29958**	**28877**	**29423**	**27851**	**-0.22**	**0.19**	**-0.42**	**-0.18**
	All India	**136981**	**139044**	**140716**	**142289**	**141279**	**0.15**	**0.11**	**-0.05**	**0.08**

Source: As in Table 2.1

During 1962-65 to 1980-83, net area sown rose at a rate of 0.15 per cent per annum at the all-India level. Its growth rate decelerated to 0.11 per cent pa during 1980-83 to 1990-93 and further to -0.05 per cent pa during 1990-93 to 2003-06. All the regions except the central region recorded a deceleration in their net sown area during this period. Thus except for the central region, net sown area has ceased to be a source of growth of agricultural output in most parts of India.

Total Cropped Area

Notwithstanding the fact that yield growth has become the dominant contributor to growth of output after the advent of green revolution, growth of gross cropped area continues to be an important source of growth of output in some states and regions of India (Table 2.4).

Area under crops can grow either through increases in net area sown or through increases in intensity of cultivation. Since a limit has been reached with regard to the possibility of increasing net sown area on a substantial scale, hence, the only method of increasing gross cropped area is through increased intensity of cultivation brought about through irrigation and through the introduction of short duration crops.

During 1962-65 to 1980-83, cropped area recorded a growth of 0.51 per cent per annum at the all India level. Whereas, its growth rate was 0.83 per cent pa in the north western region, and 0.57 and 0.56 per cent per annum respectively in the eastern and central regions, the growth rate of cropped area was negative in the southern region. Cropped area registered rapid growth in Punjab, Haryana and some other north-western states primarily because in addition to some increase in net sown area, the introduction of short duration crops resulted in substantial increases in the intensity of cultivation in these states.

During 1980-83 to 1990-93, there was a deceleration in the growth rate of cropped area to 0.19 per cent compared with 0.51 per cent during 1962-65 to 1980-83. The only states where the growth rate in cropped area was reasonably high were Punjab, Haryana, J&K in the north-western region, Assam and West Bengal in the east, Madhya Pradesh and Rajasthan in the central region and Karnataka in the southern region.

Finally, during 1990-93 to 2003-06, GCA recorded a paltry growth rate of 0.22 per cent per annum, but net sown area actually declined recording a growth rate

of (-) 0.05 per cent per annum. During this period, at the regional level, among the north-western states, Punjab and Haryana continued to record medium growth in GCA, while in the eastern region only West Bengal recorded medium growth of GCA and in the Central region, Gujarat, Madhya Pradesh and Rajasthan recorded fairly high growth in their GCA. As growth of net sown area had ceased to be an important factor, most of the increase in GCA at the all-India and state levels was because of increase in cropping intensity (Table 2.5).

Table 2. 4

State and Region wise Level and Growth of Gross Cropped Area during 1962-65 to 1980-83, 1980-83 to 1990-93 and 1990-93 to 2003-06

(44 Crops)

Sl. No	State	Average Area (GCA) 000 Hectares					Annual Compound Growth Rate (%)			
		1962-65	1970-73	1980-83	1990-93	2003-06	1980-83/ 1962-65	1990-93/ 1980-83	2003-06/ 1990-93	2003-06/ 1962-65
1	Haryana	4151	4606	5066	5327	5988	1.11	0.50	0.90	0.90
2	Himachal Pradesh	816	866	908	899	861	0.59	-0.10	-0.33	0.13
3	Jammu & Kashmir	813	824	902	972	964	0.58	0.75	-0.06	0.42
4	Punjab	4092	4935	6042	6707	7124	2.19	1.05	0.46	1.36
5	Uttar Pradesh	23583	24937	25903	24331	24612	0.52	-0.62	0.09	0.10
	North-West Region	**33455**	**36168**	**38821**	**38236**	**39549**	**0.83**	**-0.15**	**0.26**	**0.41**
6	Assam	2625	2791	3325	3645	3538	1.32	0.92	-0.23	0.73
7	Bihar	10689	10722	10195	9597	9244	-0.26	-0.60	-0.29	-0.35
8	Orissa	5928	6480	7833	7916	6227	1.56	0.11	-1.83	0.12
9	West Bengal	6412	6987	7063	7893	8405	0.54	1.12	0.48	0.66
	Eastern Region	**25655**	**26980**	**28416**	**29050**	**27413**	**0.57**	**0.22**	**-0.45**	**0.16**
10	Gujarat	9032	8831	9126	8561	9437	0.06	-0.64	0.75	0.11
11	Madhya Pradesh	18465	19823	20799	22554	24342	0.66	0.81	0.59	0.68
12	Maharashtra	17964	16512	19277	19700	19512	0.39	0.22	-0.07	0.20
13	Rajasthan	13878	15240	16394	18095	20406	0.93	0.99	0.93	0.94
	Central Region	**59338**	**60406**	**65596**	**68911**	**73697**	**0.56**	**0.49**	**0.52**	**0.53**
14	Andhra Pradesh	12270	12312	12199	12256	11639	-0.03	0.05	-0.40	-0.13
15	Karanataka	10343	9574	10295	11602	11928	-0.03	1.20	0.21	0.35
16	Kerala	2213	2676	2566	2575	2452	0.83	0.03	-0.38	0.25
17	Tamil Nadu	7026	7398	6305	6304	5174	-0.60	0.00	-1.51	-0.74
	Southern Region	**31852**	**31960**	**31366**	**32736**	**31193**	**-0.09**	**0.43**	**-0.37**	**-0.05**
	All India	**151315**	**156622**	**165698**	**168817**	**173718**	**0.51**	**0.19**	**0.22**	**0.34**

Source: As in Table 2.1

Part 5

Input Use and levels and Growth of agricultural output

The essence of the new seed-technology lay in fact that the new HYV seeds were highly amenable to the use of modern inputs like fertilisers in irrigated conditions and resulted in achieving much higher yield levels.

Table 2.5 brings out the clear association between the levels of land productivity and use of modern inputs. Thus all the high productivity states like Punjab and Haryana in the north-western region, Kerala, Tamil Nadu and Andhra Pradesh in the Southern region, West Bengal in the Eastern region and Gujarat in the central region have been using large doses of modern inputs during all the periods of the study.

On the other hand, during all periods, the use of modern inputs continues to be at abysmally low in the very low yield states of Rajasthan, Madhya Pradesh, Maharashtra, and Orissa. Thus compared with 412 kilograms per hectare of fertiliser used in Punjab during 2003-06, the use of fertilisers was just 58, 61, 80 and 94 kilograms per hectare in Rajasthan, Orissa, Madhya Pradesh and Maharashtra, respectively (Table 2.5). This situation holds for other inputs as well.

The role of inputs in raising yields is confirmed by the fairly high correlation between quantum and intensity of inputs used and yield levels across states. For instance during 2003-06, the ‘Pearson coefficient of correlation’(r) between state level yields and use of fertilizers, pumpsets and irrigation turned out to be 0.70, 0.69 and 0.50, respectively. Furthermore, the association between the levels of yields and use of inputs has gotten strengthened overtime. For instance, the correlation between yield levels and pumpsets improved from 0.32 during 1962-65 to 0.69 during 2003-06, that for tractors from 0.14 to 0.40 and for irrigation from 0.31 to 0.50, over the same period.

One also sees an association between the growth rates of output and the use of modern inputs at the all-India level and in various states of India although in the case of output growth the relationship is not as strong as for yield levels. During 1980-83 to 1990-93, when the growth rate of agricultural output accelerated significantly, at the all India level, per hectare consumption of fertilizers more than doubled as compared with the period 1962-65 to 1980-83. Again, there was a substantial increase in the percentage of GCA under irrigation from 29 per cent during 1980-83 to 36 per cent during 1990-93.

Table 2.5

State wise Use Of Various Input During 1962-65, 1980-83, 1990-93 and 2003-06

States	Tractors (No.s/0000Hc)				Pump setss(Nos/000Hc)				Fertilizer Consumption Kg/Hc)				% of Total cropped Area Irrigated				Cropping Intensity (%)			
	1962	1982	1992	2003	1962	1982	1992	2003	1962	1980	1990	2003	1962-5	1980-3	1990-3	2003-6	1962-5	1980-3	1990-3	2003-6
Haryana	7	170	444	549	2	71	143	155	2	71	175	307	31	62	76	84	131	153	164	181
Himachal Pradesh	0	16	45	130	0	3	4	20	1	33	62	87	17	17	18	19	162	166	170	179
Jammu Kashmir	2	11	18	70	0	1	5	28	2	36	65	119	36	40	41	41	125	137	146	147
Punjab	24	254	508	704	8	158	170	170	8	209	318	412	58	87	95	97	129	158	180	189
Uttar Pradesh	5	82	201	397	1	64	132	191	4	75	129	205	27	47	62	70	128	143	148	150
North-West Region	**8**	**118**	**274**	**451**	**2**	**77**	**133**	**175**	**4**	**93**	**160**	**245**	**32**	**56**	**67**	**75**	**129**	**147**	**156**	**161**
Assam	3	1	3	5	0	1	2	0	0	5	16	89	20	17	15	5	119	128	142	139
Bihar	2	18	19	130	1	47	89	117	3	24	77	108	18	34	43	48	141	133	133	133
Orissa	1	2	4	28	0	3	6	19	1	14	33	61	16	22	26	30	121	141	152	150
West Bengal	2	3	12	34	1	37	54	119	5	49	136	226	23	25	54	52	118	132	160	176
Eastern Region	**2**	**8**	**11**	**62**	**1**	**27**	**46**	**76**	**3**	**26**	**74**	**123**	**19**	**27**	**30**	**39**	**128**	**134**	**146**	**149**
Gujarat	3	29	70	150	9	59	67	92	4	41	75	120	8	23	29	37	105	113	114	114
Madhya Pradesh	1	13	24	130	1	22	47	107	1	14	50	80	6	12	21	28	113	116	121	130
Maharashtra	1	12	50	60	7	33	66	62	2	27	69	94	7	13	15	17	105	109	117	128
Rajasthan	3	35	90	184	1	28	54	88	1	10	30	58	13	21	27	32	107	117	118	126
Central Region	**2**	**21**	**55**	**128**	**4**	**32**	**57**	**88**	**2**	**21**	**55**	**86**	**8**	**16**	**22**	**27**	**108**	**114**	**118**	**126**
Andhra Pradesh	2	19	52	85	5	62	101	148	10	56	137	185	29	36	40	39	111	115	120	122
Karnataka	2	20	37	60	4	30	58	79	3	37	82	118	9	13	23	25	104	108	115	119
Kerala	2	6	9	10	4	45	88	196	15	49	111	98	20	13	12	15	122	132	135	137
Tamil Nadu	4	26	52	102	32	211	212	210	12	80	136	153	45	49	48	50	119	119	121	115
Southern Region	**2**	**20**	**44**	**73**	**10**	**78**	**106**	**137**	**8**	**54**	**116**	**149**	**26**	**29**	**33**	**34**	**111**	**114**	**119**	**121**
ALL INDIA	**3**	**37**	**86**	**167**	**5**	**49**	**79**	**111**	**4**	**44**	**91**	**136**	**19**	**29**	**36**	**41**	**115**	**124**	**130**	**135**
Coefficient of variations (%)	**398**	**544**	**636**	**152**	**554**	**259**	**128**	**62**	**531**	**347**	**143**	**118**	**251**	**175**	**111**	**88**	**13**	**15**	**18**	**19**

Source: As in Table 2.1

Finally, the deceleration in the growth rates of output and yield during the post-liberalisation period 1990-93 to 2003-06, as compared with the pre-liberalisation period 1980-83 to 1990-93 is also reflected in decelerated growth in the use of almost all inputs. For example, compared with more than 100 per cent growth in fertilizer consumption per hectare during 1980-83 to 1990-93, its growth rate was just 50 per cent over the period 1990-93 to 2003-06. Similarly, pumpsets increased only by 41 percent in the later period compared with an increase of 61 per cent during the earlier period.

Table 2.5 also brings out that in India, the inter-state disparity in the use of modern inputs is declining over time. Over the 1962-65 to 2003-06, the coefficient of variations among states declined from 398 to 152 for tractors used, from 733 to 62 for number of tubewells, from 531 to 118 for fertiliser consumption, and from 251 to 88 for irrigation intensity.

One of the important questions that have been raised is whether it is sustainable in the long run to maintain the tempo of agricultural growth through increasingly higher use of costly and heavily subsidised inputs that not only impose a high fiscal burden but also lead to soil and environmental degradation.

Part 6

Cropping Pattern Changes [3]

Introduction

In India, area allocation among various crops has shown a measure of structural rigidity that reflects the traditional character of Indian agriculture wherein foodgrains have remained the predominant crop accounting for two thirds to three fourths of the gross cropped area since the early 1950's. This also reflects the impact of the prevalent demand structure. However, within the foodgrains sector, substantial changes have taken place.

Policy makers in India have been stressing the need for crop diversification to higher value crops as major strategy of agricultural development. This is because, with a rise in per capita income whereas the demand for foodgrains is likely to grow at a slow rate, that for oilseeds, fibres, sugarcane, livestock and horticulture products is projected to grow at a much faster rate. The planners feel that such diversification

3 It may be noted that the discussion in this section is based on the share of area under different crops in the GCA of each state and not in area under 44 crops. The difference between area under 44 crops and the GCA is covered under the head 'remaining crops'.

not only offers opportunities for raising farm incomes significantly, these are also likely to put less pressure on natural resources.

Most of the foodgrains crops that account for a major share of total cultivated area, in particular coarse cereals and to some extent pulses, have remained low yield low value crops for a very long time. The introduction of new seed fertiliser technology during the mid-sixties resulted in substantially raising the yield levels of some of the major foodgrains crops like wheat and rice (Table 2.6). This combined with a positive price climate resulted in increasing area allocation to these crops. The new technology was able to impact on the yield levels of non-foodgrain crops like oilseeds, fibre crops, sugarcane and fruit and vegetables after some time lag thereby resulting in significant cropping pattern changes over time.

1962-65 to 1980-83-the Initial Phase of Green Revolution

During the 18 years from 1962-65 to 1980-83, the process of cropping pattern changes was slow and halting. Foodgrains, which accounted for 74.7 per cent of the gross cropped area in 1962-65, still claimed 73.0 per cent of area during 1980-83. Again, the share of foodgrains in the total value of crop output (at 190-93 constant prices) also came down only marginally from 57.6 per cent during 1962-65 to 57.4 per cent during 1980-83.

But significant diversification took place within the foodgrains segment during 1962-65 to 1980-83. At the all-India level, whereas the area under high yielding wheat increased from 8.6 per cent during 1962-65 to 13.0 per cent of GCA by 1980-83, area under coarse cereals and pulses recorded a notable decline (Table 2.7).

The change was most marked in the north-western region where the share of area under wheat increased from 20.1 per cent in 1962-65 to 33.9 per cent in 1980-83 and the share of area under rice to total cropped area in the region increased 15.4 per cent to 19.0 per cent. On the other hand, the share of area under coarse cereals and pulses registered a sharp decline. The shift from low value coarse cereals and pulses to high value wheat and rice resulted in increasing the share of foodgrains in the total value of output from 62.2 per cent during 1962-65 to 68.74 per cent during 1980-83.

During 1962-65 to 1980-83, cropping pattern changes in regions other than the north-western regions were not that significant. In the eastern region, the share of area under rice declined and the share of area under wheat and oilseeds increased

significantly. In the central region, the share of area under coarse cereals declined during 1962-65 to 1980-83, but the share of area under high value remaining crops increased from 7.7 per cent in 1962-65 to 10.1 per cent in 1980-83. The value share of ‘remaining crops’ went up from 9.8 cent during 1962-65 to 12.7 per cent during 1980-83. Despite some decline in the share of coarse cereals, it is noteworthy that nearly one third to one half of the total GCA in the central states is under low value and low yield coarse cereals and pulses.

Table 2. 6

All India Compound Annual Growth Rates of Area, Production and Yield of Major Crops: 1962-65 to 2003-06

Sl.No.	States	1962-65 to 1980-83			1980-83 to 1990-93			1990-93 to 2003-06			1962-65 to 2003-06		
		Area	**Production**	**Yield**	**Area**	**Production**	**Yield**	**Area**	**Production**	**Yield**	**Area**	**Production**	**Yield**
1	Rice	0.55	1.91	1.36	0.65	3.72	3.05	0.06	1.33	1.27	0.42	2.16	1.74
2	Wheat	2.93	7.33	4.26	0.58	3.73	3.13	0.76	1.73	0.97	1.66	4.63	2.92
3	Coarse Cereals	-0.34	1.01	1.35	-1.91	0.77	2.73	-1.11	0.69	1.82	-0.97	0.85	1.84
4	Pulses	-0.25	0.06	0.31	1.41	1.32	-0.09	-1.13	0.49	1.64	-0.13	0.50	0.63
5	**Foodgrains**	**0.42**	**2.27**	**1.84**	**0.01**	**2.94**	**2.92**	**-0.34**	**1.26**	**1.60**	**0.08**	**2.11**	**2.03**
6	Groundnut	-0.03	0.38	0.41	1.60	2.84	1.21	-1.99	-0.09	1.94	-0.26	0.82	1.09
7	Rapeseed & Mustard	1.71	3.53	1.79	1.14	8.72	4.39	0.60	2.54	1.92	1.95	4.45	2.46
8	Nine Oil Seeds	0.89	1.58	0.69	3.11	5.56	2.38	0.54	2.28	1.73	1.31	2.76	1.43
8	Fibre Crops	-0.21	1.27	1.48	-0.61	3.14	3.78	0.60	3.31	2.69	-0.05	2.36	2.42
9	Cotton	-0.13	1.46	1.59	-0.48	3.33	3.82	0.80	3.54	2.72	0.08	2.57	2.49
10	Sugarcane	1.47	2.88	1.39	1.88	3.15	1.25	0.52	0.30	-0.22	1.27	2.12	0.84
11	Plantation Crops	2.19	3.99	1.77	1.94	3.82	1.85	2.32	3.14	0.80	2.17	3.68	1.48
12	Condiments & Spices	2.25	1.65	-0.57	1.13	3.93	2.77	0.72	4.22	3.47	1.49	3.02	1.50
13	Remaining Crops	1.49	2.98	1.46	2.23	6.26	3.94	2.98	2.24	-0.72	2.14	3.53	1.36
	Non- Foodgrains	**0.81**	**2.21**	**1.39**	**0.75**	**3.98**	**3.21**	**1.73**	**2.36**	**0.62**	**1.08**	**2.69**	**0.62**
	All Crops	**0.50**	**2.25**	**1.73**	**0.59**	**3.82**	**3.21**	**0.25**	**1.74**	**1.48**	**0.46**	**2.48**	**2.01**

Source: As in Table 2.1

Table 2.7

State and Region wise Share of various Crops in Total Gross Cropped Area: 1962-65 to 2003-06

Region	Triennium	Rice	Wheat	Coarse cereals	Pulses	All food-grains	Oil Seeds	Fibres	cotton	Sugar--cane	Planta-tion	Cardimom & spices	Remaing Crops
North-Western	1962-5	15.4	20.1	23.3	21.1	79.8	12.3	2.5	2.2	4.6	0.0	0.2	0.6
	1980-3	19.0	33.9	16.1	10.8	79.7	10.7	2.9	2.8	4.7	0.0	0.1	1.8
	1990-3	20.9	35.2	11.8	8.9	76.9	6.3	3.0	2.9	5.2	0.0	0.1	8.4
	2003-6	23.0	37.3	9.6	7.2	77.1	4.6	2.5	2.5	5.6	0.1	0.2	9.8
Eastern	1962-5	57.0	2.6	6.7	14.2	80.5	3.0	3.8	0.1	0.9	0.9	0.3	10.6
	1980-3	55.7	7.1	7.2	11.9	81.9	5.5	3.2	0.0	0.8	1.0	0.6	7.0
	1990-3	54.9	7.3	4.5	9.8	76.5	6.3	2.8	0.0	0.7	1.0	0.8	11.9
	2003-6	54.3	8.0	3.7	6.2	72.3	4.5	2.8	0.1	2.2	1.3	1.0	16.1
Central	1962-5	10.0	9.1	36.1	15.8	70.9	11.4	9.0	8.8	0.4	0.0	0.6	7.7
	1980-3	9.9	9.9	33.5	16.6	70.0	11.2	7.5	7.4	0.6	0.0	0.6	10.1
	1990-3	9.9	9.3	28.4	16.4	64.0	17.6	6.4	6.3	0.8	0.0	0.6	10.6
	2003-6	9.5	9.6	22.3	16.4	57.9	20.7	7.1	7.0	0.8	0.0	0.8	12.7
Southern	1962-5	23.9	1.0	35.2	9.2	69.4	11.7	5.9	5.5	0.8	1.0	2.0	9.2
	1980-3	23.6	1.0	28.4	10.8	63.9	13.2	5.4	5.0	1.6	1.7	2.6	11.7
	1990-3	21.9	0.6	20.1	11.7	54.4	20.7	4.8	4.5	2.0	2.2	2.5	13.4
	2003-6	21.2	0.8	18.5	13.5	53.9	18.4	4.9	4.7	2.1	2.9	2.6	15.2
All India	1962-5	22.8	8.6	28.0	15.3	74.7	9.8	6.1	5.1	1.5	0.4	0.6	6.9
	1980-3	22.8	13.0	23.9	13.2	73.0	10.4	5.3	4.6	1.8	0.5	0.9	8.2
	1990-3	23.0	13.0	18.6	14.4	68.9	13.3	4.7	4.1	2.0	0.6	0.9	9.6
	2003-6	22.4	13.9	15.5	12.0	63.8	13.8	4.9	4.4	2.1	0.8	1.0	13.6

Source: As in Table 2.1

In the southern region, there was a substantial decline in the share of area under coarse cereals and foodgrains and some increase in the share of area under pulses, cotton, sugarcane, plantations and 'remaining crops'. As in many states in the central region, Andhra Pradesh and Karnataka in the southern region also had large shares of their area under coarse cereals and pulses. Although rice dominated the cropping pattern in Tamil Nadu, a sizeable proportion (22.4 per cent) of its cropped area was under coarse cereals even by 1980-83 (Appendix 2.1).

1980-83 to 1990-93 -the maturing of green revolution

The cropping pattern changes became more pronounced during 1980-83 to 1990-93 when a notable acceleration took place in the yield levels and growth rates of output of many crops across all states and regions of India as compared with the earlier period, 1962-65 to 1980-83.

At the all-India level, the proportion of area under foodgrains which had remained almost unchanged during 1962 to 1980-83, registered a sharp decline from 73.0 per cent of total area in 1980-83 to 67.3 per cent of GCA during 1990-93. It is the first time since 1962 that area under foodgrains declined in absolute terms from 126.97 million hectares during 1980-83 to 124.29 million hectares during 1990-93. The shift away from foodgrains occurred mainly from area under coarse cereals.

During 1980-83 to 1990-93, the main area shift that took place was from coarse cereals towards oilseeds. At all-India level, the share of area under coarse cereals in gross cropped area declined rapidly from 23.9 per cent during 1980-83 to 18.6 per cent of during 1990-93. On the other hand, crop area under oilseeds increased by about 8 million hectares and the share of oilseeds in GCA increased from 10.4 per cent in 1980-83 to 13.3 per cent in 1990-93.

During 1980-83 to 1990-93, there was a decline in the share of coarse cereals in all regions. In the central and southern regions, the decline in the share of coarse cereals went to an increase in the share of oilseeds. In the north western region, the share under coarse cereals declined but the main gainers were rice, wheat and 'remaining crops'.

Post-reform period 1990-93 to 2003-06

The process of diversification in cropping pattern from foodgrains to non-foodgrains which began during 1980-83 to 1990, continued in 1900-93 to 2003-06 albeit at a slower rate and the share of foodgrains in gross cropped area declined from 67.3 per cent in 1990-93 to 63.7 per cent by 2003-06.

The economic reforms initiated during the early 1990's were expected to hasten the process of crop diversification from low value foodgrains to high value non foodgrain crops. However, during the post-reform period 1990-93 to 2003-06, the yield growth rates of most of the important crops including wheat and rice, oilseeds, sugarcane decelerated considerably compared with the pre-reform period 1980-83 to 1990-93 (Table 2.6). Consequently during the post-reform period, the

pace of cropping pattern changes towards higher value crops slowed down as compared with the pre-reform period 1980-83 to 1990-93.

During 1990-93 to 2003-06, like during 1980-83 to 1990-93, the shift has occurred mainly from area under coarse cereals and from some other crops like pulses. However, unlike the earlier period 1980-83 to 1990-93, when oil seeds were the main gainers, during 1990-93 to 2003-06, although share of oilseeds has also increased marginally, it is the 'remaining crops' which are the biggest beneficiaries. Some other crops like cotton and sugarcane have also marginally increased their share in area during this period. But the share of pulses has declined.

Contrary to the all-India pattern, where the share of area under foodgrains has declined sharply, in the north-western region, the share of area under foodgrains has marginally increased (Table 2.7). In this region, area shifts away from pulses and coarse cereals got diverted mainly to wheat and rice.

For example, in Punjab the share of area under foodgrains in total GCA increased from 75.4 per cent in 1990-93 to 78.8 per cent by 2003-06. Because of high yields combined with subsidised inputs and a remunerative price regime, wheat and rice are highly profitable crops in Punjab. Because of this, in Punjab, the share of area under rice increased from 27.3 per cent in 1990-93 to 32.8 per cent by 2003-6. Similarly, the share of wheat increased from 30.8 per cent in 1962-65 to 43.2 per cent by 2003-06 (Appendix 2.1).

The rapid increase in the share of rice in the total cropped area in Punjab has occurred in spite of an ambitious programme of diversification of area away from paddy launched by the state government during the 1990's. The argument was that the extensive cultivation of highly water intensive rice has led to depletion of underground water, deterioration in soil fertility and had highly adverse impact on the ecological balance in the state. Despite the involvement of some of the important private sector companies, this programme has been able to increase the share of area and value of output of remaining crops only marginally. The programme has failed to bring about any substantial changes in the cropping pattern in the state. Policy makers need to analyse the main reasons for this failure.

Unlike the north-western region, there took place a steep decline in the area under foodgrains in both the eastern and central regions. In the eastern region, share of area under foodgrains declined from 76.56 per cent in 1990-93 to 72.3 per cent in

2003-06 and in the central region from 64.0 per cent to 57.9 per cent. The share of area under foodgrains also registered a small decline in the southern region.

In the central region the decline in the share of coarse cereals and foodgrains was compensated by a substantial increase in the share of area under cotton, oilseeds and 'remaining crops'. The most remarkable shift was in Gujarat where area under cotton increased from 10.0 per cent during 1990-93 to as much as 16.2 per cent by 2003-06 (Appendix 2.1).

In Tamil Nadu, the share of area under coarse cereals and pulses has gone down while there is a big increase in the share of area under rice and the share of foodgrains in total cropped area has gone up (Appendix 2.1).

Kerala has a unique cropping pattern where only 9.9 per cent of the gross cropped area is devoted to foodgrains as against a national average of 63.8 per cent. About 90 per cent of Kerala's area is under high value plantation crops like condiments and spices and 'remaining crops'. Because of the preponderance of high value crops in the state, Kerala along with Punjab has the highest levels of crop productivity in the country (Appendix 2.1).

To sum up, in India as a whole, during 1980-83 to 1990-93, there was a big diversion of area under coarse cereals towards oilseeds. Oilseed cultivation got a boost due to favourable prices and the programmes of the 'Technology Mission on Oil Seeds' launched in 1986. Consequently, area under oil seeds increased rapidly and the share of oilseeds in gross cropped area increased from 10.4 per cent during 198-83 to 13.3 per cent during 1990-93.

The post-reform period is characterised by a set back to the process of diversification of area from coarse cereals to oil seeds. At the all-India level the share of area under oilseeds increased only marginally from 13.3 per cent in 1990-93 to 13.8 per cent in 2003-06 as compared with a an increase from 10.4 per cent during 1980-83 to 13.4 per cent during 1990-93. During 1990-93 to 2003-06, it is only the states in the central region that have registered a notable increase in their share of area under oilseeds.

The slow down in diversification towards oilseeds and in oilseeds production comes at a time when the demand for edible oils is increasing very rapidly consequent to rapid rise in per capita incomes in the country. This has resulted in increasing India's dependence on imported edible oils.

But oilseeds in India are unable to compete internationally. Although individual oilseeds like rapeseeds and mustard and groundnut used to have a captive domestic market, this is fast giving way to imported Palm oil which is much cheaper. The reduction in custom duties on both refined and crude edible oils in 2008 have tended to depress the prices in the Indian market, much to the detriment of the interests of oilseeds producers in the central states

Edible oil import is a typical case where policy makers have to face the problem of a trade off between better prices for the producers versus low prices for the consumers.

Relative Crop Shares in Value of Output 4

Major changes in area allocation to different crops are also reflected in changes in the share of various crops in the total value of output during 1962-65 to 2003-06. As expected, the degree of shifts in value of output is much higher than that for area shifts for high value crops and vice-versa for low value crops.

During the earlier period 1962-65 to 1980-83, at the all-India level, the share of foodgrains in the total value of output had remained almost constant at about 57 per cent. However during 1980-83 to 1990-93, along with a decline in the share of area under foodgrains to GCA from 73.0 per cent to 68.9 per cent, the share of foodgrains in the total value of output declined from 57.4 per cent in 1980-83 to 52.7 per cent in 1990-93. There was also substantial decline in the share of coarse cereals and pulses in the tool value of output.

On the other hand, during 1980-83 to 1990-93, whereas the share of oil seeds in the total value of output increased from 10.4 per cent to 12.3, that of 'remaining crops' increased from 14 per cent in 1980-83 to 17.6 per cent in 1990-93, and that of condiments and spices, plantation and fibre crops remained almost constant.

4 Total value output here means the total value of output of the gross cropped area. Total value output= (value output of 44 crops/area under 44 crops)*Gross cropped area.

Table 2.8

State and Region wise Share of various Crops in total Value of Output: 1962-65 to 2003-05

State/ Region	Triennium	Rice	Wheat	Coarse cereals	Pulses	All food-grains	Oil Seeds	Fibres	cotton	Sugar--cane	Planta-tion	Cardamom & spices	Remaining Crops
North-Western	1962-5	12.8	15.3	11.0	23.1	62.2	11.0	4.8	4.6	18.1	0.0	0.7	3.1
	1980-3	19.4	34.4	6.4	8.5	68.7	6.9	4.2	4.2	14.4	0.0	0.5	5.4
	1990-3	21.6	33.5	4.6	5.5	65.1	5.2	4.9	4.9	13.4	0.0	0.2	11.1
	2003-6	23.3	34.2	3.7	3.7	64.8	3.9	4.1	4.1	12.7	0.1	0.9	13.5
Eastern	1962-5	55.8	1.3	3.1	11.1	71.3	2.4	4.2	0.1	3.6	3.9	1.6	13.1
	1980-3	48.4	6.7	3.2	8.5	66.7	5.9	3.6	0.0	3.0	5.2	2.4	13.2
	1990-3	49.4	6.2	2.3	5.6	63.5	5.9	3.0	0.0	2.3	4.3	2.7	18.3
	2003-6	49.5	5.2	2.2	2.9	59.7	3.7	3.2	0.1	1.2	4.4	3.5	24.4
Central	1962-5	13.0	7.4	19.3	15.5	55.1	17.1	11.2	11.1	3.9	0.0	2.8	9.8
	1980-3	11.9	11.5	16.8	14.3	54.5	16.1	8.7	8.6	6.2	0.0	1.8	12.7
	1990-3	10.8	11.3	13.8	12.5	48.3	23.1	6.7	6.7	6.0	0.0	1.8	14.1
	2003-6	8.7	9.9	9.4	10.3	38.3	27.9	10.0	10.0	3.7	0.0	2.7	17.4
Southern	1962-5	29.5	0.2	11.6	3.2	44.5	14.4	3.5	3.3	5.7	2.2	6.3	23.4
	1980-3	29.4	0.3	9.5	3.6	42.8	11.6	3.6	3.5	8.4	4.0	5.8	23.7
	1990-3	26.0	0.1	6.4	3.4	36.0	16.0	4.0	3.9	7.9	4.5	6.1	25.5
	2003-6	25.3	0.2	7.8	4.5	37.8	11.5	4.4	4.3	7.2	7.0	11.7	20.3
All India	1962-5	26.7	6.0	11.9	13.0	57.6	11.8	6.2	5.2	7.7	1.4	3.0	12.4
	1980-3	25.0	14.2	9.5	8.7	57.4	10.4	5.1	4.5	8.5	1.9	2.7	14.0
	1990-3	24.8	14.1	7.0	6.8	52.7	12.3	4.8	4.3	8.0	1.9	2.7	17.6
	2003-6	23.5	14.1	6.1	5.8	49.6	13.2	5.9	5.4	6.6	2.3	3.7	18.8

Note: total value of output obtained by inflating the value output of 44 crops to the total gross cropped area
Source: As in Table 2.1

Post reform period 1990-93 to 2003-06

The pattern of declining share of area under and value of output of foodgrains in total GCA and total value of output continued during the period 1990-93 to 2003-06 also. Thus, while the share of area under foodgrains to total GCA declined from 73.0 per cent during 1990-93 to 68.9 per cent during 2003-06, the share foodgrains in total value of output declined from 52.7 per cent to 49.6 per cent (Table 2.8).

At the all-India level, there was only a marginal increase in the share of oilseeds in total value of output from 12.3 per cent during 1990-93 to 13.2 per cent during 2003-06. It is only in the central region that the share of oilseeds in total value of output has substantially increased during the post reform period 1990-93 to 2003-06 compared with the earlier period. In the rest of the three regions, the share of oilseeds in value of output has declined.

Again during this period, there was an increase in the share of fibre crops in total value of output and some increase in the share of plantation crops, cardamom and spices and remaining crops, but there was a decline in the share of sugarcane in total value of output (Table 2. 8).

Kerala registered a spectacular increase in its share of value of output of plantation crops in total value of output from 16.7 per cent in 1990-93 to 36.3 per cent during 2003-06 (Table 2.8). As condiments and spices are important export crops, trade liberalisation has created favourable market situation that induced farmers to increase the area and production of these crops. On the other hand, unrestricted imports of cheap spices (black pepper) from Sri Lanka and some East Asian countries has posed some problems for the cultivators (Appendix 2.1).

Punjab and Karnataka also registered a substantial increase in their share of foodgrains to total value of output during this period. In both these states, the shift to foodgrains has mainly occurred from oil seeds, cotton and sugarcane. Interestingly as in other states, the share in the total value of remaining crops has also increased in these states during this period (Appendix 2.1).

To sum up, there was a significant change in cropping patterns during 1990-93 to 2003-06 both in terms of area allocation and share in total value of output. The most important change was a significant decline in the share of area under coarse cereals and increase in the share of area under higher value crops brought about because of changes in relative prices and productivity. During 1980-83 to 1990-93, shifts occurred mainly towards oilseeds and to some extent towards remaining crops.

But during the post-reform period 1990-93 to 2003-06, whereas the diversification of area as well as value of output towards plantation and condiments and spices, and towards 'remaining crops' has continued, the diversification towards oilseeds has slowed down considerably.

However, there is a diversification of area as well as of value of output towards plantation and condiments and spices, and towards 'remaining crops' (that includes other fruit and vegetables). But in the north-western region, despite an ambitious programme of diversification away from rice and other foodgrains, the share of rice and total foodgrains in total cropped area has actually increased and the share of foodgrains in total value of output has remained constant. In short, economic reforms and trade liberalisation have failed to hasten the process of diversification in agriculture.

But, despite this slow down at the all-India level, most of the states in the central region registered an increase in their share of area under as well as value of output of oilseeds as well as cotton. On the face of it, diversification away from coarse cereals to high value oilseeds, cotton and remaining crops should be a desirable development. However, in dry land agriculture this shift also exposes the cultivators to much greater weather borne risks. These risks are further exacerbated because of increased vulnerability to world commodity price volatility following trade liberalisation. These risks pose a serious problem for the livelihood of cotton and oilseed farmers.

Part 7

Summary and Conclusions

A state level analysis of levels and growth of agricultural output during 1962-65 to 2003-06 has brought out the outstanding characteristics of agricultural development in India during the post-green revolution period beginning in the mid-sixties. To begin with, the new technology was instrumental in raising the yield and output levels of wheat and was confined to irrigated states in the north western region of India. This resulted in raising crop yields and promoting growth of agricultural output in most of the north-western states. However, the spread of new technology remained confined to irrigated states only.

The new technology matured during the period 1980-83 to 1990-93 when it spread widely to more areas and encompassed more crops. The result was notable increase in the levels and growth rates of yields and output in most states and regions

of India during 1980-83 to 1990-93. As would be discussed in Chapter 5, rapid growth of output in these states also resulted in raising agricultural worker productivity in these states (Table 5.3).

Thus during 1980-83 to 1990-93, crop output recorded an unprecedented annual growth rate of 3.40 per cent compared with a growth rate of 2.24 per cent during 1962-65 to 1980-83. Yet another important improvement during 1980-83 to 1990-93 was significant changes in the cropping pattern with a visible increase in crop diversification away from coarse cereals towards more valuable oilseeds crops in the rainfed states of central India, and towards rice and wheat in the north western and eastern states.

But the post-reform period 1990-93 to 200306 is characterised by a serious retrogression both in the matter of levels and growth rates of yield and output in most states and regions and a slow down in diversification towards oilseeds.

There are different reasons for slow down of growth of yield and output in different regions. However, the decline in public investment in irrigation and water management, and in scientific research has adversely affected the profitability of farmers in all parts of India.

In the north western region, it is excessive use of inputs and deceasing input use efficiency that has eroded profitability as well as adversely affecting its resource base like water table and soil quality. The decline in public investment in irrigation, water management and flood control has specially affected the resource-poor eastern region.

Although there took place a slow down in diversification towards oilseeds at the all-India level, the states in the central region have diversified in favour of cotton and oilseeds as also towards remaining crops, despite weather induced uncertainties Although, this has helped in raising the output and income levels of resource poor farmers in these regions, it has also exposed them to much greater weather borne and price fluctuation risks. These risks are further exacerbated because of increased vulnerability to world commodity price volatility following trade liberalisation. These risks pose a serious problem for the livelihoods of cotton and oilseed farmers driving some of them to utter desperation leading to suicides.

The Indian economy has registered a visible acceleration in its GDP growth rate as well as of per capita income since the initiation of economic reforms in 1991. It should be a matter of great concern for the policy makers that in this optimistic

scenario, the agricultural sector should face a deceleration its growth rates of aggregate yield and output and the process of agricultural diversification should slow down. Again, as would be discussed in detail in Chapter 5, a more serious matter is that agricultural workers who constitute 58 per cent of the total workforce should be facing deceleration in their productivity and income levels as well as facing distress during the post-reform period (Table 5.3).

It is beyond the scope of this article to undertake a comprehensive analysis of the main reasons for the failure of economic liberalisation to improve the state of agriculture in India. But, it is hoped that the state and region wise analysis of agricultural growth during the pre- and post-liberalisation period undertaken above would provide a backdrop to scholars and policy makers to undertake an in- depth analysis of the reasons for slow down in agriculture in the post-reform period.

Chapter - III
Levels of Agricultural Output: District-wise Analysis

Introduction

The preceding chapter was devoted to an analysis of inter state variations in yield levels, in output growth rates and changes in cropping pattern during the period 1962-65 to 2003-06 and its various sub-periods. Considering the fact that states are large geographical entities consisting of several non-homogenous agro-economic sub-regions with widely varying yield levels and output growth rates, it would be more meaningful to undertake an analysis of the regional pattern of levels and growth of agricultural output in smaller geographical units. In India, districts or *Zilas* which are much smaller administrative units are likely to be agro-climatically more homogenous than states.

This chapter is devoted to an analysis of the spatial pattern of inter-regional variations in levels of land productivity with a view to identifying the main determinants of these differences by using districts as units of analysis.

As discussed in detail in Chapter I, for this study, 281 composite districts have been constituted out of the 523 districts in existence in 2003, by combining many of the newly created districts into the old units. For the district level study, area and output data have been collected for 35 crops for 1962-65, 1970-73, 1980-83, 1990-93 and 2003-06.

Regional Variations in Yield Levels

The performance of Indian agriculture at the district level has been studied by first combining various districts according to their yield levels (in value terms at constant 1990-93 prices) and then by looking at the changes in the share of area and output under each category over various periods of time. Secondly, the association between the productivity levels of various categories and the use of modern inputs is examined for all five periods namely 1962-65, 1970-73, 1890-83, 1990-93, and 2003-06. This is followed by a detailed analysis of the spatial pattern of districts according to their yield levels and changes therein over various periods. The extent of inter-district variations in yield levels and the issue of concentration of output have also been examined with the help of Gini ratios and coefficients of variation.

The 281 districts have been divided into the following three categories on the basis of their value of output per hectare (GCA).

A. *High Yield level Districts*: districts with yield exceeding Rs. 10,200/hectare;

B. *Medium Yield level Districts*: districts with yield ranging between Rs. 6,250-10,200/hectate;

C. *Low Yield level Districts*: districts with yield less than Rs. 6,250/hectare.

Disparities in Levels of Development

Yield levels during the pre-green revolution triennium 1962-65

The most important consequence of the adoption of new technology after the mid-sixties was a perceptible increase in the yield levels and output of many important crops in a few irrigated areas of the north western region and a gradual deepening and extension of new technology to new areas. Table 3.1 gives details about the distribution of districts according to their yield levels during 1962-65, 1970-73, 1980-83 1990-93 and 2003-06.

During the pre-green revolution triennium 1962-65, Indian agriculture was by and large characterised by backwardness and low productivity and most of the country except Kerala and to some extent Tamil Nadu was trapped in low productivity levels (Table 2.2).

Thus during 1962-65, as many as 248 out of 281 districts accounting for 90.9 per cent of area and 83.2 per cent of output of 35 crops belonged to the low productivity category with productivity levels less than Rs. 6,250 per hectare. Another 26 districts registered medium productivity ranging between Rs. 6,250 to Rs. 10,200/hectare. They accounted for only 7.7 per cent of area and 14.6 per cent of aggregate output. Finally, only 7 districts belonged to high productivity categories with yields exceeding Rs. 10,200/hec. These accounted for a meagre 1.5 per cent of area and 2.2 per cent of output of 35 crops.

Spatial pattern of districts- pre-green revolution period-1962-65

The spatial pattern of changes in the productivity levels of districts across various regions over time brings out that the overall pattern of a large number of districts moving up the productivity ladder is not uniform across regions and states.

During 1962-65 the 248 low productivity districts were spread across all the regions of India with a major concentration in the central, north western and eastern regions. Thus, out of 248 low productivity districts, 111 were located in the arid central region, 65 in the north-western region, 42 in the eastern region and only 30 in the southern region. It is interesting to note that in the pre-green revolution period 1962-65, low productivity districts were concentrated not only in the arid central and rainfed eastern and southern regions of India, but also encompassed the north-western states which were to transform themselves later as a consequence of adoption of new technology. In the southern region, both Andhra Pradesh and Karnataka also had a large number of low productivity districts.

During 1962-65, out of the 26 medium productivity districts, 17 were located in the southern region, 5 in the eastern region and 3 in the north-western region and only 1 in the central region.

Finally, during 1962-65, only 7 districts belonged to high productivity categories with yields exceeding Rs. 10,200/hec. Six out of seven high productivity districts were located in Kerala and one in Karnataka in the southern region.

Initial phase of green revolution1962-65 to 1980-83--Yield levels 1980-83

The introduction of new seed-fertilizer technology in Indian agriculture during the late sixties had a profound impact on the yield levels of wheat in the irrigated north western states of Punjab, Haryana and western Uttar Pradesh, the major wheat producing states of India. As a result, at the all-India level, wheat yields increased from 811 kg/hect during 1962-65 to 1,322 Kg/hec during 1970-73 and further to 1712 kg/hect by 1980-83. In the mean time, wheat output increased from 10.9 mn tons in 1962-65 to 24.3 mn tons by 1970-73 and to 25.7 mn tons by 1980-83.

Although a beginning had been made in HYV rice in Punjab and Haryana, the new technology in rice was yet to be introduced on a large scale even in these states. Thus during 1962-65 to 1980-83, there was only a marginal rise in rice yields from 1,014 Kg/hect during 1962-65 to 1291 kg/hect by 1980-83 and rice output rose from

36.5 mn tons during 1962-65 to 41.51 mn tons during 1970-73 and further to 51.33 mn tons by 1980-83 .

The green revolution during this period was appropriately called the wheat revolution. Because of the concentration of new technology in only a few small states and because of the limited weight of wheat output in total agricultural output during the period 1962-65 to 1980-83, the impact on agricultural growth at the all India level was limited despite the fact that some regions recorded high growth rates (Table 2.1).

The new technology made a small advance and extended to a few more areas during the period 1962-65 to 1980-83 but the progress was limited and halting. During the seventies, the introduction of high yielding varieties of IR-8 rice led to visible increases in rice yields and output in many north western areas as well as in coastal areas in the South. Some other crops like *jowar* and *ragi* also registered increases in yields and output. Another major development during the seventies was a further extension of the green revolution not only to coastal districts in the south but also to hitherto backward eastern Uttar Pradesh.

As a result the number of low productivity districts in UP came down from 46 in 1962-65 to 31 by 1980-83. Furthermore, the new technology had by and large bypassed the rainfed central region of India during the initial period. But, by 1980-83, a beginning had been made in area shift from low value coarse cereals towards high value oilseeds.

Consequently, at the all-India level, the number of low productivity districts declined from 248 in 1962-65 to 198 by 1980-83. Although backwardness was fairly wide spread and covered 70 per cent of districts, its extent had been reduced from 90.9 per cent of total area during 1962-65 to 74.4 per cent of total area (area under 35 crops) by 1980-83. Simultaneously, the output share of low productivity districts also declined from 83.2 per cent during 1962-65 to 56.1 per cent by 1980-83.

Again, the number of mid-productivity districts increased from 26 during 1962-65 to 58 by 1980-83 and these now accounted for 19.1 per cent of area and 29.7 per cent of output. A much more significant development was the increase in the share of high productivity districts. The number of districts with high productivity (above Rs. 10,200/hec) increased from only 7 in 1962-65 to 25 during 1980-83 and their share in total area increased from 1.5 per cent to 6.5 per cent while that in total value of output increased from 2.2 per cent in 1962-65 to 14.3 per cent by 1980-83 (Table 3.1).

Spatial Pattern 1980-83

The advent of new technology made a big dent in the number and weight of low productivity districts across various regions. The number of low productivity districts had declined from 248 during 1962-65 to 198 during 1980-83. During 1980-83, as many 101 out of 198 low productivity districts were located in the central region, 39 in the eastern region, 37 in the north-western region and 21 in the southern region.

As compared with 26, the number of mid-productivity districts rose to 58 during 1980-83. As many as 23 out of 58 medium productivity districts were located in the north-western region, 18 in the southern region, 10 in the central region and only 7 in the eastern region

Finally out of the 25 high productivity districts during 1980-83, 15 were in the southern region, 8 in the north-western region, and one each in the eastern and central regions

Maturing of green revolution 1980-83 to 1990-93--Yield levels 1990-93

The new technology made significant headway and extended both to new areas and to more crops during the eighties. An important development during this period was the extension of new technology to the eastern region. This resulted in a sharp acceleration of growth in this region (Table 2.1) and a noteworthy improvement in yield levels in some districts. Specially commendable was the performance of West Bengal during this period.

In addition to the eastern region, the new technology made headway in the dry central region also. The breakthrough in oil seeds technology during the 1980's resulted in the diversification of area from low value coarse cereals towards high value oilseeds in many rainfed states in the central region leading to a significant change in cropping pattern in these areas. The southern region also saw a revival of growth during this period. This resulted to wider spread of the green revolution to most parts of India. The change, which was gradual from 1962-65 to 1980-83 had taken a qualitative jump during 1980-83 to 1990-93.

As a consequence of the spread of new technology to hitherto lagging regions, there was a noteworthy improvement in the yield levels of many districts by 1990-93. Whereas the number and weight of low productivity districts went down sharply that of medium and high productivity districts recorded a distinct improvement.

Thus, the number of low productivity districts declined from 198 during 1980-83 to 138 during 1990-93, and their share in area fell from 74.4 per cent during 1980-83 to 52.4 per cent during 1990-93. More important, the low productivity districts accounted for only one third of total output in 1990-93 compared 56.1 per cent during 1980-83.

The number of districts in the medium productivity category further increased from 58 during 1980-83 to 84 during 1990-93. While their share of area increased from 19.1 per cent during 1980-83, to 29.1 per cent during 1990-93, their share of output increased from 29.7 per cent during 1980-83 to 33.6 per cent during 1990-93.

There was a big improvement in the weight of high productivity districts; their number increased from 25 in 1980-83 to 59 during 1990-93. The 59 high productivity districts accounted for nearly $1/5^{th}$ of the area and $1/3^{rd}$ of the aggregate output compared with 1.5 per cent of area and 2.2 per cent of aggregate output during 1962-65 (Table 3.1). This remarkable increase in agricultural productivity brought about significant rise in agricultural income in almost all the districts of India. This laid the basis for rapid growth not only of agriculture but also of the non agricultural sectors of the economy in both rural and urban areas through various direct and indirect linkages.

Spatial pattern of Districts 1990-93

By 1990-93, the number of low productivity districts had declined to 138, but 91 of these were still located in the states in the central region, 25 were located in the eastern region, 10 in the north-western region and 12 in the southern region.

Out of the 84 mid-productivity districts during 1990-93, 37 were in the north-western region (30 in UP), 17 in the central region, 16 in the eastern region and 14 in the southern region.

Finally, out of the 59 high productivity districts during 1990-93, as many as 28 were in the southern region , 21 in the north western region, 6 in the eastern region (4 in West Bengal), and only 4 in the central region (3 in Gujarat).

Table 3.1

Share of Districts in Area, Output and Inputs used by Yield Levels during 1962-65 to 2003-06.

Yie ld Level (Output/hectare in Rs)	Number of districts					% Share in Area (35 Crops)					% Share in output (35 Crops)					% Share in Gross irrigated area				
	60s	70s	80	90s	2003	60s	70s	80	90s	2003	60s	70s	80	90s	2003	60s	70s	80	90s	2003
High exceeding 10,200	7	10	25	59	94	1.5	2.2	6.5	18.5	30.3	2.2	6.5	14.3	33.9	49.8	1.0	1.7	9.6	27.2	37.3
Medium 6250-10200	26	44	58	84	93	7.7	14.6	19.1	29.1	30.9	14.6	26.4	29.7	33.6	29.0	17.0	29.1	29.1	38.7	35.7
Low Less than 6250	248	227	198	138	94	90.9	83.2	74.4	52.4	38.7	83.2	67.1	56.1	32.6	21.2	82.0	69.2	61.3	34.0	27.0
Total	281	281	281	281	281	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Yield Level (Output/hectare in Rs)	%Share in Fertilizer					% Share in Tractors					% Share in Pumpsets					% Share in Agricultural Workers				
	60s	70s	80	90s	2003	60s	70s	80	90s	2003	60s	70s	80	90s	2003	60s	70s	80	90s	2003
High exceeding 10,200	0.7	2.7	16.5	35.6	41.8	1.0	1.3	13.7	34.0	40.8	1.2	1.9	12.1	30.5	42.1	1.7		6.8	21.5	29.7
Medium 6250-10200	15.8	46.1	34.6	32.4	35.5	28.2	45.8	34.2	30.7	32.4	18.5	31.9	30.5	38.2	33.9	11.0		22.1	30.6	33.1
Low Less than 6250	83.5	51.2	48.9	32.0	22.7	70.8	52.9	52.1	35.3	26.8	80.2	66.3	57.5	31.3	24.0	87.3		71.1	47.9	37.2
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0		100.0	100.0	100.0

Source: Compiled from district level data reproduced in Annexure 1(a) - 1(e).

Post-reform period 1990-93 to 2003-06--Yield levels 2003-06

The tempo of agricultural growth decelerated during the post reform period 1990-93 to 2003-06. This not-withstanding, even lower growth enabled many more districts to graduate up the development ladder.

The number of districts in the low productivity category declined, from 138 during 1990-93 to 94 by 2003-06. As compared with 52.4 per cent of total share of area during 1990-93, the low productivity districts accounted for only 38.7 per cent of area under 35 crops during 2003-06.

The number of medium productivity districts and their share in total area only increased marginally during 2003-06 as compared with 1990-93 whereas their share in the total value of output recorded a small decline (Table 3.1).

But there was a noteworthy increase in the number and share of high productivity districts. The number of high productivity districts increased from 59 during 1990-93 to 94 during 2003-06. In the meantime, whereas their share in area increased from 18.5 per cent to 30.3 per cent, their share in value of output increased from 33.9 per cent to 49.8 per cent.

Table 3.2

Spatial Distribution of Districts in Different States by Levels of Productivity

Yield Level (Output/hectare in Rs)	**North Western region**					**Eastern region**					**Central region**					**Southern region**					**All India**
	HAR	**J&K**	**PB**	**UP**	**ALL**	**ASS**	**BH**	**OR**	**WB**	**ALL**	**GJ**	**MP**	**MAH**	**RJ**	**ALL**	**AP**	**KAR**	**KER**	**TN**	**ALL**	
1962-65																					
High exceeding 10,200	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	6	0	7	7
Medium 6250-10200	0	0	1	2	3	3	0	0	2	5	0	0	1	0	1	4	4	1	8	17	26
Low Less than 6250	7	2	10	46	65	4	15	11	12	42	18	43	24	26	111	13	14	0	3	30	248
All	**7**	**2**	**11**	**48**	**68**	**7**	**15**	**11**	**14**	**47**	**18**	**43**	**25**	**26**	**112**	**17**	**19**	**7**	**11**	**54**	**281**
1970-73																					
High exceeding 10,200	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	2	6	1	9	10
Medium 6250-10200	1	0	9	4	14	4	0	0	4	8	2	0	1	0	3	4	5	1	9	19	44
Low Less than 6250	6	2	2	43	53	3	15	11	10	39	16	43	24	26	109	13	12	0	1	26	227
All	**7**	**2**	**11**	**48**	**68**	**7**	**15**	**11**	**14**	**47**	**18**	**43**	**25**	**26**	**112**	**17**	**19**	**7**	**11**	**54**	**281**
1980-83																					
High exceeding 10,200	0	0	5	3	8	0	0	0	1	1	0	0	1	0	1	2	4	7	2	15	25
Medium 6250-10200	2	1	6	14	23	4	0	0	3	7	7	0	3	0	10	5	5	0	8	18	58
Low Less than 6250	5	1	0	31	37	3	15	11	10	39	11	43	21	26	101	10	10	0	1	21	198
All	**7**	**2**	**11**	**48**	**68**	**7**	**15**	**11**	**14**	**47**	**18**	**43**	**25**	**26**	**112**	**17**	**19**	**7**	**11**	**54**	**281**

Table 3.2 cont.

Yield Level (Output/hectare in Rs)	**North Western region**					**Eastern region**					**Central region**					**Southern region**					**All India**
	HAR	**J&K**	**PB**	**UP**	**ALL**	**ASS**	**BH**	**OR**	**WB**	**ALL**	**GJ**	**MP**	**MAH**	**RJ**	**ALL**	**AP**	**KAR**	**KER**	**TN**	**ALL**	
1990-93																					
High exceeding 10,200	1	0	10	10	21	2	0	0	4	6	3	0	1	0	4	6	6	7	9	28	59
Medium 6250-10200	5	1	1	30	37	3	3	2	8	16	3	7	3	4	17	6	6	0	2	14	84
Low Less than 6250	1	1	0	8	10	2	12	9	2	25	12	36	21	22	91	5	7	0	0	12	138
All	**7**	**2**	**11**	**48**	**68**	**7**	**15**	**11**	**14**	**47**	**18**	**43**	**25**	**26**	**112**	**17**	**19**	**7**	**11**	**54**	**281**
2003-06																					
High exceeding 10,200	5	0	11	20	36	2	0	1	12	15	8	0	3	1	12	9	6	7	9	31	94
Medium 6250-10200	2	1	0	24	27	5	4	6	2	17	8	13	4	8	33	7	7	0	2	16	93
Low Less than 6250	0	1	0	4	5	0	11	4	0	15	2	30	18	17	67	1	6	0	0	7	94
All	**7**	**2**	**11**	**48**	**68**	**7**	**15**	**11**	**14**	**47**	**18**	**43**	**25**	**26**	**112**	**17**	**19**	**7**	**11**	**54**	**281**

Source: Compiled from district level data reproduced in Annexure 1(a) - 1(e).

Spatial Pattern 2003-06

The number of low productivity districts further declined from 138 during 1990-93 to 94 during 2003-06. Of the 94 low productivity districts, 67 were still located in the Central, 15 in the eastern (11 in Bihar), 5 in the north-western and 7 in the southern region (Table 3.2).

During 2003-06, the number of mid-productivity districts increased to 93 as compared with 84 districts that had recorded medium productivity during 1990-93. During 2003-06, out of the 93 mid productivity districts, 33 were located in the central region, 27 in the north-western region, 17 in the eastern region and 16 in the southern region.

The number of high productivity districts increased from 59 during 1990-93 to 94 during 2003-06. During 2003-06, of the 94 high productivity districts, 36 belonged to the north-western region (all 11 of Punjab, 20 of UP and 5 out of 7 of Haryana), 31 to the southern region (all 7 districts of Kerala, 9 out of 11 of T N), 15 to the eastern and 12 to the central region (8 out of 18 of Gujarat).

Notably, many districts in the central region recorded substantial improvement in their productivity during 1990-93 to 2003-06. The number of districts in the high productivity range in this region increased to 12 during 2003-06 from just 4 during 1990-93. Within the region, the progression is mainly due to unprecedented improvement in district level performance of agriculture in Gujarat.

During 1990-93, 12 out of 18 districts of Gujarat districts belonged to low productivity category. By 2003-06, the number of low productivity districts had come down to only 2. In the meantime, the number of medium productivity districts had increased from 3 to 8. But more important, the number of high productivity districts had also increased from 3 to 8.

Region wise, the largest increase in the high productivity districts took place in the north western region where their number increased from none in 1962-65 to 36 by 2003-06. The number of high productivity districts increased from 7 in 1962-65 to 31 by 2003-06 in the Southern region, from none to 12 in the Central region and from none to 15 in the Eastern region, over the same period (Table 3.2).

During 2003-06, Kerala and Punjab were the two states which had all their districts in high productivity range exceeding yield level of Rs.10,200/hectare. In the case of Punjab, this has been achieved as a consequence of successful adoption of new seed-fertiliser technology in wheat and rice leading to unprecedented increase in

their yield and output levels. On the other hand, in Kerala high productivity is a consequence of unique cropping pattern. Unlike the rest of India, in Kerala 90 per cent of area is allocated to high value plantation and other crops and only 10 per cent is covered by foodgrain crops.

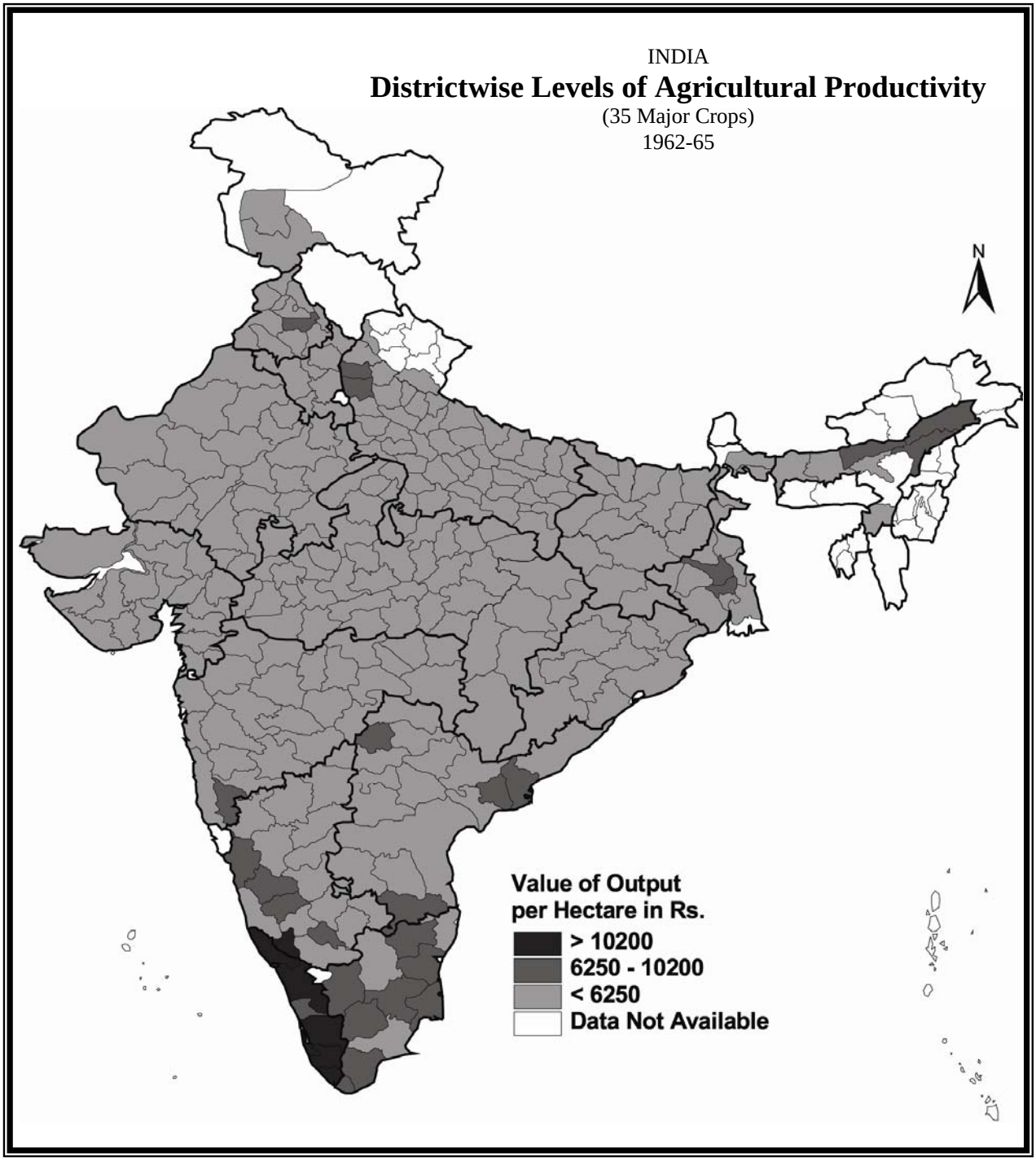
Besides Punjab and Kerala, Haryana, Assam, West Bengal and Tamil Nadu are other states that had none of their districts belonging to low productivity category during 2003-06. Again, only 2 districts in Gujarat and 1 each in Andhra Pradesh and Jammu and Kashmir were left in the low productivity category by 2003-06.

Maps 3.1 to 3.5 present a visual view of the changes in the spatial pattern of districts classified into high, medium and low levels of productivity during 1962-65 to 2003-06.

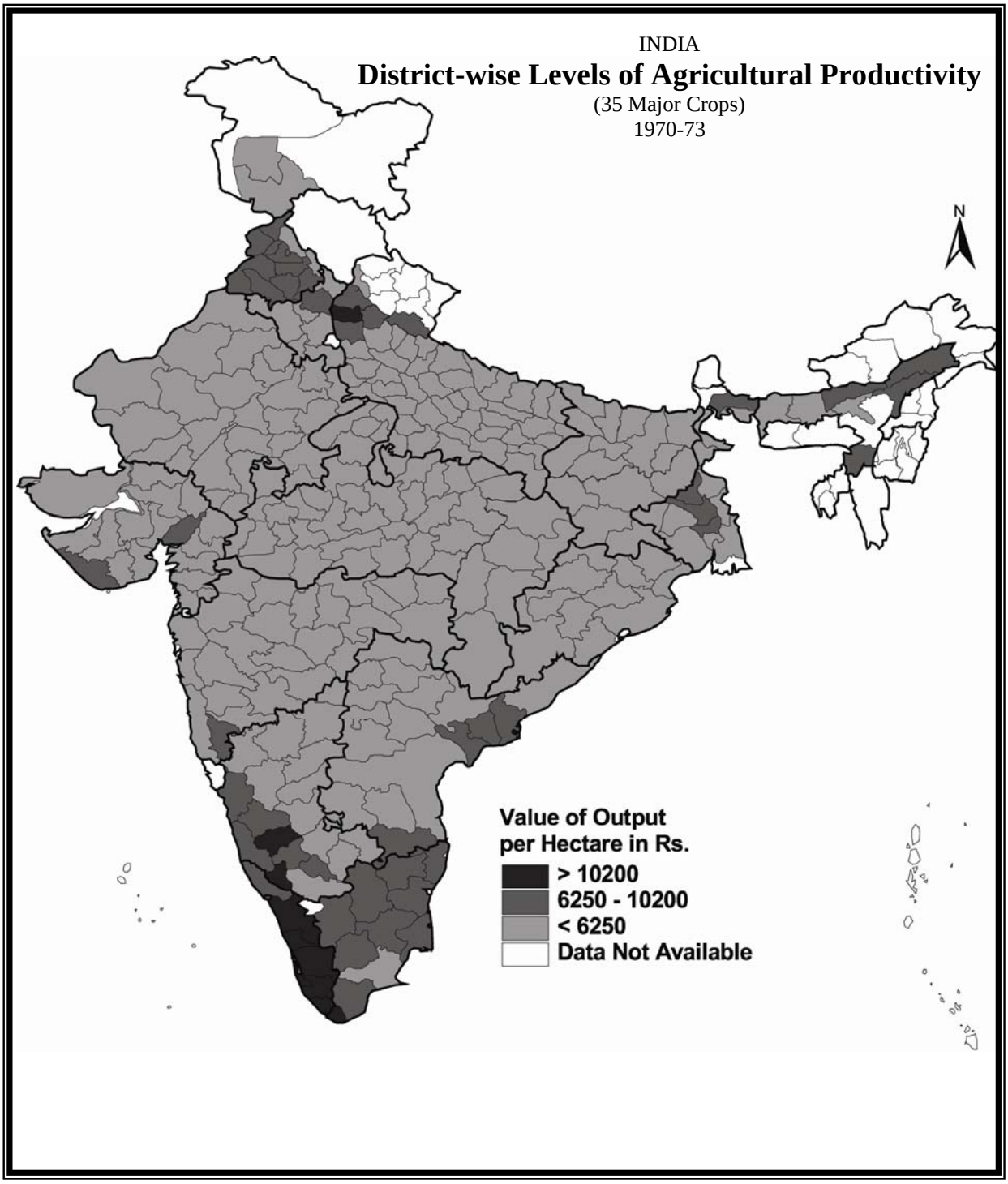
Except Gujarat, the other states in the central region are still caught in a low level equilibrium trap. About three-fourth of the districts in Madhya Pradesh, Maharashtra and Rajasthan belonged to low productivity category even during 2003-06. The commendable agricultural development in Gujarat in this region is only a recent phenomenon. Besides these three central region states, Bihar in eastern region is another state where about three-fourth of the districts are in low productivity range. In fact more than 80 per cent of the agriculturally backward districts in 2003-06 were located in four states namely, Bihar in the eastern region and Madhya Pradesh, Maharashtra and Rajasthan in the central region.

To sum up, the agricultural economy of India seems to have recorded quite significant progress since the introduction of new technology during the mid-'sixties. The north-western region was the earliest to harvest rich dividends on rapid adoption of the new technology. Also among the earlier gainers were the irrigated districts in the coastal areas of the southern region. By the eighties productivity improved substantially in many districts in the eastern region in general and those in West Bengal in particular. The Central region districts however continued to be trapped at a low level of development by 1990-93. The subsequent decade and a half however, witnessed a substantial improvement in agricultural productivity even in this region. Many districts in this lagging region, particularly those in Gujarat state, broke the shackles of low productivity trap and progressed substantially up the development ladder by 2003-06 (Map 3.1 to 3.5).

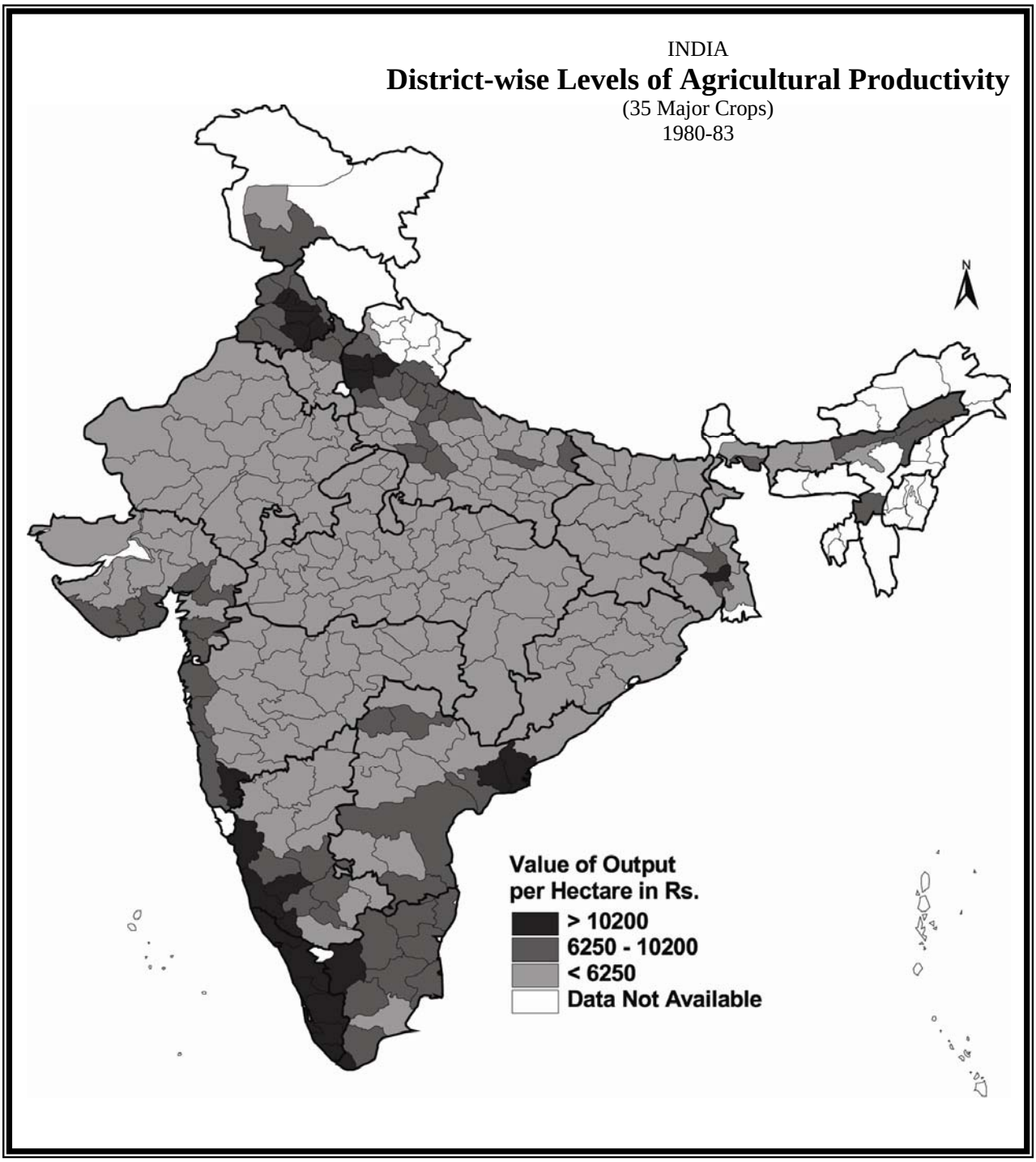
Map 3.1


INDIA
Districtwise Levels of Agricultural Productivity
(35 Major Crops)
1962-65
N
Value of Output
per Hectare in Rs.
> 10200
6250 - 10200
< 6250
Data Not Available

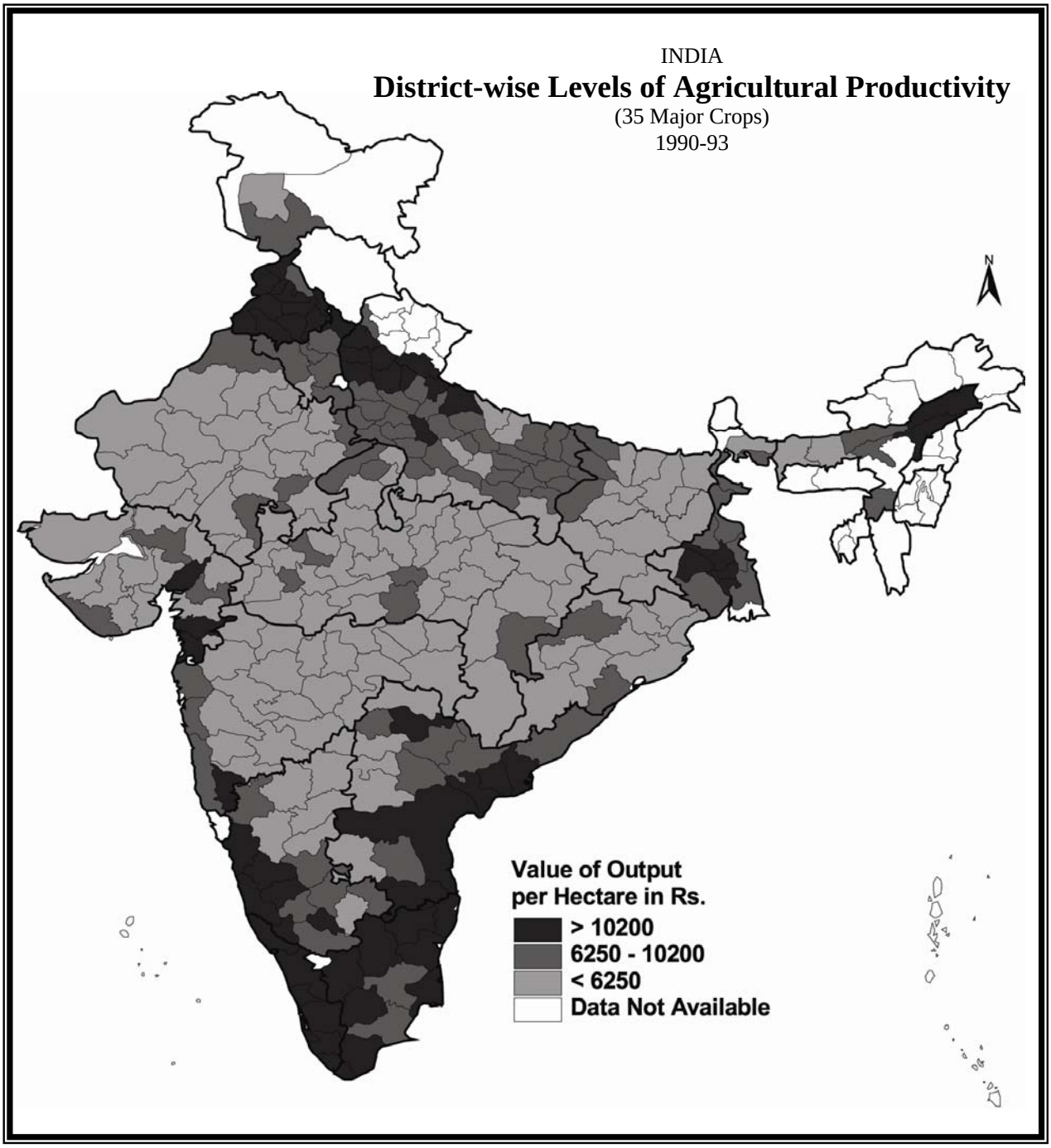
Map 3.2


INDIA
District-wise Levels of Agricultural Productivity
(35 Major Crops)
1970-73
N
Value of Output
per Hectare in Rs.
> 10200
6250 - 10200
< 6250
Data Not Available

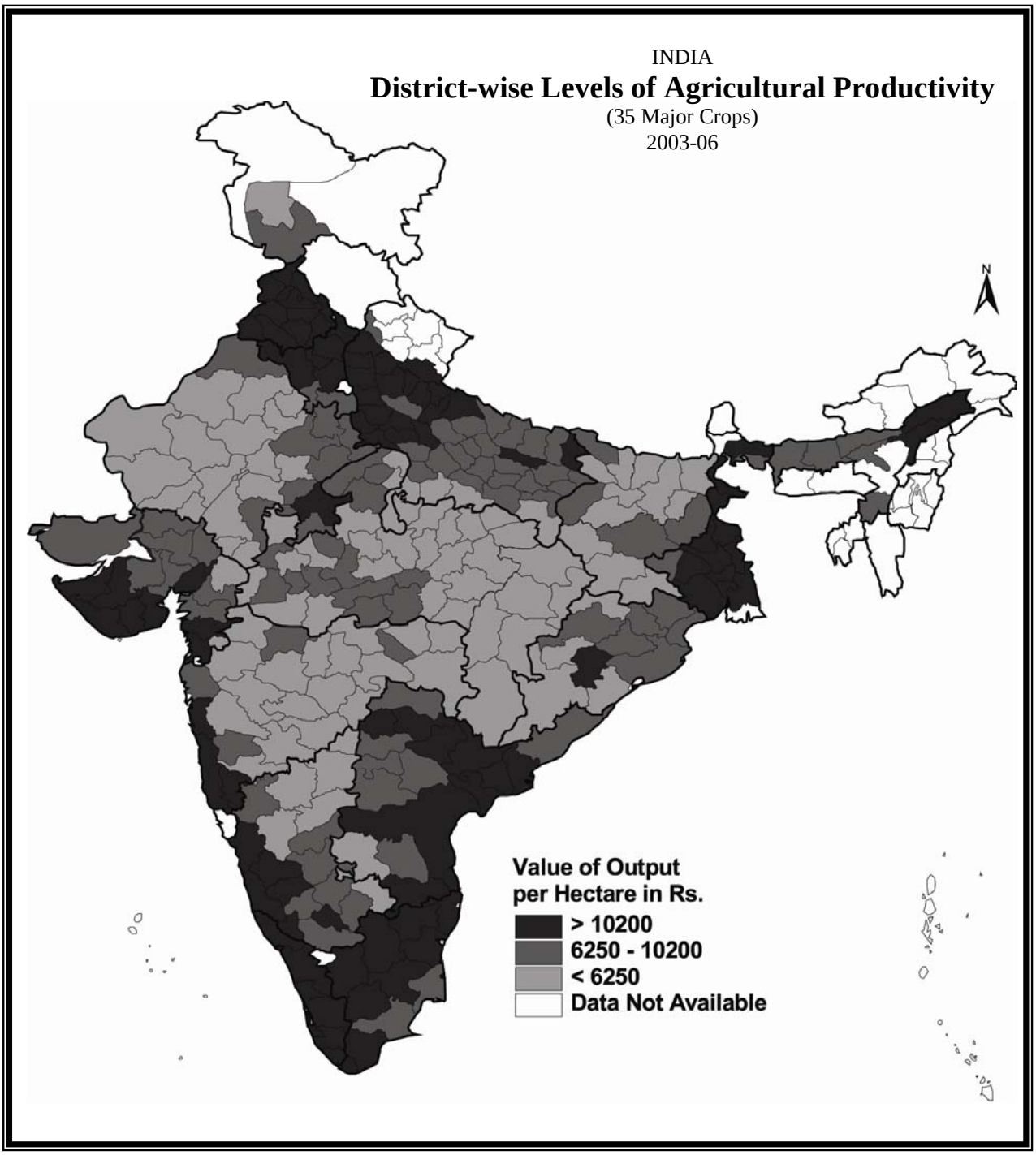
Map 3.3


INDIA
District-wise Levels of Agricultural Productivity
(35 Major Crops)
1980-83
N
Value of Output
per Hectare in Rs.
> 10200
6250 - 10200
< 6250
Data Not Available

Map 3.4


INDIA
District-wise Levels of Agricultural Productivity
(35 Major Crops)
1990-93
N
Value of Output
per Hectare in Rs.
> 10200
6250 - 10200
< 6250
Data Not Available

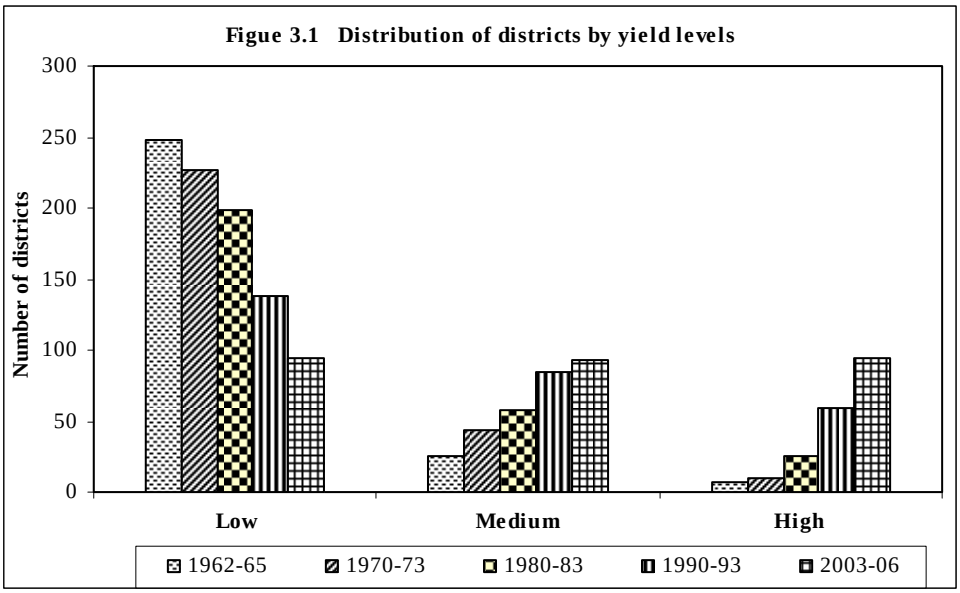
Map 3.5


INDIA
District-wise Levels of Agricultural Productivity
(35 Major Crops)
2003-06
N
Value of Output
per Hectare in Rs.
> 10200
6250 - 10200
< 6250
Data Not Available

Frequency Distribution - Graphical Illustration

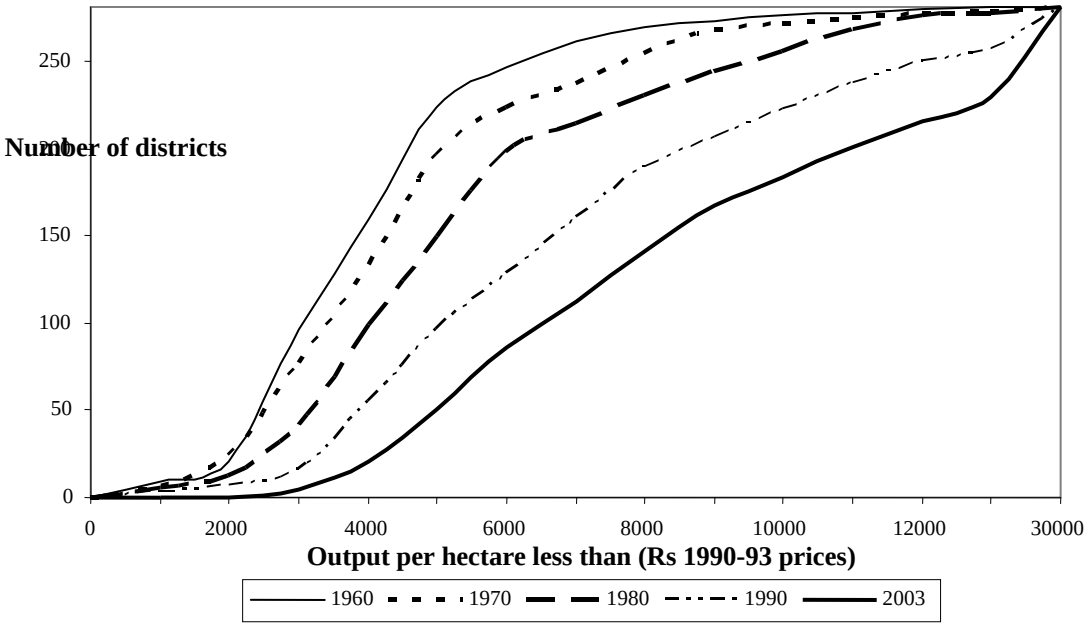
The bar diagram and frequency distribution curves for the sixties, the seventies, the eighties, the nineties and the 2000's given in Fig. 3.1 and Fig .3.2 bring out in a disaggregated manner the changes that have taken place in the number of districts that fall in the various productivity categories.

The bar diagram shows continues graduation of districts from low to medium and higher productivity levels.



The distribution of districts across various productivity ranges seems to be improving in each successive period. This has been confirmed by the Fig. 3.2. The cumulative frequency distribution of districts ranked by yield levels in each subsequent period shifted away from the vertical axis and towards horizontal axis suggesting a continuous move towards a more superior distribution.

Fig. 3.2 Cumulative frequency of districts based on yield levels



With the only exception of 1970-73, the cumulative curves for other periods clearly have no intersection with their preceding period curve. It will be noticed that after the intersection point that represents about 38 districts whose productivity is less than Rs. 1500 per hectare, the cumulative frequency curve for the 'seventies is to the right of the 'sixties curve for the rest of the distribution. Again, the 1980-83 curve is to the right of 1970-73 curve almost at all points of distribution. The same is true about the 1990-93 curve which recorded a visible shift compared with the 1980-83 distribution at all levels. The cumulative frequency curve shifted further downward during 2003-06 suggesting further improvement in distribution at all levels.

During 2003-06, there are two visible deviations in this shift from the earlier ones. While the downward shift occurred at all levels, it seems to be comparatively more apparent near the end points. Rapid reduction in the number of districts at the lower end by yield levels during 1990-93 to 2003-06 curve indicates an improvement at the lower end. On the other hand, the number of high productivity districts registered an increase at the upper end. The net result was a reduction in inter-district disparities in yield levels across districts during 2003-06 compared with the earlier period.

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Development and Inter-District Disparities

The observed superiority of the distribution implies that compared with the earlier period; most of the districts had higher levels of productivity during the latter period. But, it fails to suggest much regarding the inter-district differences in productivity or regional concentration of agricultural production.

To measure trends in inter-district inequality in the process of agricultural growth several measures have been used, these being the coefficient of variation, Gini coefficients, the Lorenz curve, and the share of each quintile in total output for the periods 1962-65, 1970-73, 1980-83, 1990-93 and 2003-06 The following table gives the results.

Table - 3.3

Changes in Inter-District Inequality in Average Yield Levels

Measures	1962-65	1970-73	1980-83	1990-93	2003-06
Gini Coefficient of Inequality	0.256	0.287	0.276	0.275	0.271
Coefficient of Variation (per cent)	49.9	56.0	51.2	50.2	50.8
Share(%) of the bottom quintile	10.0	7.9	9.0	8.9	12.2
Share(%) of Middle quintiles	33.0	33.3	31.5	31.0	31.5
Share (%) of the Top quintile	34.0	31.3	36.7	36.0	33.5
Share of top/bottom quintiles.	3.40	3.96	4.17	4.05	2.74
Yield of bottom quintile districts*	1959	1864	2475	3209	4196
Yield of middle (2^{nd}, 3^{rd}& 4^{th}) quintiles*	3748	4148	4933	6637	8191
Yield of top quintile districts*	6919	8438	9927	12756	15922
Ratio of top to bottom quintile districts	3.53	4.53	4.01	3.98	3.79

Note: *- yield is value output per hectare of the gross cropped area (in Rupees at 1990-93 prices).
Source: *As in Tables 3.2*

The coefficient of variation and the Gini Ratios above confirm that inter-district inequality measured on the basis of district data seems to have increased considerably during the period 1962-65 to 1970-73, and then declined during 1980-83, 1990-93 and 2003-06.

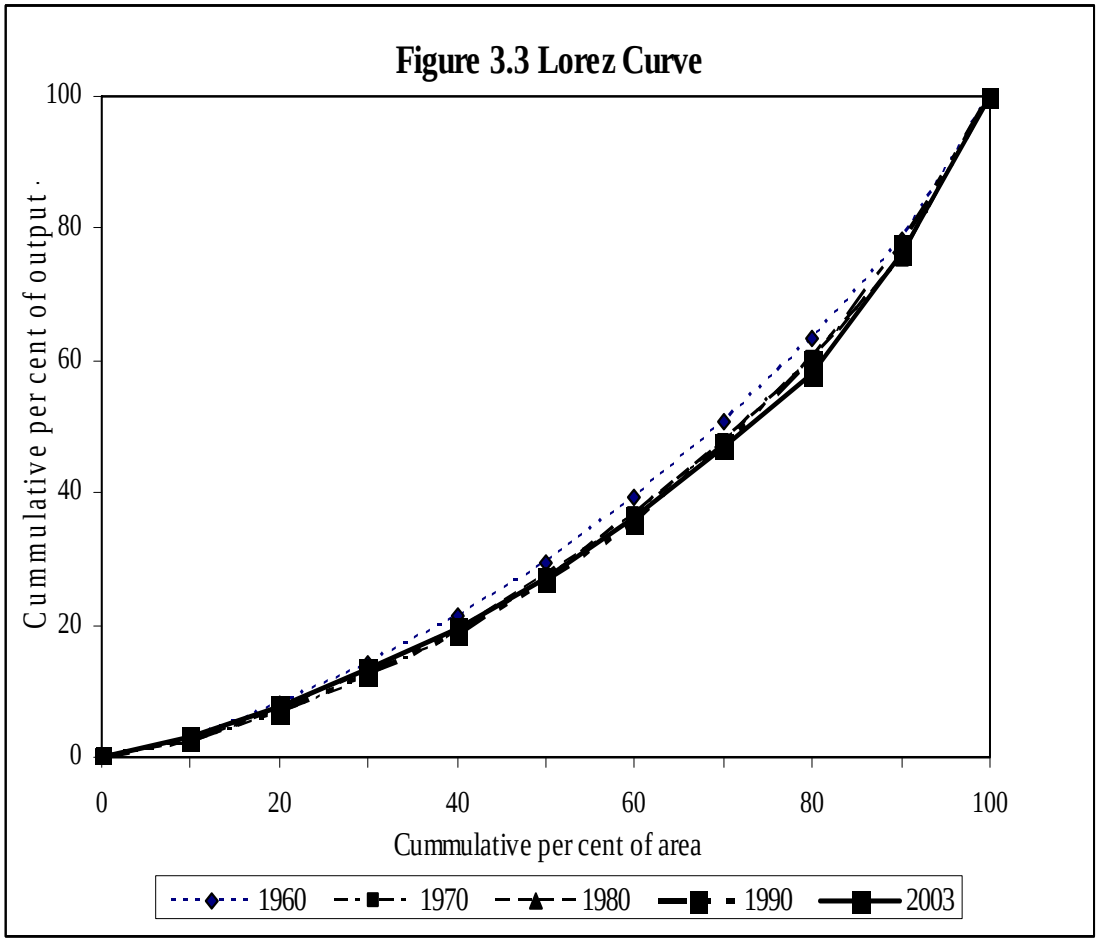
The coefficient of variation of the distributions increased from 49.9 percent during 1962-65 to 56.0 per cent during 1970-73 and then declined to 51.2 per cent during 1980-83 and to 50.8 per cent during 2003-06. This clearly indicates that there took place a notable increase in inter-district disparities in yield levels between the periods 1962-65 and 1970-73, which declined afterwards. This is also confirmed by

the concentration ratio between area and total agricultural output. The Gini coefficient increased from 0.256 during 1962-65 to 0.287 during 1970-73, but declined to 0.276 during 1980-83 and to 0.271 during 2003-06.

Table 3.3 also brings out that the absolute share of the districts in the lowest quintile (the lowest 20 per cent) worsened during the sixties. This was also attributable to low rainfall and other climatic factors during this period especially for the districts in the central region. However, the weather was more favourable and growth was more widespread during the seventies. Consequently, the bottom group gained during the seventies and the eighties.

A noteworthy change occurred during the nineties as the share of bottom quintile of the districts in overall output improved substantially to 12.2 per cent during 2003-06 from 8.9 per cent during 1990-93. This is because, during 1990-93 to 2003-06, many of the low productivity districts in the central region recorded acceleration in their growth rates. On the other end of the distribution, the share of the top quintile of the highest productive districts declined considerably from 36.0 during 1990-93 to 33.5 during 2003-06. The result was that the ratio of the share of top to bottom quintile declined from 4.05 during 190-3 to 2.74 during 2003-06. This is also confirmed by the fact that the ratio of average yield of top to bottom quintile districts declined from 2.84 during 1990-93 to 2.74 during 2003-06. This happened because during1990-93 to 2003-06, many of the high productivity districts in the north-western and southern regions recorded a deceleration in their growth rates. Consequently, the ratio to top to bottom quintiles declined to 2.74 during 2003-06 from 4.05 during 1990-93. The net result was a reduction in inter-district disparities in yield levels.

The Lorenz Curve given in Fig. 3.3 confirms that inter-district disparities clearly worsened during 1962-65 to 1970-73 as the curve for the seventies shifted away from the line of equality compared with corresponding curve for the sixties. However, the Lorenz curve fails to give a clear picture about changes in disparities after 1970-73, since the curves for the 1970’s, 1980’s, 1990’s and for 2003-06 tend to overlap/intersect each other at many points.



To sum up, most of the indicators bring out that the introduction of new technology led to an increase in inter-district inequality during the period 1962-65 to 1970-73, presumably because to begin with the high yielding new technology was confined to wheat and rice in limited irrigated areas in North West India.

The inequality came down subsequently during the seventies, the eighties and the nineties, both because of deepening of the new technology and more importantly, its wider spread to many more new areas. A rapid reduction in inequality during the 1990's was also because whereas there was a speed up of growth in low productivity districts, there took place a slow down in growth of high productivity districts.

But, it needs to be underlined that despite a decline in inequality, the degree of inter-district inequality as measured by various methods continues to be high. Such inequities ultimately get reflected in the earnings of agricultural households in different region. For more inclusive growth, the districts still trapped at the lowest end of the distribution warrant more focused policy initiatives for wider distribution of

technological gains and greater well-being of the population dependent upon agriculture for its livelihood.

The preceding discussion presents the spatial and temporal changes in the pattern of inter-district differentials in level of development in Indian agriculture. The differences in productivity per hectare among districts can be (a) either due to differences in the quantity of output produced per hectare of a crop i.e. due to differences in physical yield (Y_{ij}) (b) and/or due to differences in the cropping pattern. Thus, it is possible for a district to have a higher level of value productivity than another district, even when it has a lower physical yield in most crops, provided its share of area under high value crops is much greater.

To a large extent, cropping patterns get determined by physical conditions of production like soil type, rainfall pattern, topography and elevation from sea level. But within the set of crops that can be grown in a region, crop combinations get determined by relative yield levels and prices. Thus along with relative prices, the new technology can also help change the cropping pattern. For example, extensive production of rice in Punjab is a post-green revolution phenomenon.

However, it is important to note that the degree of maneuverability in raising yield levels through technological innovations and through provision of necessary infrastructural facilities is much greater than through changes in cropping patterns. For example, under a given state of technology, it is difficult to develop a cropping pattern similar to Assam's in say a district in a state like Rajasthan located in the arid zone. But, by making investments in tubewells, or by increasing the application of yield raising inputs like fertilizers, pesticides, new seed varieties etc., it is possible to raise the yield level of the crop in both states. This brings home the relative importance of capturing the role that modern inputs have played in raising value productivity by raising physical yields as well as by bringing about cropping pattern changes.

Productivity Levels and Use of Modern Farm Inputs

The section is devoted to a discussion of the relationship between the use of modern inputs and the yields level at the district level.

That there exists a high degree of association between the levels of agricultural productivity and the use of modern inputs is brought into sharp focus if one looks at their output values and input use on a per hectare basis (Table 3.1 and Table 3.4).

At the all-India level, average productivity per hectare of all crops taken together rose from Rs. 3803 during 1962-65 to Rs. 8526 during 2003-06. Simultaneously, the proportion of gross irrigated area to total cropped area rose from 18.9 per cent to 40.0 per cent. During the same period the use of fertilizers per hectare increased from 3.3 to 97.9 kg per hectare. The same is the story about the use of tractors and pump sets or tube-wells. Starting with only 0.3 tractors per thousand hectares during 1962-65, their number rose to 13.0 by 2003-06. Similarly, per thousand hectares, the number of pump sets/tube-wells increased from 5.8 during 1962-65 to 83.5 during 2003-06.

The very large concentration in the use of modern inputs in the high productivity districts is also brought out in Table 3.4. For example, during 1962-65, compared with an average fertilizer consumption of 3.3 kg per hectare, the high productivity districts were consuming 11.9 kg per hectare. During 2003-06, compared with an average of 97.9 kg per hectare, the very high productivity districts were using 157.9 kg of fertilizers per hectare. A similar picture emerges with respect to the use of tractors and tube-wells and also the percentage of gross irrigated area. Again, during 1990-93 compared with an all India average of 40.0 per cent of gross irrigated area, 55.2 per cent of GCA was irrigated in the very high productivity districts.

At the other extreme, the use of modern inputs was very low in the low productivity districts. During 1962-65, low productivity districts consumed only 2.5 kg fertilizer per hectare compared with 11.9 kg in high productivity districts. By 2003-06, as compared with very high productivity districts, very low productivity districts had, on a per thousand hectare basis, only two-fifth the number of tractors and one-half the number of tubewells and less than a half of the area under irrigation. Thus, their share in total input use was low. During the period 1962-65, with 90.9 per cent of the gross cropped area, the low productivity districts accounted for 83.2 per cent of total value of output in the country. Their use of inputs was relatively low- they accounted for 82.0 per cent of the gross irrigated area, 83.5 per cent of fertilizer consumption and 70.8 per cent of tractors (Tables 3.1). By 2003-06, while their share in the gross cropped area declined from 90.9 to 38.7 per cent, that in the gross irrigated areas decreased from 82.0 per cent in 1962-65 to only 27.0 per cent by 2003-06 and that in fertilizer consumption came down from 83.5 per cent to 22.7 per cent.

Table 3.4
Distribution of Districts and Input use by Productivity Levels during 1962-65, 1970-73, 1980-83, 1990-93 and 2003-6

Yield Level (Output/hectare in Rs)	Number of districts					Fertilizer consumption (Kgs/hectare)					No. of Tractors per 000 Hc of GCA				
	60s	70s	80s	90s	2003	60s	70s	80	90s	2003	60s	70s	80	90s	2003
High exceeding 10,200	7	10	25	59	94	11.9	28.5	86.3	131.3	157.9	0.2	1.0	7.7	20.4	17.9
Medium 6250-10200	26	44	58	84	93	12.1	38.4	67.9	78.8	92.4	0.7	2.7	5.4	12.4	15.0
Low Less than 6250	248	227	198	138	94	2.5	10.9	21.0	40.8	55.1	0.3	0.5	1.9	6.5	7.6
Total	281	281	281	281	281	3.3	15.3	34.1	68.5	97.9	0.3	0.9	3.0	10.8	13.0

Yield Level (Output/hectare in Rs)	No. of Pumpsets/000 GCA Hc.					% GCA under irrigation					Agricultural Workers /000 Hc of GCA			
	60s	70s	80	90s	2003	60s	70s	80	90s	2003	60s	80s	90s	2003
High exceeding 10,200	3.7	11.6	85.6	98.8	111.8	15.0	19.8	55.5	56.3	55.2	918	1109	1328	1228
Medium 6250-10200	21.2	63.0	71.8	59.3	87.5	45.8	51.1	46.9	47.0	44.0	1221	1200	1260	1355
Low Less than 6250	4.5	12.7	27.9	36.3	57.9	16.7	18.6	22.5	20.4	24.8	818	985	1050	1213
Total	5.8	20.0	39.9	54.6	83.5	18.9	23.4	29.3	34.6	40.0	850	1034	1161	1261

Source: Compiled from district level data reproduced in Annexure 1(a) - 1(e).

The tables bring out the positive association between productivity levels and use of modern inputs over the period from 1962-65 to 2003-06. It may however, be noted that the relationship is not very strong in the beginning during 1962-65 and 1970-73. During the period high yields are more dependent on the rich quality alluvial soils and assured irrigation or normal rainfall and are confined to the coastal districts in Kerala, Tamil Nadu, Karnataka and Andhra Pradesh. In many of these districts, high productivity also was recorded because of traditionally high yield in rice cultivation combined with the cultivation of plantation crops. The positive relationship between the use of inputs and productivity is consistent over time.

Role of Modern Inputs: An Econometric Analysis

The tabular analysis in the preceding section brings out that the use of modern inputs like fertilizer, tubewells and tractors, and availability of irrigation facilities and cropping intensity, are closely related with the levels of agricultural development. Since many of these inputs are used together, the contribution of individual inputs cannot be differentiated from mean and proportion tables. Therefore, an attempt has been made in this section to supplement the tabular findings with econometric analysis of the input-output relationship using district level data.

For the present analysis, the following unrestricted form of Cobb-Douglas production function has been estimated on the input-output data from 281 districts.

$$\text{Log}_n(\text{Output}) = \beta_0 + \beta_1\text{Log}_n(\text{Land}) + \beta_2\,\text{Log}_n(\text{Labour}) + \beta_3\,\text{Log}_n(\text{Fertiser}) + \beta_4\text{Log}_n(\text{Tractors}) + \beta_5\text{Log}_n(\text{Tubewells}) + \beta_6\,\text{Log}_n(\text{Irrigation}) + \beta_7\,\text{Log}_n(\text{Roads}) + \beta_8\,\text{Log}_n(\text{Markets}) + \beta_9\,\text{Log}_n(\text{Rainfall}) + \sum_{i=1}^{14}\delta_i DZ_i + \sum_{j=1}^{15}\gamma_j DS_j + U$$

Where,

Output = Value of output of all the crops in thousand rupees at 1990-93 constant prices
Land = Gross cropped area in hectares in the district
Labour = Number of agricultural workers in the district
Fertiliser = Chemical fertilizers (NPK in tons) consumed in the district,
Tractors = Number of tractors in the district
Tubewells = Number of energised tubewells/pumpsets in the district
Irrigation = Per centage of the gross cropped area under irrigation in the distrct
Roads = Road length in the district
Markets = Number of regulated markets in the district
Rainfall = Annual rainfall (in mm) in the district
DZ_i = Agro-climatic specific dummies
DS_j = State specific dummies
β = Regression parameter, interpreted as output elasticity of the respective input
δ, γ = Coefficients of zones and state dummies respectively.
U = Stochastic error term

The choice of factors as explanatory variables has been dictated partly by their theoretical importance as contributors to agricultural production and partly by the availability of reliable and comparable data for these variables at the district level. With the only exception of fertiliser used, and rainfall other included inputs are measured in stock terms. This is because of the non availability of flow data in the case of many inputs like labour, machinery etc at the district level. Consequently, all variables included in the model, except fertilizers and rainfall,l are measured in the stock form; that is as stock available during the period rather than actual amount of flow[1].

The underlying hypothesis in this production relationship is that the district level production is an increasing function of land, labour, fertiliser, irrigation, tractors

[1] This drawback notwithstanding, measurement of included variables in regression model in the stock form has a specific advantage as it overcomes the problem of endogeneity that generally may arise in case all variables are entered in the flow form.

and tubewells used in agricultural production. Additional availability of infrastructure services from roads and regulated markets in a district further improve resource use efficiency and hence facilitate higher agricultural production. Similarly, higher rainfall is also hypothesized to contribute to more agricultural production, specially in non-irrigated arid and semi-arid districts. Besides rainfall, region specific endowments like physiographic characteristics, soils, and geological formation and climate conditions also influence the productive capacity of resources in a region. The role of such factors therefore needs to be accounted for in an empirical production function analysis aimed to examine the role of various inputs and resources in inter-district variations in agricultural development. Consequently, we included 14 dummy variables in our econometric model to control for agro-climatic variations across districts in India. These zone dummies are based on fifteen broad agro-climatic zones into which the Planning Commission delineated the country during the mid-term appraisal of the Seventh Five Year Plan (GOI, 1989).

Like the agro climatic conditions, a number of state specific factors and constraints also play an important role in inter-district differentials in agricultural production and productivity in Indian agriculture.

This is mainly because agriculture being state subject in India, states differ considerably in priority given to agricultural development, allocation of resources to the sector, investment in agriculture research, financing of agricultural education and extension services, size and structure of land resources, and development and funding of social and economic services, agricultural input and output markets, governance and functioning of grass root level Panchayati Raj Institutions (PRIs). There also exist considerable differences in the matter of provision of subsidies and support, and institution governing property rights, These policies, programmes and institutions play a crucial role in development and growth of agriculture by facilitating the use and dissemination of technology, improving knowledge, attitude and practices of the farmers, and enhancing their access to basic infrastructural services that differs considerably across states in India (Bhalla, 2006). However inclusion of all these important correlates is neither possible as comparable authenticated information on many of these accounts is ready available nor it is desirable as many of them are not directly involved in crop production in the same way other included inputs like fertilizer do. However to control the impact of these state specific factors and forces, we included state specific dummy variables in our econometric model.

It may be pointed out that there exists a high degree of correlation among the selected explanatory variables (appendix 3.1). This leads to serious problem of multicollinearity that distorts the results to an unknown degree (Bhalla and Singh, 2001).[2]

Among various alternatives to the least squares, the ridge regression developed by Hoerl and Kennard(1970) is one of the most suitable methods for overcoming the problem posed by multicollinearity (Bhalla and Singh 2001).

The procedure suits well to estimate parameters of the Cobb-Douglas production function (Hoerl and Kennard 1970 and Brown and Beattie 1975, Lin and Kmenta 1982 and Hoerl et.al.1986)[3]. Therefore, like our earlier study, in order to deal with the problem of multicollinearity, an attempt has been made to estimate the parameters by the ridge regression procedure. Second, the method also helps us to estimate the significance of climatic and state specific policy differences as determinants of inter-district differentials in agricultural development. Our results confirm that 10 to 19 of the 29 included agro-climatic, zonal and state specific dummies turned out to be statistically significant.

Results:

Results of the ridge regression are reported in Table 3.5 suggest that the influence of various included factors as determinants of inter-district differentials in agricultural development is statistically significant and on expected lines. The magnitude of the coefficient of two traditional inputs namely land and labour, show interesting patterns overtime.

The contribution of land that first declined marginally from 1970-73 to 1980-83, registered marginally consistent improvement from 1980-83 to 2003-06.

The main reason seems to be that return to additions/variations in the increasingly scarce factor (GCA) would become greater as the abundant factor

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2. That there is serious problem of multicollinearity in district data is brought out by the fact that negative and significant value of some input elasticities and very high value of conditional index (125.7-178.4) exceeds the minimum value of 30 indicating serious magnitude of the problem of estimation of model with usual OLS method in all the four triennia (Appendix 3.1).

3. Other such methods developed recently include principal component regression, James and Stein-type Minimax estimator and Minimax estimator with the ridge property (for detail see Vinod and Ullah 1982, and Judge et. al. 1992).

(labour) became over abundant therefore returns to it declined. Or, in common sense terms, the more land per worker there is, the larger will be the marginal output from other inputs.

A second reason could be that public and private investment in land improvement and better management of land resources due to its increasing scarcity may have been reflected in the increasing magnitude of the land coefficient.

The public policies include investment in flood control measures, subsidies under various land conservation and improvement programmes, and policies relating to ownership and consolidation of land and tenancy reforms. The private efforts includes investment in soil conservation measures and land improvement practices like land leveling and tracing, renovation/construction of irrigation channels and drainage facilities. With hardly any scope left for extending new frontiers for cultural purposes, more intensive utilisation of existing land base is the only way out to expand area under crops. Rising output elasticity of land is a desirable outcome on many accounts. Firstly, with ever rising population pressure and limited land resources in the country and rising demand of land for non-agricultural purposes, higher productivity of land is very crucial to achieve food security of the country, both at the micro and macro levels. Secondly, with division of family farms the average land holdings are declining rapidly. Therefore, increasing land productivity is the only way to compensate for declining farm family income due to squeezing of their land holdings.

However in contrast to land, the contribution of labour declined overtime and ultimately it ceases to be a significant determinant of inter-district differentials in agricultural development during 2003-06.

The coefficient of fertiliser bears a positive sign and is significant statistically for all the periods. The magnitude of fertiliser coefficient improved overtime. It seems that farmers overtime have become judicious users of costly chemical fertiliser by learning from their past experience. This is mainly because, given the complementary role of fertilizers as artificially compensating for the deficiency of nitrogen(N), Phosphorous(P) and Potassium (K) components in soil, an appropriate choice of fertilizer (N:P:K ratio) is very crucial. Results imply that the further deepening and extension of modern technology in the form of modern seeds and higher and balanced use of inputs like fertilizers can play a significant role to advance agricultural production in the lagging regions in Indian agriculture.

Table 3.5

Inter-District Variations in Agriculture Production: Ridge Regressions, All India

Variables	Estimates of regression coefficients			
	1970-73	**1980-83**	**1990-93**	**2003-06**
Land	0.396* (.025)	0.353* (.035)	0.397* (.026)	0.413* (.023)
Labour	0.225* (.021)	0.140* (.029)	0.154* (.022)	0.020 (.019)
Fertilizer	0.110* (.011)	0.178* (.013)	0.144* (.013)	0.181* (.013)
Tractors	0.059* (.009)	0.022** (.011)	0.070* (.010)	0.038* (.009)
Tubewells	0.023* (.008)	0.003 (.011)	0.047* (.010)	0.017*** (.009)
Irrigation	0.018** (.010)	0.051* (.017)	0.022*** (.012)	0.026** (.013)
Roads	0.056** (.014)	0.062* (.021)	0.034* (.016)	0.031** (.015)
Markets	0.009 (.012)	0.034*** (.019)	0.063* (.016)	0.072* (.016)
Rainfall (Annual)	0.059** (.024)	0.161* (.030)	0.065* (.019)	0.080* (.027)
Zone Dummies Number significant	9	3	9	9
State Dummies- Number significant	9	7	9	10
Constant term	3.945 (.436)	4.281 (.537)	4.2008 (.413)	6.218 (.451)
R^2	0.88	0.81	0.88	0.82
Number of Observations	281	281	281	281

Note: 1. Figure in parenthesis is standard errors of the coefficients.

2. 14 dummies one each for agro climatic zones included but coefficients not reported for want of space.

3. 15 dummies one each for each state included but coefficients not reported for want of space.

3. Asterisk *, ** and *** indicate coefficients significant at 1 per cent, 5 per cent and 10 per cent level of significance respectively for two tailed t-test.

The coefficient of tractors as a contributor to production is as expected positive and significant statistically for all the years. It seems that timely and efficient performance of various farm operations mechanically leads to higher agricultural production. Like tractors, coefficient of tubewells also bears positive sign and significant statistically. This implies that even when rainfall and irrigation remain the same, irrigation through tubewells is more productive compared with other surface

and ground water sources of irrigation like canals, rivers, tanks and tubewells. Tubewells enable the farmers to have more control over time and quantum of water. This seems to be the main reason for the higher production efficiency of tubewell irrigation. Like the tubewells, coefficients of both irrigation and rainfall also turned out to be statistically significant suggesting that expansion of area under irrigation tends to bridge inter-district disparities in agricultural development.

Besides the farm level resources, results also underline the importance of accessibility to rural infrastructure in agricultural development as the coefficients of both rural roads and agricultural markets variables turned out to be statistically significant. Interestingly the magnitude of their coefficients behaves differently overtime. The magnitude of coefficient of road expansion declined whereas that of market increased. This may be due to the fact that expansion of rural connectivity through road network under various rural development and poverty alleviation programmes has helped in bridging the gap between developed and lagging districts in India. On the other hand, increasing role of agricultural markets seems to be due to the fact that their availability is leading to more competition in input and output markets and increased access to information on agricultural technology and other market opportunities. Moreover increased numbers of markets strengthen rural-urban linkages enabling better access to quality education and health services and consumer markets, which contributes to higher agricultural production through various indirect pathways.

The all-India level results bring out that modern technology embodied in modern inputs like fertilizers and new improved seeds along with expansion of area under irrigation play a crucial role in accelerating growth and in bridging the gap between developed and underdeveloped regions. Rising area elasticities and limited cultivable land base in the country also suggest the need to promote intensification of land use. Tractorisation further helps to obtain higher production by enabling the farmers to undertake timely and quick application of modern inputs. Results also suggests the need to enhance public investment in irrigation, flood control measures, land conservation and rejuvenation programmes, rural roads and agriculture markets in the agriculturally underdeveloped districts in India. These findings are quite in line with similar findings from tabular analysis.

The critical assumption underlying the all-India estimates is that the technical possibilities available to all the producers in the different districts can be described by

the same production function. This may not be a tenable assumption due to known regional diversities in cropping pattern, rainfall and agro-climatic factors, acees to and quality of rural infrastructure and priorities to agricultural development attached by different state governments. An attempt is therefore made to estimate the production function for four regions separately and the results are detailed in Tables 3.6 to 3.9 below.

North Western Region

The results of ridge regression for the north- western region presented in Table 3.6 are on expected lines and are in line with All-India results.

However three main points need to be noted. These are: (i) Compared with the all-India estimates, a higher value R^2 (0.9) for this region indicates a better fit for the production function that includes traditional and modern inputs and infrastructural variables. This implies a higher level of resource use efficiency of modern inputs in this region and further that and further that inter-district differences in this region are mainly because of differences in the intensity of use of modern inputs. Higher input use efficiency in this region is primarily factors such as higher technical efficiency of farmers, more suitable agro-climatic conditions, higher irrigation intensity, low market risk due to effective implementation of the minimum support price for paddy, wheat, cotton and sugarcane crops.

(ii) Contrary to the marginal improvement in the all-India case, the magnitude of area elasticity declined substantially in this region form 0.658 during 1970-73 to 0.391 during 2003-06.

Overexploitation of land resources and excessive use of fertilisers and other agro-chemicals in this region has resulted in serious deterioration in the quality of land with soils becoming deficient in many crucial nutrients and adversely affecting its productivity. Rapidly receding ground water in many areas in this region is leading to harmful salts getting accumulated on its surface (High Powered Committee on Agriculture (ICAR, 1998) and the National Farmers Commission (2005). (iii) Compared with all-India results, higher magnitude of tractors and tubewells elasticities in this region suggests comparatively more importance of mechanisation in agricultural production in the region (Table 2.5). For example during 2003-06, compared with the all-India level of 167 tractors and 111 tubewells per 1000 hectares of Net Sown Area, the north-west region had 451 tractors and 175 tubewells.

Similarly cropping intensity in the region was 161 percent compared with 135 percent for the country as a whole during the same period.

Table 3.6

Inter-District Variations in Agriculture Production: Ridge Regressions

(North West Region)

Variables	Estimates of Regression Coefficients			
	1970-73	**1980-83**	**1990-93**	**2003-06**
Land	0.658*	0.436*	0.488*	0.391*
	(.058)	(.043)	(.035)	(.040)
Labour	0.040*	0.102*	0.163*	0.035
	(.044)	(.035)	(.024)	(.031)
Fertilizer	0.091*	0.192*	0.242*	0.240*
	(.032)	(.026)	(.024)	(.029)
Tractors	0.042**	0.147*	0.116*	0.112*
	(.018)	(.021)	(.019)	(.027)
Tubewells	0.035***	0.002	0.025**	0.121*
	(.020)	(.015)	(.014)	(.026)
Irrigation	0.187*	0.118*	0.059	0.028
	(.046)	(.044)	(.043)	(.050)
Roads	0.073**	0.042***	0.041	0.048
	(.036)	(.027)	(.028)	(.045)
Markets	0.089*	0.086*	0.031	0.068*
	(.033)	(.030)	(.025)	(.028)
Rainfall (Annual)	0.012	-0.019	-0.124	-0.023
	(.050)	(.048)	(.031)	(.049)
Dummy-Haryana	-0.079	-0.221	-024	0.084
	(.076)	(.062)	(.052)	(.068)
Dummy-J&K	0.132	0.247**	0.313*	0.041
	(.149)	(.011)	(.094)	(.124)
Dummy-Punjab	0.036	0.031	0.141*	0.106*
	(.058)	(.041)	(.037)	(.046)
Constant term	2.900	3.911	2.865	5.357
	(.690)	(.761)	(.573)	(.783)
R^2	0.91	0.92	0.95	0.90
Number of Observations	68	68	68	68

Note: 1. Figure in parenthesis is standard errors of the coefficients.

2. Asterisk *, ** and *** indicate coefficients significant at 1 per cent, 5 per cent and 10 percent level of significance respectively for two tailed t-test.

Eastern Region

The ridge regression estimates for this region provided in Table 3.7 reveals that coefficients of all included variables are statistically significant for most of the periods. However, as compared with the earlier triennia, for the triennium 2003-06, the overall fit of the model to data declined substantially as the magnitude of the coefficient of determination (R^2) reduced to 0.7 from 0.9 during earlier periods. The magnitude of land, fertiliser and irrigation declined considerably and unlike the previous trienniums, 1970-73, 1980-83 and 1990-3, the estimated coefficients of labour, tractors, tubewells, roads and markets turned out to be insignificant statistically.

Many districts in the eastern region are periodically marked by adverse weather and climatic conditions like floods and droughts and this might have reduced the explanatory power of the relationship.

Results for the whole period taken together seem to suggest a considerable role of modern technology in enhancing the production in the hitherto lagging districts in this region as the experience of West Bengal shows where unprecedented high growth was achieved during the eighties by more intensive use of chemical fertilisers and phenomenal expansion of tubewells and area under assured irrigation (Table 2.3 & 2.6). However, realisation of gains from the new technology requires huge investment in flood control and increased investment in surface and underground irrigation.

Table 3.7

Inter-District Variations in Agriculture Production: Ridge Regressions

(Eastern Region)

Variables	Estimates of Regression Coefficients			
	1970-73	**1980-83**	**1990-93**	**2003-06**
Land	0.423* (.046)	0.468* (.050)	0.547* (.042)	0.401* (.058)
Labour	0.135* (.038)	0.137* (.043)	0.313* (.032)	0.005 (.036)
Fertilizer	0.125* (.021)	0.042** (.021)	0.119* (.017)	0.077* (.029)
Tractors	0.023*** (.012)	0.037** (.016)	0.031* (.011)	0.016 (.019)
Tubewells	0.009 (.013)	-0.004 (.011)	0.018*** (.010)	0.006 (.011)
Irrigation	0.021 (.014)	0.050*** (.031)	0.018 (.012)	0.030*** (.017)
Roads	0.026 (.038)	0.053 (.038)	0.111* (.027)	0.055 (.050)
Markets	0.056** (.027)	0.077** (.031)	0.044*** (.024)	0.051 (.049)
Rainfall (Annual)	-0.026 (.064)	0.172** (.081)	0.037 (.047)	0.201*** (.108)
Dummy-Assam	0.197* (.068)	0.267* (.066)	0.254* (.057)	0.007 (.066)
Dummy-Bihar	-0.141** (.049)	-0.256* (.054)	-0.176* (.041)	-0.393* (.062)
Dummy-Orissa	-0.064 (.054)	-0.072 (.056)	-0.174* (.041)	-0.116 (.070)
Constant term	6.3274 (1.015)	3.980 (1.122)	2.460 (.729)	7.136 (1.327)
R^2	0.87	0.85	0.96	0.71
No. of Observations	47	47	47	47

Note: 1. Figure in parenthesis is standard errors of the coefficients.

2. Asterisk *, ** and *** indicate coefficients significant at 1 per cent, 5 per cent and 10 percent level of significance respectively for two tailed t-test.

Central Region

As observed earlier most of the agriculturally backward districts in India are from this region. The ridge regression results bring out that the nature of the impact of various inputs and services on agricultural output, on the whole, is in line with all-India estimates (Table 3.8). The labour coefficient which was comparatively unusually high in this region up to 1990-93, turned out to be statistically insignificant during 2003-06, but the contribution of land seems to be increasing in the region. Contrary to the north western region, the coefficient of land in the central region increased from 0.269 during 1970-73 to 0.411 during 2003-06. This is encouraging as the region is known for very low level of land productivity and comparatively low use of modern inputs.

This seems to suggest the greater scope of agricultural development in this region through investment in infrastructure and expansion of new technology. Recent experience of Gujarat in achieving rapid growth through the adoption of Bt cotton technology on a large scale corroborates the scope of growth through technological development in this region.

Table 3.8

Inter-District Variations in Agriculture Production: Ridge Regressions

(Central Region)

Variables	Estimates of Regression Coefficients			
	1970-73	**1980-83**	**1990-93**	**2003-06**
Land	0.269* (.061)	0.229* (.040)	0.373* (.039)	0.411* (.042)
Labour	0.425* (.057)	0.271* (.035)	0.439* (.046)	0.016 (.045)
Fertilizer	0.111* (.022)	0.153* (.012)	0.094* (.018)	0.206* (.022)
Tractors	0.057* (.021)	0.026*** (.015)	0.079* (.019)	0.029 (.021)
Tubewells	0.046** (.022)	0.076* (.015)	0.069* (.015)	0.032 (.027)
Irrigation	0.052** (.023)	0.035*** (.019)	0.068* (.022)	0.065** (.030)
Roads	0.016 (.049)	0.049*** (.029)	0.177* (.029)	0.037 (.023)
Markets	0.032 (.021)	0.053** (.023)	0.115* (.026)	0.048** (.022)
Rainfall (Annual)	0.087*** (.047)	0.089** (.034)	0.095* (.023)	0.071*** (.043)
Dummy-Gujarat	0.273* (.080)	0.364* (.058)	0.177* (.055)	0.237* (.057)
Dummy-Madhya Pradesh	0.165** (.067)	0.169* (.047)	0.079*** (.044)	-0.140* (.043)
Dummy-Maharashtra	-0.264* (.076)	0.070 (.050)	-0.052 (.049)	-0.008 (.049)
Constant term	2.667 (0.858)	4.169 (.679)	1.680 (.657)	6.516 (.838)
R^2	0.84	0.86	0.87	0.78
No. of Observations	112	112	112	112

Note: 1. Figure in parenthesis is standard errors of the coefficients.

2. Asterisk *, ** and *** indicate coefficients significant at 1 per cent, 5 per cent and 10 per cent level of significance respectively for two tailed t-test.

Southern Region

Like the north-western region, the southern region is also a highly productive region. The observed nature and magnitude of results from ridge regression for this region (Table 3.9), on the whole, are in conformity with the all-India results. But like the eastern region, the results for the triennium 2003-06 are slightly different from those for the earlier triennia.

For example, the overall explanatory power (R^2) of the model declined and the same happened to the magnitude of most of the estimated coefficients. The coefficients of tractors, tubewells and irrigation turned from significant during earlier trienniums to non-significant during 2003-06. Interestingly comparatively high magnitude to road and market variable suggest a bigger role of rural infrastructural services in explaining inter-district differentials in agricultural development in this region. However like other regions, the coefficients of labour turned out to be statistically insignificant for this region also.

Table 3.9

Inter-District Variations in Agriculture Production: Ridge Regressions

(Southern Region)

Variables	Estimates of Regression Coefficients			
	1970-73	**1980-83**	**1990-93**	**2003-06**
Land	0.239* (.045)	0.346** (.172)	0.351* (.036)	0.330* (.044)
Labour	0.230* (.042)	0.183 (.208)	0.373* (.051)	0.025 (.026)
Fertilizer	0.176* (.037)	0.215** (.098)	0.222* (.031)	0.162* (.037)
Tractors	0.084* (.032)	0.080 (.056)	0.056** (.023)	0.025 (.018)
Tubewells	0.032 (.024)	0.013 (.047)	0.026 (.021)	0.002 (.031)
Irrigation	0.018 (.031)	0.007 (.087)	0.067** (.031)	-0.013 (.043)
Roads	0.087*** (.054)	0.184* (.155)	0.161* (.034)	0.104* (.038)
Markets	0.024 (.033)	0.014 (.009)	0.040*** (.021)	0.098** (.044)
Rainfall (Annual)	0.173* (.050)	0.249* (.076)	0.168* (.039)	0.274* (.065)
Dummy-Andhra Pradesh	-0.271* (.065)	-0.202 (.138)	-0.073* (.046)	0.047 (.064)
Dummy-Karnataka	-0.116*** (.062)	-0.287*** (.165)	-0.242* (.045)	-0.071 (.053)
Dummy-Kerala	0.369* (.092)	0.270 (.255)	0.231* (.066)	0.250* (.079)
Constant term	4.874 (.092)	3.030 (1.621)	1.382 (.759)	5.793 (.972)
R^2	0.81	0.83	0.92	0.76
Number of Observations	54	54	54	54

Note: 1. Figure in parenthesis is standard errors of the coefficients.

2. Asterisk *, ** and *** indicate coefficients significant at 1 per cent, 5 per cent and 10 percent level of significance respectively for two tailed t-test.

To sum up, findings of the econometric analysis discussed above brings out that the inter-district disparities in Indian agricultural are largely due to the differences in intensity of the use of modern inputs such as fertiliser, tractors, energised pumpsets, and also by differences in the levels of investment in infrastructure like rural roads and markets. This underlines the need of polices and programmes that facilitate the increased used of modern inputs by the Indian farmers and their better accessibility to rural infrastructure like rural roads, regulated markets, irrigation etc. The findings also suggest the need for taming of inter-state and some times international rivers that periodically cause devastation in many areas of the eastern India. The development of flood control and rural infrastructure require huge public investment and therefore the central government has to play a pro-active role. The same is true about investment in research and more so in extension. Farmers need to be acquainted with the new technology through a network of public sector agricultural extension services to induce farmers to adopt new technology. Increased supply of institutional finance can enable the small and marginal farmers who constitute an overwhelming majority of farmers to buy and use more modern inputs.

Importance of institutional credit in extension of modern inputs, irrigation and increasing production has been clearly brought out by very high elasticity coefficients of use of fertilisers, tractors and tubewells with respect to supply of institutional credit at the district level reported in Table 3.10.

At the all India level, credit elasticities for use of fertilisers, tractors and tubewells hovered around 0.85 per cent suggesting that 10 per cent increase in supply of direct institutional credit to the farmers to leads to 8-9 per cent increase in use of fertiliser, tractors and tubewells in long run. Like the level of development and input used, similar variations are evident in variations of credit elasticities across the regions. The credit elasticities are exceptionally very high for tractors, tubewells and irrigation for the technologically backward eastern region. As noted earlier in chapter 2, with exception of West Bengal, the other states in this region have very low level of productivity and use very low quantum of modern inputs.

Exceptionally high values of credit elasticities, low use of modern inputs and low level of development indicates a bigger role of credit in modernisation of agriculture in this region. This indicates the potentials of technological modernisation of this region by strengthening the role credit supplying institutions. Furthermore , high credit elasticities for use of fertilisers, tubewells, tractors and irrigation seems to

suggest the indispensability of institutional credit for purchase of variable modern inputs like fertilisers, pesticides, and oils and lubricants and also for investment in tubewells and other irrigation structures, tractors and other implements, farm buildings, livestock, and on many land improvement operations. The results above also underline the imperative need for investment in land in many green revolution areas in view of declining production elasticity of land in the north western region-known for its early and rapid adoption of the new technology.

Table 3.10
Institutional Credit Elasticities in Indian Agriculture: 2003-06

[Log_n (input used/value output) = α constant + β Log_n (institutional credit)]

Region	Credit Elasticities (β)			
	Fertilizers	**Tractors**	**Tubewells**	**Irrigation**
All India	0.82*	0.79*	0.88*	0.73*
North- Western Region	0.85*	0.90*	0.65*	0.30*
Eastern Region	0.69*	1.43*	1.86*	1.62*
Central Region	1.06*	0.64*	0.50*	0.78*
Southern Region	0.99*	1.26*	0.65*	1.14*

Source: Appendix 1

Note : 1. Asterisk * indicates coefficient is significant at 1 per cent level for two tailed t-test.
2. Institutional credit at the district level constitute the average amount outstanding direct credit supplied by the co-operatives and Scheduled Commercial Banks.
3. Fertiliser is defined as average quantity of NPK consumed in the district.
4. Tractors and Tubewells are in term of the existing numbers in the district.
5. Irrigation is the hectares of gross cropped area under irrigation in the district.

Besides investment in land improvement programme, rapidly receding groundwater also needs immediate attentions of policy makers. The results above bring out that adoption of new technology and its extension to various areas has been the main engine of growth. In this context, there is a need for large investment in agricultural research and extension to reverse the trend of recently observed technology fatigue, decline in input use efficiency and ecological degradation not only to maintain the momentum of development but also for ecological sustainability of agriculture in all the regions of India.

Summary and Conclusions

The district level analysis undertaken in this Chapter on the nature and pattern of inter-district variations in yield levels during 1962-65 to 1990-93 confirm many of the results at the state level.

To begin with during 1962-65, the yield levels in most of the districts in India were abysmally low. As many as 248 districts out of 281 with 90.9 % share in total GCA in the country had low levels of yields. Another 26 districts recorded medium productivity levels ranging between Rs. 6250/hect to Rs. 10,200/hect and only 7 districts mainly belonging to the southern region that had high productivity exceeding Rs. 12,500/hect.

During 1962-65, the low productivity districts were spread over all the regions of India. These low productivity districts were located not only from the states in the arid central (111) and rainfed eastern region (42), but also included 65 districts from the north-western states which were later on to transform rapidly on adoption of new technology.

An analysis of data on regional variations at the district level during 1962-65, 1970-73, 1980-83, 1990-93 and 2003-06 brings out the impact that the introduction of new technology has made in raising yield levels in various districts after the mid sixties.

During 1962-65 to 1970-73, the extension of new technology was rather slow and as many as 227 districts still had low productivity. But the pace of new technology gathered some momentum during the seventies and by 1980-83 the number of low productivity districts had come down to 198. However, even by 1980-83 70 per cent districts accounting for 74 per cent of total area had low productivity levels. Although quite a few districts in the north-western region were able to graduate to higher productivity levels, but a majority of the districts in the rainfed eastern and arid central regions remained untouched by the new technology.

The eighties mark a turning point in the history of Indian agriculture. It was during 1980-83 to 1990-93 that new technology further extended both to more crops and new areas. A significant development was the extension of new technology to the eastern region with the result that many districts in the hitherto low yield eastern region in general and in West Bengal, in particular registered sharp rise in productivity.

The period also witnessed breakthrough in oil seeds technology under aegis of the Technology Mission on Oilseeds leading to notable rise in productivity levels of oilseeds. This combined with appropriate price climate resulted in raising the yield and income levels of a large number of oilseeds producing districts in the central and southern regions and large scale diversion of area from low yield coarse cereals and pulses crops to high values and yield oil seeds. This resulted in geographically more wide-spread extension of new technology.

There was a big improvement in the weight of high productivity districts and their number increased from 25 in 1980-83 to 59 during 1990-93. The number of districts in the medium productivity category further increased from 58 during 1980-83 to 84 during 1990-93. On the other hand, the number of low productivity districts declined from 138 during 1980-8 to 94 by 1990-93.

By 2003-06, many more districts had graduated to higher productivity levels. The number of high productivity districts increased from 59 during 1990-93 to 94 by 2003-06 and that of medium productivity districts from 84 to 93 by 2003-06. There also took place a big improvement in the weight of high and medium productivity districts. On the other hand, the number of low productivity districts declined from 138 during 1990-93 to 94 by 2003-06 and their weightage in terms of share in area and output recorded a significant decline.

The spatial distribution during 2003-06 brings out that out of the 94 high productivity districts, 36 were situated in the north western and 31 in the southern region, 15 in the eastern and 12 in the central region. Specially creditable has been the performance of West Bengal in the eastern and Gujarat in the central region.

The mid productivity districts are mainly concentrated in the central (33) and the north western region (27) with only 17 in the eastern and 16 in the southern region.

By 2003-06, out of the 94 low productive, as many as 67 belonged to the central region, 15 to the eastern region and 7 to the southern and only 5 to the north-western region. Districts in Gujarat did extremely well during this period. As compared with 12 districts during 1990-93, only 2 of its 18 districts were left in the low development category.

The spectacular progress notwithstanding, Indian agriculture is still marked by persistent inter-regional disparities. On the one side we have states like Kerala and Punjab having all their districts in high productivity range exceeding yield level of

Rs.10,200/hectare. Besides Punjab and Kerala, Haryana, Assam, West Bengal and Tamil Nadu are other states that have none of their districts belonging to low productivity category during 2003-06. On the other hand, are the states of Madhya Pradesh, Maharashtra and Rajasthan in the central and Bihar in the eastern region which still have about three-fourth of their districts caught in low equilibrium trap. Different measures of inequality have brought out that although over time there took place A reduction of initial inequality experienced during the earlier phase of the introduction of the new technology, yet the degree of inter-district inequality continues to be high in Indian agriculture. Such inequities are ultimately reflected in earnings of agricultural households in different region. For more inclusive growth envisaged in the Eleventh Five Year Plan, the districts still trapped at the lowest end warrant more focused policy initiatives for wider distribution of technological gains and well-being of the population depending on agriculture for their livelihood.

The success of new technology in raising yields is intimately related with the use of modern inputs. Both the tabular and the econometric analysis reveal that the inter-district disparities in Indian agricultural are largely due to the differences in intensity of the use of modern inputs such as fertiliser, tractors, and pumpsets, and differences in the availability of infrastructure like irrigation, roads and markets. The inter-district differentials are also determined by the regional differences in agro-climatic endowments and rainfall across districts in the country.

Therefore, reduction of regional disparities and rejuvenation of agriculture in the hitherto backward districts requires both state and farm level initiatives. While the state has to invest more in rural infrastructure like roads, regulated markets, research and development, flood control and soil conservation programmes, the farmers should be encouraged to adopt modern technology embodied in inputs like HYV seeds, fertiliser and modern machines and perform various farm practices in a scientific manner. The regression results bring out that there is a very high output elasticity (ranging between 0.8-0.9) for use of costly inputs like fertilisers, tractors and tube wells. Since availability of credit is essential for purchase of these inputs, the supply of institutional credit plays a crucial role in diffusion of modern technology in Indian agriculture. One of the major initiatives would be supply of timely institutional credit to farmers. This also underlines the need for strengthening rural credit institutions for not only spreading technological modernisation to backward regions,

but also enabling small and marginal farmers to purchase costly new inputs and machinery.

CHAPTER - IV

SPATIAL PATTERN OF GROWTH OF AGRICULTURAL OUTPUT: DISTRICT LEVEL ANALYSIS

District-wise Growth of Output

Chapter III was devoted to a discussion of the spatial variations at the district level, in the levels of agricultural output and changes therein over the periods 1962-65 to2003-06. This Chapter examines the nature and pattern of output and productivity growth at the district level during the period 1962-65 to 2003-06 as a whole and the sub-periods 1962-65 to 1980-83, 1980-83 to 1990-93 and 1990-93 to 2003-06[1]. The special focus of the Chapter is to undertake a comparison between the growth performances of agriculture at the district level during the post reform period 1990-93 to 2003-06 with that of the immediate pre-reform period 1980-83 to 1990-93. An attempt is also made to analyse the association, if any, between growth rates of output and intensity of use of modern farm inputs. Finally, the tables containing cross-classification of districts according to their growth of output and levels of productivity enables one to analyse more closely the performance of districts in various states and regions of India.

The 281 districts were divided into the following three categories on the basis of rates of growth recorded in their value of output:

A. *High growth districts* –those with annual growth rates exceeding 3.5 per cent.
B. *Medium growth districts* –those with annual growth rates between 2.5 to 3.5per cent.
C. *Low growth districts* – those with annual growth rates less than 1.5 per cent.

Spatial Disparities in Growth Rates

Immediately after its inception during the late sixties, the new seed-fertilizer technology was highly biased in favour of assured irrigated areas. Although over the years, this bias has slightly diminished, nevertheless irrigated areas were able to record

1 Since, the triennium 1970-73 was the period of prolonged drought in much of the country, growth rates have not separately been worked out for 1962-65 to 1970-73 and 1970-73 to 1980-83. However, interested readers can work the growth rates for these periods from the data given in Annexure 1 (a) to 1 (e).

much higher growth rates after the adoption of new technology. Consequently, the post green revolution period in India is characterised not only by rapid transformation of agriculture but also by wide variations in its growth performance among various regions.

The Overall Period- 1962-65 to 2003-06

During the period 1962-65 to 2003-06, the overall growth rate of aggregate output of 2.4 per cent per annum was associated with a productivity growth rate of 2.0 per cent and area growth of only 0.4 per cent per annum. Thus, at the all India level, yield growth accounted for nearly 80 per cent of the output growth. The picture is similar across all growth categories (Table 4.1).

Whereas 49 districts accounting for 16.1 per cent of area under 35 crops in India during 1962-65 recorded growth rates exceeding 3.5 per cent per annum, 169 districts recorded a medium growth rate of 1.5 per cent to 3.5 per cent.

The 49 high growth districts accounted for only 15.8 percent of area and 12.8 percent of output during the base year 1962-65.The 169 medium growth districts accounted for 58.4 per cent of area and 58.3 per cent of output (of 35 crops) during 1962-65. Finally, as many as 63 districts recorded a low growth rate of less than 1.5 per cent per annum. The 63 low growth districts accounted for 25.8 per cent of area and 28.9 per cent of output during 1962-65 (Tables 4.1 (a) to Table 4.1 (d)).

Table 4.1 (a)
Share of districts in Area, output and inputs used by yield levels during 1962-65 to 2003 -06.

Growth rate of output (percent per annum)	Number Of Districts				1962-65 to 1980-83			1980-83 to 1990-93			1990-93 to 2003-06			1962-65 to 2003-06		
	80/62	90/80	2003/90	2003/62	Output	Area	Yield	Output	Area	Yield	Output	Area	Yield	Output	Area	Yield
High ≥ 3.5 percent	50	138	61	49	4.7	1.3	3.3	5.1	1.0	4.0	5.4	1.4	4.0	4.0	1.0	3.0
Medium 1.5–3.5 percent	137	97	98	169	2.3	0.5	1.8	2.6	0.4	2.2	2.3	0.4	1.8	2.5	0.5	2.0
Low < 1.5percent	94	46	122	63	0.5	-0.1	0.6	0.1	-0.2	0.4	0.1	-0.6	0.7	0.9	-0.2	1.1
Total	281	281	281	281	2.2	0.5	1.8	3.5	0.6	2.9	1.8	0.2	1.6	2.4	0.4	2.0

Table 4.1 (b)
Distribution of districts by growth rate of output during 1962-65 to 2003-06 and category wise share (percent) of district in area, inputs and output

Growth rate of output (percent per annum)	No of Districts	Output		Area		Fertiliser		Tractor		Tubewells		Area irrigated NIA		A W	
		1962-5	2003-6	1962-5	2003-6	1962-5	2003-6	1962-5	2003-6	1962-5	2003-6	1962-5	2003-6	1962-5	2003-6
High ≥ 3.5 percent	49	12.8	24.2	15.8	20.2	11.2	22.5	33.5	31.2	13.4	21.6	19.1	21.4	9.8	12.0
Medium 1.5–3.5 percent	169	58.3	60.3	58.4	59.8	58.7	59.5	50.3	58.8	48.6	59.5	53.4	59.2	57.2	57.8
Low < 1.5percent	63	28.9	15.6	25.8	20.0	30.1	18.0	16.2	9.9	38.0	18.9	27.5	19.4	33.0	30.2
Total	281	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: Compiled from district level data produced in Annexure 1(a) - 1(e).

Table 4.1 (c)
Distribution of districts by growth rate of output during 1962-65 to 2003-06 and category wise growth rates of inputs

Growth rate of output (percent per annum)	No of Districts	Output	Area	Yield	Fertiliser	Tractor	Tubewells	Irrigation GIA	AW
High ≥ 3.5 percent	49	4.0	1.0	3.0	11.0	9.6	8.5	2.7	3.7
Medium 1.5–3.5 percent	169	2.5	0.5	2.0	9.1	10.2	7.8	2.7	1.6
Low < 1.5percent	63	0.9	-0.2	1.1	7.7	8.5	5.4	1.1	-0.5
Total	281	2.4	0.4	2.0	9.1	9.8	7.2	2.3	1.4

Source: Compiled from district level data produced in Annexure 1(a) - 1(e).

Table 4.1 (d)
Distribution of districts by growth of output during 1962-65 to 2003-06 and categories-wise inputs used: 1962-65 and 2003-06

Growth rate of output(percentpa)	Number districts	Yield (Rs./ Hect)		Fertilizer(Kgs/Hc)		Tractors (No/000Hc)		Tubewell (No/000Hc)		% Area Irrigated gia		Agric Workers	
		1962-65	2003-06	1962-65	2003-06	1962-65	2003-06	1962-65	2003-06	1962-65	2003-06	1962-65	2003-06
High >= 3.5 percent	49	3073	10203	1.9	146.3	0.6	27.0	3.9	119.2	18.3	60.2	420	2063
Medium 1.5 - 3.5 percent	169	3803	8582	3.2	96.3	0.3	12.7	4.6	82.2	16.1	39.3	803	1257
Low < 1.5percent	63	4254	6643	5.1	72.0	0.3	5.3	11.0	64.5	27.7	29.3	1412	786
All	281	3804	8522	3.3	97.9	0.3	13.0	5.8	83.5	18.9	40.0	848	1264

Source: Compiled from district level data produced in Annexure 1(a) - 1(e).

Spatial Patterns

The details about the spatial distribution of districts according to their output growth rates during 1962-65 to 2003-06; 1962-65 to 1980-83, 1980-83 to 1990-93 and 1990-93 to 2003-06 are given in Tables 4.5 (a) to Table 4.5 (d) and Figures 4.1 to 4.3.

During 1962-65 to 2003-06, out of the 49 districts that recorded high growth (exceeding 3.5 per cent per annum.), 29 belonged to the central region (that included 10 districts in MP and 14 in Rajasthan), 15 belonged to the north-western region (that included 9 districts in Punjab and 4 of Haryana and 2 districts of Uttar Pradesh), and 2 to the eastern region and 3 to the southern region.

The spread of new technology was most pronounced in the assured irrigation north-western region. The inclusion of a large number of districts in the central region in the set of high growth districts was because even small incremental increases in output enabled many of them to record high growth because of their low base of productivity levels in the initial period. Secondly, many districts in the central region are rainfed and characterised by great instability in their growth performance. Only a few districts in the southern region could record very high growth rates because of their high initial productivity base. And except for West Bengal, very little headway was made by the new technology in the eastern region.

Out of 169 medium growth districts that recorded an annual growth rate between 1.5 to 3.5 per cent per annum, 62 districts belonged to the central region (mainly Madhya Pradesh, and Maharashtra), 52 districts belonged to the north western region (UP 46), 32 to the southern region (mainly AP and Karnataka), and 23 to the eastern region (mainly Assam and West Bengal).

Finally, out of 63 districts that recorded low growth rates less than 1.5 per cent per annum during 1962-65 to 2003-06, 22 were located in the eastern region (Bihar 14 and Orissa 8), 21 were located the central region and 19 in the southern region. Interestingly, the north-western region had only one low growth district.

1962-65 to 1980-83 - A Period of Moderate Growth

For a comparative analysis it is useful to sub-divide the entire period 1962-65 to 2003-06, into three sub- periods namely the period 1962-65 to 1980-83, 1980-83 to 1990-93 and the period 1990-93 to 2003-06. While there was a moderate rate of growth of 2.2 per cent per annum in agricultural output during the 1962-65 to 1980-83[2], there took place a significant acceleration in the growth rate of output during the period 1980-83 to 1990-93 when output grew at an unprecedented rate of 3.5 per cent per annum.

During 1962-65 to 1980-83, the overall rate of output growth of 2.2 per cent per annum was associated with a yield growth rate of 1.8 per cent per annum and an area growth rate of only 0.5 per cent per annum. Thus, the predominant source of growth during this period was yield growth, the contribution of area growth being only 20 per cent.

During 1962-65 to 1980-83, there were 50 districts accounting for only 14.8 per cent of the area and 16.0 percent of output that recorded a growth rate exceeding 3.5 per cent per annum. Among the remaining 231 districts, 137 recorded a medium rate of 1.5 to 3.5 per cent p.a.; whereas as many as 94 districts had a growth rate below 1.5 per cent per annum. While mid growth districts accounted for nearly 50 per cent of total area as well as output during 1962-65, the 94 low growth districts accounted for 37.0 per cent of the area and 37.5 percent of output during the base year (Tables 4.2 (a) and Table 4.2 (b).

Differential growth of output and yields (and area) over the period 1962-65 to 1980-83 brought about distinct changes in the relative shares of various categories of districts in the terminal period as compared with the initial period.

Because of rapid growth of output and yield during 1962-65 to 1980-83, the share of high growth districts in area and output had increased by the terminal year 1980-83. During 1980-83, the high growth districts accounted for 17.4 per cent of area and to 24.8 per cent output. . Thus with a small increase in area, these districts were able to record a considerable increase in their share in total output (Table 4.2 (c)).

[2]For the detailed analysis of levels and rates of growth during 1962-65 to 1970-73 and 1970-73 to 1980-83 see Bhalla and Tyagi (1989), op cit. The calculations in that book are done by valuing crop output at 1969-70 prices.

The 137 medium growth districts were able to record a modest growth rate of 1.8 per annum in their yield levels thereby increasing their yields from an average of Rs. 3702/Hec to Rs. 5121/Hec during this period. There was no significant change in the share of 137 medium growth districts either in total area or total value of output. Their shares of both area and output were in the neighbourhood of 48 per cent during both the initial and terminal periods.

However in the case of 94 low growth districts, both the shares in area and output declined substantially. While their share of area declined from 37.0 per cent during 1962/65 to 33.8 per cent during 1980-83, their share in output declined from. 37.5 per cent to 27.7 per cent (Table 4.2 (c).

During the base period 1962-65, the 50 high growth districts had a disproportionately large share in irrigated area. With only 14.8 per cent share of area under 35 crops, these claimed 25.4 per cent of the net irrigated area in the country. They had also relatively a very high share in tractors, but these were so few that one can ignore them. It can, thus, be postulated that the higher irrigation base provided them the initial impulse to adopt new technology and to record higher growth rates of output (Table 4.2 (c)).

In all the three-category classification of districts, a predominant contribution to growth of output was made by growth of yield in almost all the growth categories. Growth of area also contributed positively to growth of output in almost all the districts but its contribution ranged between only 22 per cent to 32 per cent (Table 4.1(a)).

Table 4.2 (a)
Distribution of districts by growth of output during 1962-65 to 1980-83 and growth in area, yield & inputs used

Growth rate of output (percent per annum)	No of districts	Yield (Rs./Hc)		Growth rate (percent pa) of							
		1962-5	1980-3	Output	Area	Yield	Fertilizer	Tractor	Tubewells	GIA	AW
High >= 3.5	50	4108	7472	4.7	1.3	3.3	17.4	14.2	14.4	4.2	2.7
Medium 1.5 - 3.5	137	3667	5055	2.3	0.5	1.8	14.0	13.7	12.3	3.2	1.5
Low < 1.5	94	3862	4269	0.5	-0.1	0.6	12.3	10.8	10.3	1.5	1.4
All	281	3804	5201	2.2	0.5	1.8	14.4	13.3	11.9	3.0	1.6

Table 4.2 (b)
Distribution of districts by growth of output during 1962-65 to 1980-83 and category wise share of districts in output, area and inputs in percentage

Growth rate of output (percent pa)	Percent districts	Output		Area		Fertiliser		Tractor		Tubewells		Area Irrigated		Agr Workers	
		1960s	1980s	1960s	1980s	1960s	1980s	1960s	1980s	1960s	1980s	1960s	1980s	1960s	1980s
High >= 3.5	17.8	16.0	24.8	14.8	17.4	19.7	31.3	41.1	46.8	16.7	24.8	25.4	31.1	11.3	13.7
Medium 1.5 - 3.5	48.8	46.5	47.5	48.2	48.9	48.7	46.0	35.7	37.9	38.2	40.6	42.0	43.7	47.9	46.7
Low < 1.5	33.4	37.5	27.7	37.0	33.8	31.7	22.7	23.2	15.3	45.2	34.6	32.6	25.2	40.8	39.6
All	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table 4.2 (c)
Distribution of districts by growth of output during 1962-65 to 1980-83 and categories-wise inputs used: 1962-65 and 1980-83

Growth rate of output (percent pa)	districts	Yield (Rs./ Hect)		Fertilizer Kgs/Hc)		Tractors (No/000Hc)		Tubewell (No/000Hc)		percent Area irrigated		Agr Workers	
		1962-65	1980-83	1962-65	1980-83	1962-65	1980-83	1962-65	1980-83	1962-65	1980-83	1962-65	1980-83
High >= 3.5	50	4108	7224	5.0	69.8	1.1	9.1	7.3	64.8	31.6	51.8	631	804
Medium 1.5 - 3.5	137	3667	5055	3.8	36.5	0.3	2.6	5.1	37.8	16.5	26.5	845	999
Low < 1.5	94	3862	4269	2.5	18.0	0.2	1.1	6.1	32.1	16.8	21.6	948	1200
All	281	3804	5201	3.7	38.7	0.4	3.4	6.5	45.4	18.9	29.3	850	1033

Spatial Distribution 1962- 65 to 1980 - 83

The spatial distribution of districts during 1962-65 to 1980-83 brings out that 27 of the 50 high growth districts were located in the north-western region, 14 in the central region, 3 in the eastern and 6 in the southern region. All the 11 districts of Punjab belonged to this set. Other states that significantly contributed to this category of districts were: Uttar Pradesh, Rajasthan, Gujarat, Haryana, Madhya Pradesh and Andhra Pradesh (Table 4.5 (a)).

The medium growth districts were distributed all over the country with a major concentration in the central and north western regions. Out of the 137 districts that recorded medium growth rates, 55 belonged to the central region, 40 to the north-west region (38 in U.P. alone), 25 to the southern region and 17 to the eastern region. Within these regions, their main concentration was in Uttar Pradesh, Madhya Pradesh, Maharashtra and Karnataka (Table 4.5 (a)).

The low growth districts were mainly located in the rainfed areas. Out of the 94 low growth districts, as many as 43 belonged to the rainfed states in the central region, 27 to the eastern region, mainly Bihar, Orissa and West Bengal, 23 to the southern region and only 1 to the north-western region. Their main concentration was in Madhya Pradesh, Rajasthan, Bihar, Maharashtra and Tamil Nadu (Table 4.5 (a)).

Growth during 1980-83 to 1990-93

The period 1980-83 to 1990-93 was characterised by a significant acceleration in growth rates due to the intensification of the new technology and its spread to many more areas in both the eastern and the central regions. In addition to the yield growth of major crops as a result of adoption of new technology, the second important source of growth was crop diversification from low yield and low value coarse cereals to higher yield and high value oil seeds. Finally, the period 1980-83 to 1990-93 was also characterised by continuous good weather conditions. The result was a significant increase in the number and area of high productivity districts and a decline in the weight of both the medium and more specially in the low productivity districts.

Table 4.3 (a)
Distribution of districts by growth of output during 1980-83 to 1990-93 and growth in area, yield & inputs used

Growth rate of output (% pa)	No of districts	Yield (Rs./Hc)		Growth rate (percent pa) of							
		1980-83	1990-93	Output	Area	Yield	Fertilizer	Tractor	Tubewells	GIA	AW
High >= 3.5	138	4849	7210	5.1	1.0	4.0	8.2	15.0	43	2.7	1.6
Medium 1.5 - 3.5	97	5634	7013	2.6	0.4	2.2	7.4	12.9	3.0	0.9	1.8
Low < 1.5	46	5409	5611	0.1	-0.2	0.4	7.5	15.2	3.2	0.2	1.7
All	281	5201	6902	3.5	0.6	2.8	7.8	14.3	3.7	1.8	1.7

Table 4.3 (b)
Distribution of districts by growth of output during 1980-83 to 1990-93 and category wise share of districts in output, area and inputs in percentage

Growth rate of output (% pa)	Percent Districts	Output		Area		Fertiliser		Tractor		Tubewells		Area Irrigated		Agr Workers	
		1980-83	1990-93	1980-83	1990-93	1980-83	1990-93	1980-83	1990-93	1980-83	1990-93	1980-83	1990-93	1980-83	1990-93
High >= 3.5	49.1	46.9	54.7	50.3	52.4	49.1	50.9	54.3	57.6	47.7	50.6	53.0	56.7	49.1	48.8
Medium 1.5 - 3.5	34.5	35.7	32.8	33.0	32.3	36.0	34.6	35.7	31.6	34.9	32.7	34.8	32.6	33.3	33.6
Low < 1.5	16.4	17.3	12.5	16.7	15.4	14.9	14.6	10.0	10.8	17.4	16.6	12.1	10.7	17.6	17.6
All	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table 4.3 (c)
Distribution of districts by growth of output during 1980-83 to 1990-93 and categories-wise inputs used: 1980-83 and 1990-93

Growth rate of output 1980-83 to 1990-93 (% pa)	Number districts	Yield (Rs./ Hect)		Fertilizer(Kgs/ Hc)		Tractors (No/000Hc)		Tubewell(No/000 Hc)		% Area irrigated		Agr Workers	
		1980-83	1990-93	1980-83	1990-93	1980-83	1990-93	1980-83	1990-93	1980-83	1990-93	1980-83	1990-93
High >= 3.5 %	138	4849	7210	37.8	75.0	3.6	13.4	43.0	59.5	30.4	37.8	997	1092
Medium 1.5 - 3.5 %	97	5634	7016	42.3	82.9	3.7	11.9	48.1	62.5	31.4	34.7	1055	1199
Low < 1.5%	46	5409	5611	34.7	73.2	2.0	8.5	47.3	66.6	21.4	23.9	1104	1312
All	281	5201	6902	38.7	77.3	3.4	12.1	45.4	61.6	29.2	34.6	1033	1161

During 1980-83 to 1990-93, as many as 138 districts recorded rapid growth in output exceeding 3.5 per cent per annum as compared with only 50 districts that had recorded high growth during 1962-65 to 1980-83. These 138 districts accounted for nearly half of the total area and 46.9 per cent of output during the base period 1980-83. By 1990-93 their share in area and out put had increased to 52.4 per cent and 54.7 per cent, respectively (Tables 4.3 (a) to Table 4.3 (c)).

The number and weight of medium growth and low growth districts and their weight in area and output declined sharply during 1980-83 to 1990-93, as compared with the earlier period 1962-65 to 1980-83.

The number of medium growth districts declined to 97 during 19980-83 to 1990-93 and these now accounted for only about one third of the area and output during 1980-83. During 1962-65 to 1980-83, 137 districts had recorded medium growth between 1.5 per cent to 3.5 per cent pa and these accounted for about 48 per cent of area and output during 1962-65.

Finally, during 1980-83 to 1990-93, the number of low growth districts declined to 46 only as compared with 94 districts that had recorded low growth during 1962-65 to 1980-83. These 46 low growth districts accounted for only 16.7 per cent of total area and only 17.3 per cent of total output during 1980-83. The 94 low growth districts during 1962-65 to 1980-83 had accounted for 37.0 per cent of total area and 33.8 per cent of total output (of 35 crops) during the base period 1962-65(Tables 4.3 (a) to Table 4.3 (c)).

Table 4.5 (a)
Spatial distribution of districts in different states by output growth rates during 1962-65 to 1980-83

Growth rate of output (percent per annum)	North Western region					Eastern region					Central region					Southern region					All India
	HAR	J&K	PB	UP	ALL	ASS	BH	OR	WB	ALL	GJ	MP	MAH	RJ	ALL	AP	KAR	KER	TN	ALL	
1962-65 to 1980-83																					
High >= 3.5 percent	4	2	11	10	27	1	0	0	2	3	5	4	0	5	14	4	2	0	0	6	50
Medium 1.5 - 3.5	2	0	0	38	40	6	2	4	5	17	9	23	16	7	55	8	14	1	2	25	137
Low < 1.5	1	0	0	0	1	0	13	7	7	27	4	16	9	14	43	5	3	6	9	23	94
All	7	2	11	48	68	7	15	11	14	47	18	43	25	26	112	17	19	7	11	54	281

Table 4.5 (b)
Spatial distribution of districts in different states by output growth rates during 1980-83 to 1990-93

Growth rate of output (percent per annum)	North Western region					Eastern region					Central region					Southern region					All India
	HAR	J&K	PB	UP	ALL	ASS	BH	OR	WB	ALL	GJ	MP	MAH	RJ	ALL	AP	KAR	KER	TN	ALL	
1980-83 to 1990-93																					
High >= 3.5 percent	6	0	4	27	37	1	2	10	12	25	2	29	1	21	53	8	8	1	6	23	138
Medium 1.5 - 3.5	0	0	7	19	26	5	5	1	2	13	6	10	14	4	34	7	9	4	4	24	97
Low < 1.5	1	2	0	2	5	1	8	0	0	9	10	4	10	1	25	2	2	2	1	7	46
All	7	2	11	48	68	7	15	11	14	47	18	43	25	26	112	17	19	7	11	54	281

Table 4.5 (c)
Spatial distribution of districts in different states by output growth rates during 1990-93 to 2003-06

Growth rate of output (percent per annum)	North Western region					Eastern region					Central region					Southern region					All India
	HAR	J&K	PB	UP	ALL	ASS	BH	OR	WB	ALL	GJ	MP	MAH	RJ	ALL	AP	KAR	KER	TN	ALL	
1990-93 to 2003-06																					
High >= 3.5 percent	2	0	0	1	3	0	2	0	2	4	10	18	4	17	49	4	1	0	0	5	61
Medium 1.5 - 3.5	5	0	7	19	31	1	3	2	10	16	4	15	10	2	31	7	9	4	0	20	98
Low < 1.5	0	2	4	28	34	6	10	9	2	27	4	10	11	7	32	6	9	3	11	29	122
All	7	2	11	48	68	7	15	11	14	47	18	43	25	26	112	17	19	7	11	54	281

Table 4.5 (d)
Spatial distribution of districts in different states by output growth rates during 1962-65 to 2003-06

Growth rate of output (percent per annum)	North Western region					Eastern region					Central region					Southern region					All India
	HAR	J&K	PB	UP	ALL	ASS	BH	OR	WB	ALL	GJ	MP	MAH	RJ	ALL	AP	KAR	KER	TN	ALL	
1962-65 to 2003-06																					
High >= 3.5 percent	4	0	9	2	15	0	0	0	2	2	5	10	0	14	29	3	0	0	0	3	49
Medium 1.5 - 3.5	3	1	2	46	52	7	1	3	12	23	11	26	16	9	62	10	15	4	3	32	169
Low < 1.5	0	1	0	0	1	0	14	8	0	22	2	7	9	3	21	4	4	3	8	19	63
All	7	2	11	48	68	7	15	11	14	47	18	43	25	26	112	17	19	7	11	54	281

Source: Compiled from district level data presented in Annexure 1(a) - 1(e).

Spatial Distribution of districts by their growth rates- 1980-83 to 1990-93

The spatial distribution of districts by their growth rate underwent a distinct change during 1980-83 to 1990-93 with many low productivity districts in UP, MP, Rajasthan and Karnataka recording high rates of growth and many high productivity districts in Punjab, Haryana, and western UP, and Kerala recording a slight deceleration in their growth rates. But despite this deceleration, the districts located in the irrigated north-western and southern states were characterised by a near stability in their growth rates. But the same was not true about the districts in the central region where growth rates exhibited a great deal of fluctuation depending on the vagaries of the weather.

Table 4.5 (b) and Map 4.2 that give spatial distribution of districts according to their growth rates during 1980-83 to 1990-93 show interesting results. Firstly during 1980-83 to 1990-93, out of the 138 high growth districts, as many as 53 were located in the central region (mainly MP and Rajasthan), 37 in the north-western region (mainly UP and Haryana), 25 in the eastern (mainly West Bengal and Orissa), and 23 in the southern region mainly Karnataka and Andhra Pradesh).

The main feature is that it is the low productivity areas in the rainfed areas in the central region and high rainfall areas of West Bengal in the east which recorded the highest growth rates during this period. In many cases besides favourable weather, another important reason for high growth seems to be distinct changes in their cropping patterns and a notable shift from coarse cereals to either wheat or rice in the north-western and eastern region or to oilseeds in the central region.

The 97 medium growth districts were mainly concentrated in Uttar Pradesh in the north western, Madhya Pradesh and Maharashtra in the central and Andhra Pradesh and Karnataka in the southern region. Contrary to upward mobility of districts in rest of the state, 7 out of 11 districts in Punjab slipped down from the high growth category in the earlier period to the medium growth category in the later period.

Of the 97 medium growth districts, 34 were located in the central region (MAH 14 and MP 10), 26 in the north-western region (UP 19 and PB 7), 13 in the eastern (BH 5) and 24 in the southern region (AP 7, KAR 9). Many districts in the north-western region that is 19 in UP and 7 out of 11 in Punjab also slipped down from the high growth category in the earlier period to medium growth category in the latter period.

Coming now to the 46 low growth districts, 25 of these were located in the central region, 9 in the eastern region, 7 in the southern and 5 in the north western region (Table 4.5 (b)).

Growth during the post-reform period 1990-93 to 2003-06

At the aggregate level, the growth rate of agricultural output decelerated to 1.84 per cent per annum during the post-reform period 1990-93 to 2003-06 as compared with a growth rate of 3.5 per cent per annum during 1980-83 to 1990-93. At the level of districts, 61 districts registered high growth rates exceeding 3.5 per cent per annum in the post-reform period compared with 138 districts that had registered high growth during the earlier period. The weight of these districts in terms of area also declined considerably from nearly one half during 1980-83 to only one fifth during 1990-93.

There was not much change in the number and weight of mid-growth districts during the two periods. Their number only increased from 97 during 1980-83 to 1990-93 to 98 during 1990-93 to 2003-06. Their share of area increased slightly from 33.0 per cent during 1980-83 to 36.5 per cent during 1990-93. Similarly, their share in output also registered a small increase.

On the other hand, there was a big increase in the number of low growth districts whose number increased from 46 during 1980-83 to 1990-93 to 122 during 1990-93 to 2003-06. In terms of area, the low growth districts during the post-reform period accounted for as much as 43.3 per cent of total area and 46.9 per cent of total output (of 35 crops) during 1990-93. The low growth 46 districts during 1980-83 to 1990-93 had accounted for only 16.7 per cent of area and 17.3 per cent of output during 1980-83 (Tables 4.4 (a) to Table 4.4 (c)) .

Table 4.4 (a)
Distribution of districts by growth of output during 1990-93 to 2003-06 and growth in area, yield & inputs used

Growth rate of output (% pa)	No of districts	Yield (Rs./Hc)		Growth rate (percent pa) of							
		1990-93	2003-06	Output	Area	Yield	Fertilizer	Tractor	Tubewells	GIA	AW
High >= 3.5	61	4404	7335	5.4	1.4	4.0	4.3	3.0	5.2	4.2	3.6
Medium 1.5 - 3.5	98	7606	9639	2.3	0.4	1.8	3.3	1.5	3.5	1.4	1.0
Low < 1.5	122	7472	8156	0.1	-0.6	0.7	2.6	1.6	3.1	0.6	0.7
All	281	6902	8522	1.84	0.21	1.64	3.1	1.8	3.7	1.4	0.96

Table 4.4 (b)
Distribution of districts by growth of output during 1990-93 to 2003-06 and category wise share of districts in output, area and inputs in percentage

Growth rate of output (% pa)	Percent Districts	Output		Area		Fertiliser		Tractor		Tubewells		Area Irrigated		Agr Workers	
		1990-93	2003-06	1990-93	2003-06	1990-93	2003-06	1990-93	2003-06	1990-93	2003-06	1990-93	2003-06	1990-93	2003-06
High >= 3.5	21.7	12.9	20.2	20.2	23.4	13.0	15.1	18.9	22.0	18.7	22.6	13.3	18.8	15.4	16.9
Medium 1.5 - 3.5	34.9	40.2	42.6	36.5	37.7	41.9	42.7	41.6	39.8	36.1	35.6	39.3	38.8	33.9	34.1
Low < 1.5	43.4	46.9	37.2	43.3	38.9	45.0	42.2	39.5	38.2	45.2	41.8	47.4	42.4	50.7	49.0
All	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: As in Table 4.1

Table 4.4 (c)
Distribution of districts by growth of output during 1990-93 to 2003-06 and categories-wise inputs used: 1990-93 and 2003-06

Growth rate of output (percent pa)	Number of districts	Yield (Rs./ Hect)		Fertilizer(Kgs/Hc)		Tractors (No/000Hc)		Tubewell(No/000Hc)		percent Area irrigated		Agric Workers	
		1990-93	2003-06	1990-93	2003-06	1990-93	2003-06	1990-93	2003-06	1990-93	2003-06	1990-93	2003-06
High >= 3.5 percent	61	4404	7335	50.1	72.5	11.4	14.0	57.2	92.3	20.8	43.1	846	1639
Medium 1.5 - 3.5 percent	98	7606	9639	88.8	127.4	13.8	15.8	60.8	90.3	30.3	53.3	877	1477
Low < 1.5percent	122	7472	8156	80.0	121.0	11.1	14.7	64.2	102.9	25.5	46.6	913	1617
All	281	6902	8522	77.3	112.0	12.1	15.0	61.6	95.7	26.3	48.2	883	1520

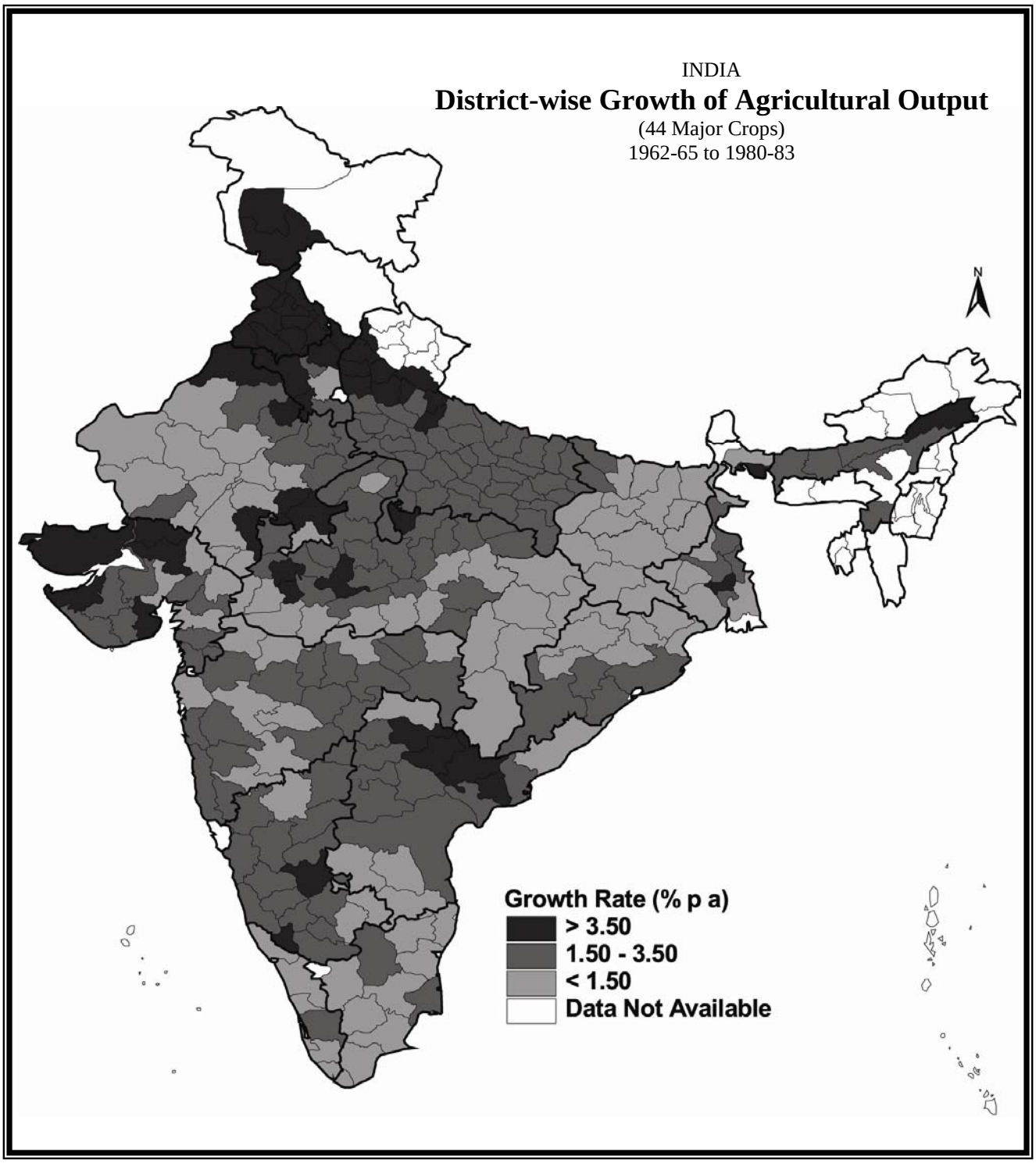
Source: As in Table 4.1

Spatial patterns during 1990-93 to 2003-06

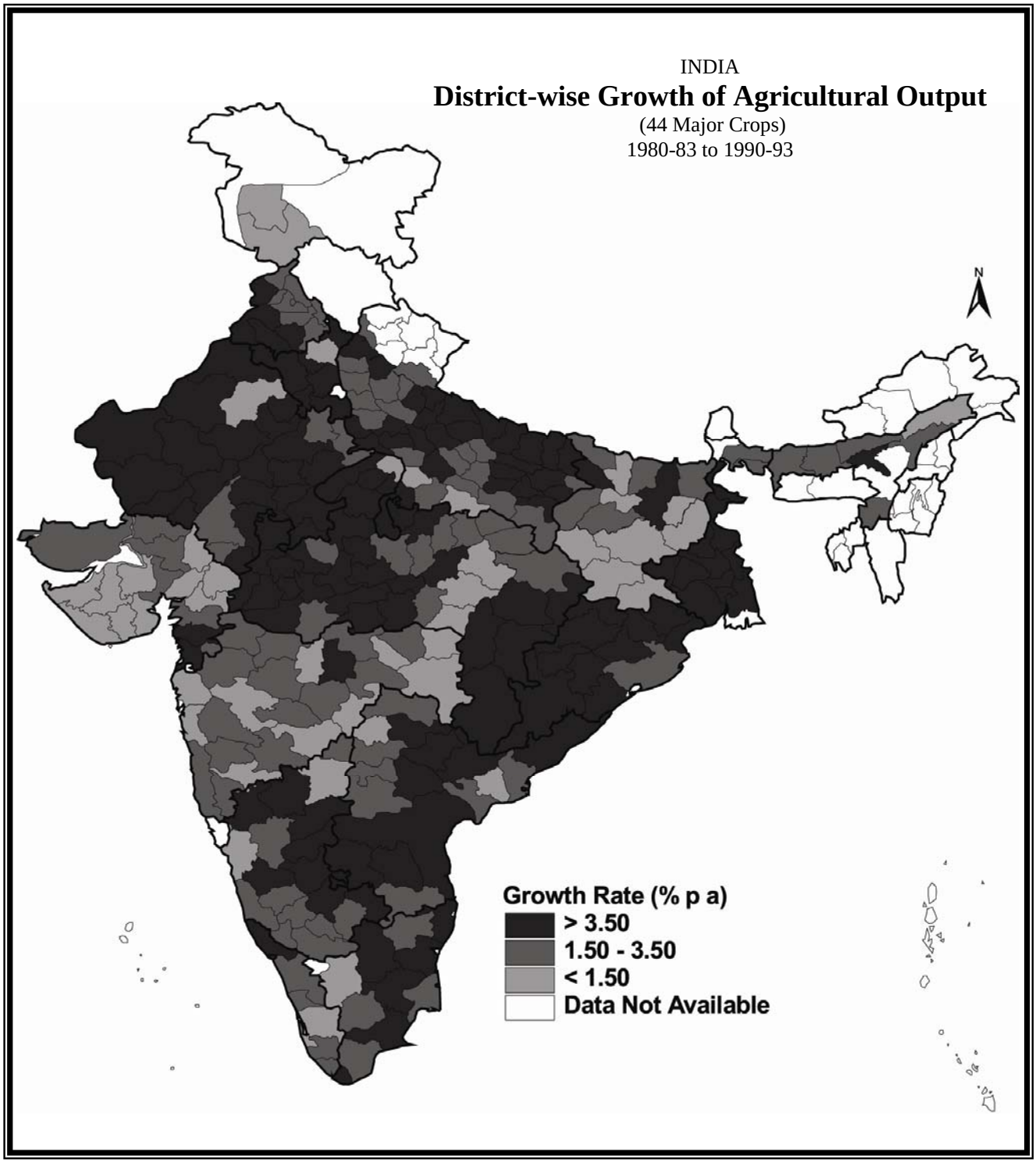
The spatial distribution of districts by their growth rate underwent a distinct change during 1990-93 to 2003-06. This happened primarily as many low productivity districts in the states located in the central region recorded high growth rates. Out of the 61 high growth districts, as many as 49 were located in the central region and the other were spread over the rest of the three regions. Thus 10 out of 18 districts in Gujarat, 18 out of 43 in Madhya Pradesh and 17 out of 26 districts of Rajasthan were able to record high growth rates exceeding 3.5 per cent per annum during this period. On the other hand, whereas 27 districts in Uttar Pradesh recorded high growth rates during 1980-83 to 1990-93, their number had come down to only 1 during 1990-93 to 2003-06. Similarly there was substantial decline in the number of districts with high growth in Punjab, Haryana and in Uttar Pradesh, in West Bengal and in all the states in the Southern region.

During 1990-93 to 2003-06, the 122 low growth districts were spread over all the regions, 34 of these were in the north-western region, 32 in the central region, 27 in the eastern region and 29 in the southern region. The main brunt of slow down and low growth was borne by the districts in the north-western region. In this region, the number of low growth districts increased from 5 in during the earlier period 1980-83 to 1990-93 to as many as 34 during 1990-93 to 2003-06 (Table 4.5 (c) and Map 4.3).

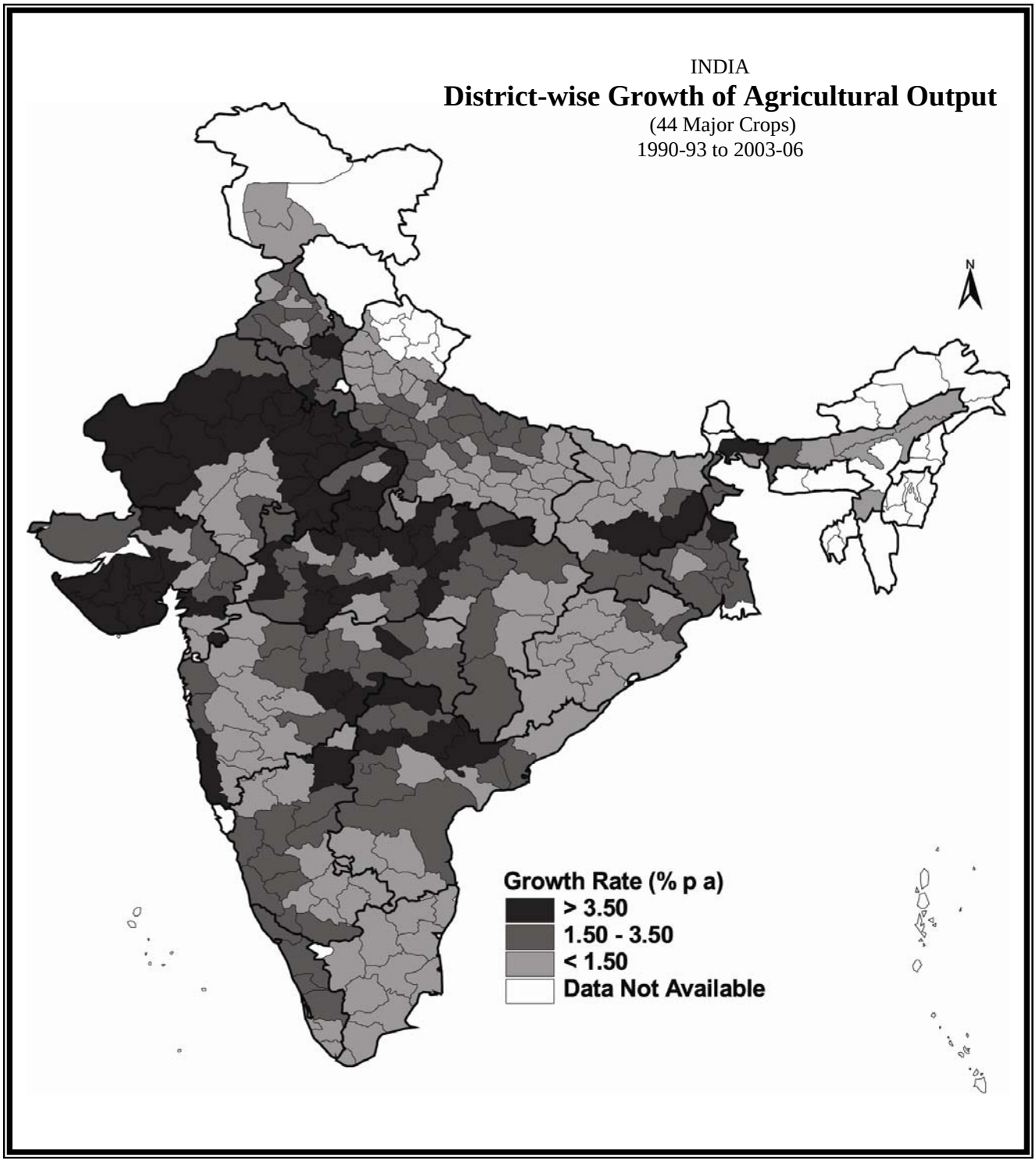
Map 4.1


INDIA
District-wise Growth of Agricultural Output
(44 Major Crops)
1962-65 to 1980-83
N
Growth Rate (% p a)
> 3.50
1.50 - 3.50
< 1.50
Data Not Available

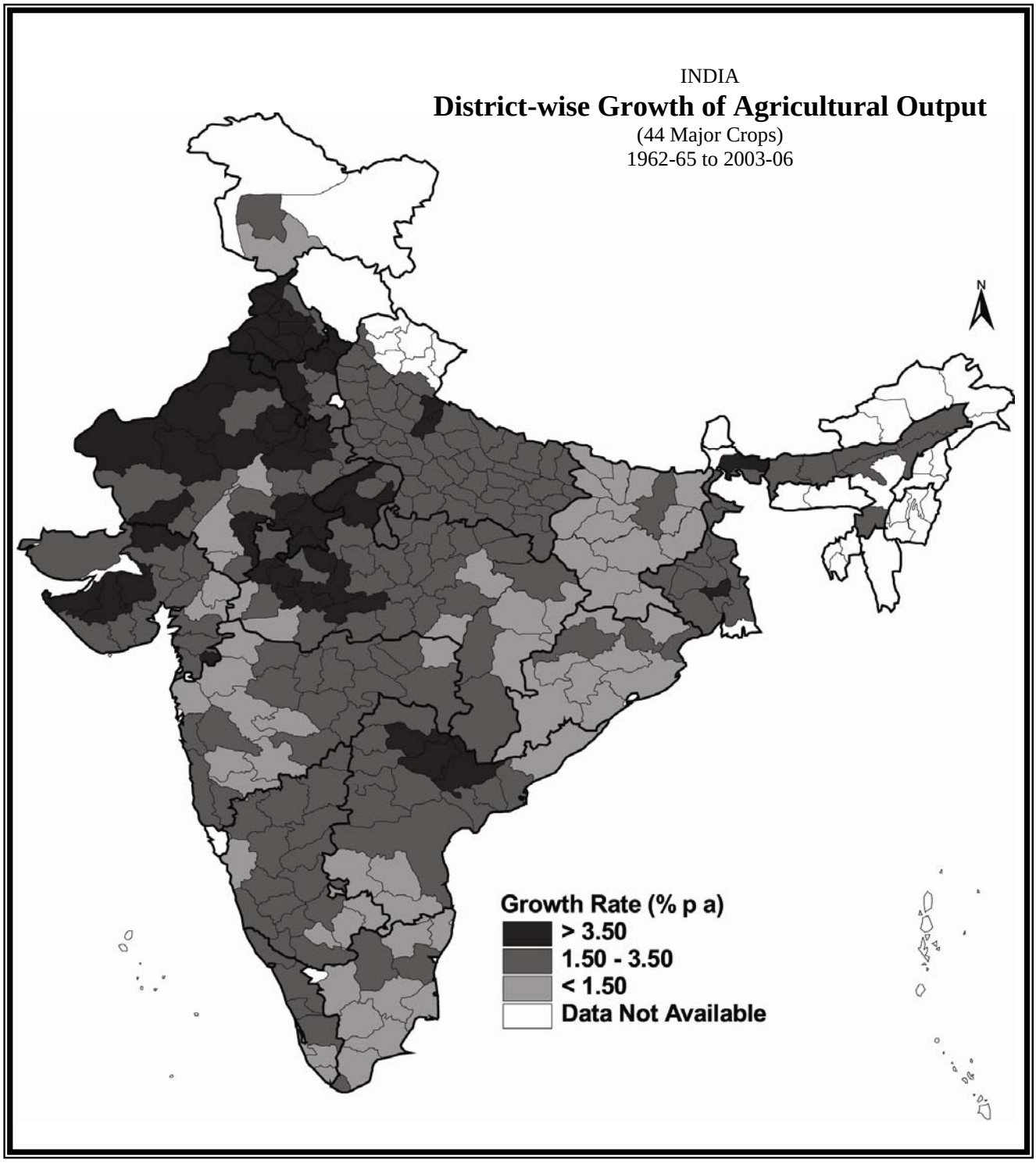
Map 4.2


INDIA
District-wise Growth of Agricultural Output
(44 Major Crops)
1980-83 to 1990-93
N
Growth Rate (% p a)
> 3.50
1.50 - 3.50
< 1.50
Data Not Available

Map 4.3


INDIA
District-wise Growth of Agricultural Output
(44 Major Crops)
1990-93 to 2003-06
N
Growth Rate (% p a)
> 3.50
1.50 - 3.50
< 1.50
Data Not Available

Map 4.4


INDIA
District-wise Growth of Agricultural Output
(44 Major Crops)
1962-65 to 2003-06
N
Growth Rate (% p a)
> 3.50
1.50 - 3.50
< 1.50
Data Not Available

Cross Classification of Districts according to their Growth Rates during 1962-65 to 1980-83 and yield levels during base year1962-65

An attempt is made to cross classify districts according to their yield levels and growth rates during different periods and to look at their movement from one yield category to another as a result of differential rates of growth recorded during various periods. Details are given Tables 4.6 to Table 4.14.

The cross classification of districts according to their growth rates during the first period 1962-65 to 1980-83 and yield levels during the base year 1962-65 is given in Table 4.6 (a) and Table 4.6(b). The movement of districts during 192-65 to 1980-83 consequent to differential growth rates recorded by them is given in Table 4.7. Table 4.8 then contains cross classification of districts by output growth during 1962-65 to 1980-83 and the yield levels during the terminal year 198-83.

Similar tables giving cross classification of districts according to growth of output during 1980-83 to 1990-93 and yield level during the base year 1980-83, the movement of districts consequent to differential growth recorded by them during 1980-83 to 1990-93 and the cross classification of districts according o growth rates during 1980-83 to 1990-93 and yield levels during the terminal year 1990-93 are given in Tables 4.9, Table 4.10 and Table 4.11, respectively. Tables 4.12, Table 4.13 and table 4.14 present similar details for the growth period 1990-93 to 2003-06. These tables shed some more light on the interrelationships between growth rates and yield levels during the various periods.

During the first period-1962-65 to 1980-83, the highest growth rate exceeding 3.5 per cent per annum was recorded by only 50 districts. Forty three of these were primarily the low productivity districts that were located in the north western states as also in some of the central states like Rajasthan, Gujarat and MP. There was only one district in Karnataka in the high productivity range that recorded high growth rates during 1962-65 to 1980-83 (Table 4.6).

Of the 137 districts that recorded medium growth between 1.5 to 3.5 per cent per annum during 1962-65 to 1980-83, as many as 125 belonged to the low productivity category with output per hectare less than Rs. 6,250/hect and another 11 belonged to the medium productivity category and only 1 to the high productivity category (Table 4.6).

The 125 low yield districts with medium growth were mainly located in U.P (38), and the central states of Madhya Pradesh, Maharashtra, Gujarat and Rajasthan and the northern Karnataka and Andhra Pradesh.

Finally, the low productivity districts were also dominant in the low growth category and as many as 80 of the 84 low growth districts belonged to this class. These districts were located in rainfed areas in the central states and Bihar, Orissa and West Bengal in the east and in Andhra Pradesh and Karnataka in the south. *These 80 districts that belonged to lowest yield category and recorded low growth rates during 1962-65 to 1980-83 constituted the hard core of agricultural backwardness in the country during the period 1962-65 to 1980-83* (Table 4.6).

To sum up, during the first period, the new technology triggered growth in those low productivity districts in north-western India that had a good irrigation base and in dry land states in the central region that had very low levels of yield.

Table 4.6 (a)
Cross classification of districts by output growth during 1962-65 to 1980-83 and yield levels during base year 1962-65

Output per Hect. during 1962-65 (at 1990-93 prices)	**Number of district in output growth (1962-65 to 1980-83) rate category**								
	≥3.5percent			**1.5-3.5percent**			**<1.5percent**		**All**
More than Rs. 10200	KAR	1		KER	1		KER	5	
Total		**1**			**1**			**5**	**7**
Rs. 6250-10200	AP	1		AP	2		AP	1	
	AS	1		AS	2		KAR	1	
	PB	1		KAR	4				
	UP	2		MAH	1		TN	7	
	WB	1		TN	1				
				WB	1				
Total		**6**			**11**			**9**	**26**
Less than Rs. 6250	AP	3		AP	6		AP	4	
	GJ	5		AS	4		BH	13	
	HR	4		BH	2		GJ	4	
	JK	2		GJ	9		HR	1	
	KAR	1		HR	2		KAR	3	
	MP	4		KAR	10		MP	16	
	PB	10		MP	23		MAH	9	
	RJ	5		MAH	15		OR	7	
	UP	8		OR	4		RJ	14	

	WB	1		RJ	7		TN	2	
				TN	1		WB	7	
				UP	38				
				WB	4				
Total		**43**			**125**			**80**	**248**
Overall		**50**			**137**			**94**	**281**

Source: Annexure 1(a)-1(e)

Table 4.6 (b)
Cross classification of districts by output growth during 1962-65 to 1980-3 and yield levels during base period 1962-65

Output per hectare During 1962-65 (at 1990-93 prices)	**Name of district in output growth rate categories:1962-65 to 1980-83**					
	≥3.5percent			**1.5-3.5percent**		
More than Rs. 10200	KODAGU	KAR	ERNAKULAM	KER	KOZHIKODA	KER
					KANNUR	KER
					KOLLAM	KER
					TIRUVANANTHAPURAM	KER
					ALEPPUZHA	KER
Rs 6250- 10200	WEST GODAVARI	AP	EAST GODAVARI	AP	CHITTUR	AP
	N.LAKHIMPUR	AS	NIZAMABAD	AP	TRISSUR	KER
	LUDHIANA	PB	JORHAT	AS	KANNIYA KUMARI	TN
	MEERUT	UP	DARRANG	AS	COIMBATORE	TN
	MUZAFFARNGR	UP	CHIKMAGALUR	KAR	SOUTH ARCOT	TN
	HOOGLY	WB	SHIMOGA	KAR	MADURAI	TN
			MANDYA	KAR	TIRUNELVELI	TN
			UTTARAKANNADA	KAR	N.ARCOT(AMB)	TN
			KOLHAPUR	MAH	TIRUCHIRAPALLI	TN
			THANJAVUR	TN		
			BURDWAN	WB		
	WEST GODAVARI	AP	EAST GODAVARI	AP	CHITTUR	AP
	N.LAKHIMPUR	AS	NIZAMABAD	AP	TRISSUR	KER
	LUDHIANA	PB	JORHAT	AS	KANNIYA KUMARI	TN
	MEERUT	UP	DARRANG	AS	COIMBATORE	TN
	MUZAFFARNAGR	UP	CHIKMAGALUR	KAR	SOUTH ARCOT	TN
	HOOGLY	WB	SHIMOGA	KAR	MADURAI	TN
			MANDYA	KAR	TIRUNELVELI	TN
			UTTARAKANNADA	KAR	N.ARCOT(AMB)	TN
Less than Rs. 6250	KHAMMAM	AP	HYDERABAD	AP	ADILABAD	AP
	KARIMNAGAR	AP	KRISHNA	AP	ANANTAPUR	AP
	WARANGAL	AP	MAH.NAGAR	AP	SRIKAKULAM	AP
	BANAS KANTHA	GJ	GUNTUR	AP	CUDDAPAH	AP
	KUTCH	GJ	MEDAK	AP	MUZAFFARPUR	BH
	BHAVNAGAR	GJ	NALGONDA	AP	PURNEA	BH
	MEHSANA	GJ	KAMRUP	AS	RANCHI	BH
	JAMNAGAR	GJ	GOALPARA	AS	BHOJPUR	BH
	KARNAL	HR	NAGAON	AS	DARBHANGA	BH
	AMBALA	HR	SILCER	AS	PALAMAU	BH
	MAHENDRAGARH	HR	CHAMPARAN(E)	BH	BHAGALPUR	BH
	HISSAR	HR	SARAN	BH	MONGHYR	BH
	JAMMU	JK	KHEDA	GJ	HAZARIBAGH	BH
	SRINAGAR	JK	DANGS	GJ	DUMKA	BH
	CHITRADURGA	KAR	SURAT	GJ	PATNA	BH
	INDORE	MP	SURENDRANAGAR	GJ	SINGHBHUM	BH

	TIKAMGARH	MP	JUNAGARH	GJ	GAYA	BH
	SEHORE	MP	AMRELI	GJ	SABARKANTHA	GJ
	UJJAIN	MP	VALSAD	GJ	AHMEDABAD	GJ
	KAPURTHALA	PB	VADODARA	GJ	BHARUCH	GJ
	PATIALA	PB	RAJKOT	GJ	PANCH MAHALS	GJ
	GURDASPUR	PB	JIND	HR	ROHTAK	HR
	FIROZPUR	PB	GURGAON	HR	BANGALORE	KAR
	JALANDHAR	PB	DAKSHINAKANNADA	KAR	BIJAPUR	KAR
	SANGRUR	PB	MYSORE	KAR	KOLAR	KAR
	ROPAR	PB	HASSAN	KAR	CHINDWARA	MP
	AMRITSAR	PB	BIDAR	KAR	SARGUJA	MP
	BHATINDA	PB	RAICHUR	KAR	BETUL	MP
	HOSHIARPUR	PB	TUMKUR	KAR	GWALIOR	MP
	GANGANAGAR	RJ	GULBARGA	KAR	SHAHDOL	MP
	CHITTORGARH	RJ	BELGAUM	KAR	RAIGARH	MP
	BUNDI	RJ	BELLARY	KAR	SEONI	MP
	JHUNJHUNU	RJ	DHARWAD	KAR	DHAR	MP
	KOTA	RJ	HOSHANGABAD	MP	BILASPUR	**MP**
	NAINITAL	UP	MANDSAUR	MP	DURG	MP
	MORADABAD	UP	DEWAS	MP	RAIPUR	MP
	PILIBHIT	UP	MORENA	MP	BASTAR	MP
	SHAHJAHANPUR	UP	GUNA	MP	EAST NIMAR	MP
	BIJNOR	UP	RAISEN	MP	JABALPUR	MP
	RAMPUR	UP	VIDISHA	MP	JHABUA	MP
	DEHRADUN	UP	SAGAR	MP	WEST NIMAR	MP
	SHAHARANPUR	UP	RATLAM	MP	BHANDARA	MAH
	COOCH-BIHAR	WB	DATIA	MP	AHMEDNAGAR	MAH
			RAJGARH	MP	THANE	MAH
			SIDHI	MP	BEED	MAH
			DAMOH	MP	SANGLI	MAH
			NARSIMPUR	MP	AMRAWATI	MAH
			PANNA	MP	JALGAON	MAH
			MANDLA	MP	SOLAPUR	MAH
			SATNA	MP	DHULE	MAH
			BALAGHAT	MP	SAMBALPUR	OR
			SHIVPURI	MP	DHENKANAL	OR
			REWA	MP	MAYURBHANJ	OR
			BHIND	MP	BALASORE	OR
			CHHATARPUR	MP	SUNDERGARH	OR
			SHAJAPUR	MP	KEONJHAR	OR
			WARDHA	MAH	BOLANGIR	OR
			PUNE	MAH	JODHPUR	RJ
			BULDHANA	MAH	BHILWARA	RJ
			YAWATMAL	MAH	PALI	RJ
			PARBHANI	MAH	JHALAWAR	RJ
			NANDED	MAH	BIKANER	RJ
			AURANGABAD	MAH	NAGOUR	RJ
			RAIGAD	MAH	SIROHI	RJ
			OSMANABAD	MAH	UDAIPUR	RJ
			RATNAGIRI	MAH	TONK	RJ
			AKOLA	MAH	AJMER	RJ
			NAGPUR	MAH	DUNGARPUR	RJ
			SATARA	MAH	BANSWARA	RJ
			NASIK	MAH	BARMER	RJ
			CHANDRAPUR	MAH	JAISALMER	RJ
			PHULBANI	OR	CHENGALPATTU	TN
			GANJAM	OR	RAMNATH PURAM	TN
			CUTTACK	OR	JALPAIGURI	WB
			KALAHANDI	OR	BIRBHUM	WB
			ALWAR	RJ	24 PARGNAS N	WB
			JAIPUR	RJ	BANKURA	WB
			SWAI MADHOPUR	RJ	MIDNAPUR W	WB
			BHARATPUR	RJ	PURULIA	WB
			JALORE	RJ	W.DINAJPUR	WB
			SIKAR	RJ		

			CHURU	RJ		
			SALEM	TN		
			JAUNPUR	UP		
			FAIZABAD	UP		
			GORAKHPUR	UP		
			DEORIA	UP		
			FARRUKHABAD	UP		
			BAREILLY	UP		
			RAEBARELI	UP		
			BULLANDSHAHR	UP		
			LUCKNOW	UP		
			GHAZIPUR	UP		
			ALIGARH	UP		
			JHANSI	**UP**		
			GONDA	UP		
			ALLAHABAD	UP		
			KANPUR (R)	UP		
			ETAWAH	UP		
			KHERI	UP		
			BADAUN	UP		
			PRATAPGARH	UP		
			JALAUN	UP		
			BALLIA	UP		
			MAINPURI	UP		
			FATEHPUR	UP		
			UNNAO	UP		
			MATHURA	UP		
			AZAMGARH	UP		
			BAHRAICH	UP		
			HAMIRPUR	UP		
			AGRA	UP		
			VARANASI	UP		
			HARDOI	UP		
			BANDA	UP		
			BARABANKI	UP		
			ETAH	UP		
			MIRZAPUR	UP		
			BASTI	UP		
			SITAPUR	UP		
			SULTANPUR	UP		
			MALDAH	WB		
			NADIA	WB		
			MURSHIDABAD	WB		
			HOWRAH	WB		
			SWAI MADHOPUR	RJ		
			CHITTORGARH	RJ		
			BHILWARA	RJ		
			BUNDI	RJ		
			ALWAR	RJ		
			JHALAWAR	RJ		
			SIROHI	RJ		
			JAIPUR	RJ		
			TONK	RJ		
			PALI	RJ		
			SIKAR	RJ		
			JALORE	RJ		
			NAGOUR	RJ		
			JHUNJHUNU	RJ		
			JODHPUR	RJ		
			FARRUKHABAD	UP		
			DEORIA	UP		
			KHERI	UP		
			BAREILLY	UP		
			RAMPUR	UP		
			ETAWAH	UP		

			MORADABAD	UP		
			BARABANKI	UP		
			ETAH	UP		
			PILIBHIT	UP		
			AZAMGARH	UP		
			VARANASI	UP		
			ALIGARH	UP		
			MAINPURI	UP		
			KANPUR (R)	UP		
			FAIZABAD	UP		

Source: Annexure 1(a)-1(e)

Growth of Output during 1962-65 to 1980-83 and Movement of Districts across Yield Level Categories during 1962-65 and 1980-83

Movement during 1962-65 to 1980-83

As a result of acceleration in the growth of output during 1962-65 to 1980-83, many districts moved to higher levels of productivity during this period. For example, during 1962-65 to 1980-83, 50 districts recorded a growth rate exceeding 3.5 per cent, another 137 –a medium growth rate (1.5 to 3.5 percent pa), and 94 a low growth of less than 1.5 percent pa. As a consequence, as compared with only 7 districts with productivity exceeding Rs.10,200/hec during 1962-65, the number of districts in this category had increased to 25 by 1980-83 (Table 4.6, table 4.7 and Table 4.8).

Out of these 25 districts, 10 belonged to high growth cum high yield category during 1980-83 as compared with only I such district during 1962-65. Out of these 10 districts, 5 belonged to PB, 3 to UP and 1 each to AP, KAR and West Bengal.

The movement of districts shows that as a result of high growth during 1962-65 to 1980-93, 10 districts moved up from medium or low yield category to high growth-high yield category. All the 5 districts in mid-yield category namely 2 from UP and one each from AP and WB moved from mid to high yield. Another 5 districts moved from low yield to high yield category as a result of high growth. Consequently, as against 1 district in the high growth cum high- yield category during 1962, the number of such districts had grown to 10 by 1980-83. These included 5 districts of Punjab, 3 of UP and 1 each of AP, KAR.

High growth also enabled 24 districts to move out of low yield category to mid or high-yield categories. 19 of these moved from low to mid-yield category. These included 10 districts from PB, 7 from UP, 2 from HAR, and 1 each from AP, GJ, JK and KAR and

WB. Interestingly another 5 low yield districts (4 from PB and I from UP) were able to move directly from low yield to high yield category. Whereas 5 of the Punjab districts moved to mid yield category another 5 moved to high yield category. Again out of 7 UP districts that moved up from low yield category, whereas 6 moved to mid-yield level, I district namely Bijnor moved from low to high yield category (Table 4.5).

Table 4.7
Output growth during 1962-65 to 1980-83 and movement of districts across yield levels during 1962-65 to 1980-83

Output/Hect. During 1962-5 (1990-3 prices)	Name of district in output growth rate categories:1962-65 to 1980-83					
	More than 3.5percent		1.5-3.5percent		Less than 1.5percent	
More than Rs 10200						
					TRISSUR	KER
Rs 6250-10200	WEST GODAVARI	AP	EAST GODAVARI	AP	COIMBATORE	TN
	LUDHIANA	PB	CHIKMAGALUR	KAR	KANIYA KUMARI	TN
	MEERUT	UP	UTTARAKANADA	KAR	**[Moved up to >=10200]**	
	MUZAFFARNAGAR	UP	KOLHAPUR	MAH		
	HOOGLY	WB	**[Moved up to >=10200]**			
	[Moved up to >=10200]					
Less Rs 6250	JALANDHAR	PB	DAKSINAKANADA	KAR	THANE	MAH
	KAPURTHALA	PB	**[Moved up to >=10200]**		CHENGALPATTU	TN
	PATIALA	PB			**[Moved up to 6250-10200]**	
	SANGRUR	PB	GUNTUR	AP		
	BIJNOR	UP	KRISHNA	AP		
	[Moved up to >=10200]		SILCER	AS		
			AMRELI	GJ		
	KARIMNAGAR	AP	JUNAGARH	GJ		
	BHAVNAGAR	GJ	KHEDA	GJ		
	AMBALA	HAR	SURAT	GJ		
	KARNAL	HAR	VADODARA	GJ		
	SRINAGAR	JK	VALSAD	GJ		
	CHITRADURGA	KAR	HASSAN	KAR		
	AMRITSAR	PB	TUMKUR	KAR		
	BHATINDA	PB	RAIGAD	MAH		
	FIROZPUR	PB	RATNAGIRI	MAH		
	GURDASPUR	PB	SALEM	TN		
	HOSHIARPUR	PB	BAREILLY	UP		
	ROPAR	PB	BULLANDSHAHR	UP		
	MORADABAD	UP	DEORIA	UP		
	NAINITAL	UP	ETAWAH	UP		
	PILIBHIT	UP	FAIZABAD	UP		
	RAMPUR	UP	FARUKHABAD	UP		
	SHAHARANPUR	UP	KANPUR	UP		
	SHAHJAHANPUR	UP	KHERI	UP		
	COOCH-BIHAR	WB	HOWRAH	WB		

	[Moved up to 6250-10200]			[Moved up to 6250-10200]				

Source: as in Table 4.1

During 1962-65 to 1980-83, in addition to 50 districts that recorded high growth of output, 137 districts recorded medium growth ranging between 1.5 to 3.5 per cent p a. Medium growth was also instrumental in the upward movement of many districts from low to mid and mid to high yield categories. As a consequence, the number of mid growth cum low-productivity districts came down from 125 during 1962-65 to only 101 during 1980-83. Further, the number of medium growth cum mid-productivity districts went up from 11 in 1962-65 to 30 by 1980-83 and that of medium growth cum high-productivity districts from 1during 1962-65 to 6 during 1980-83.

The movement of districts shows that as a result of medium growth, 8 districts of UP moved up from the low to the mid productivity category. In addition, 6 districts of Gujarat, 2 of Karnataka, 2 of MH, 2 of AP and 1each of Assam, West Bengal and Tamil Nadu moved up from low to the mid productivity category (Table 4.8). Interestingly, 1 district of KAR was able to directly jump low yield to high yield category as a result of medium growth.

There were 94 districts that recorded low growth of output of less than 1.5 percent pa during 1962-65 to 1980-83, 5 of these belonged to high yield category, 9 to mid-yield, and 80 to low yield.

Low growth of less than 1.5 percent pa was also instrumental in movement of districts from mid-yield to high yield and from low to mid yield categories. Thus 3 districts in the mid-yield category (1 from KER and 2 from TN) during 1962-65 moved to high-yield category by 1980-83 increasing the number of low growth cum high-yield districts from 5 during 1962-65 to 8 by 1980-83.

There were 80 districts in the low growth cum low-yield category during 1962-65. Because of movement of 2 districts up from low to mid-yield category their number came down to 78 by 1980-83. The two districts that moved up were 1 each from MAH and TN.

Table 4.6 contains Cross Classification of districts according to growth rate during 1962-65 to 1980-83 and yield levels during terminal year 1980-83.

Table 4.8
Cross classification of districts growth of output during 1962-65 to 1980-83 and yield levels during the terminal year 1980-83

Output (Rs/Hc) during 1980-83 (1990-93 prices)	No of district in output growth rate categories: 1962-65 to 1980-983						Total
	More than 3.5percent		1.5percent to 3.5 percent		Less than 1.5percent		
	States	No. districts	States	No. districts	States	No. districts	
More than Rs 10200	AP	1	AP	1	KER	6	
	KAR	1	KAR	3	TN	2	
	PB	5	KER	1	WB	1	
	UP	3	MAH	1			
	Total	10		6		9	25
Rs 6250-10200	AP	1	AP	3	AP	1	
	AS	1	AS	3	MAH	1	
	GJ	1	GJ	6	TN	6	
	HR	2	KAR	4			
	JK	1	MAH	2			
	KAR	1	TN	2			
	PB	6	UP	8			
	UP	6	WB	2			
	WB	1					
	Total	20		30		8	58
Less Rs 6250	AP	2	AP	4	AP	4	
	GJ	4	AS	3	BH	13	
	HAR	2	BH	2	GJ	4	
	JK	1	GJ	3	HAR	1	
	MP	4	HAR	2	KAR	3	
	RJ	5	KAR	7	MP	16	
	UP	1	MP	23	MAH	8	
	WB	1	MAH	13	ORR	7	
			ORR	4	RJ	14	
			RJ	7	TN	1	
			UP	30	WB	6	
			WB	3			
	Total	20		101		77	198
Overall		50		137		94	281

Source: As in Table 3.2

Cross Classification of Districts according to their Growth Rates during 1980-83 to 1990-93 and yield levels during base year 1980-83

There was a significant change in this situation during the second period 1980-83 to 1990-93 when the number of districts that recorded high growth rates increased to 138 compared with only 50 during the first period 1962-65 to 1980-83. But one of the similarities between the two periods was that like the earlier period, high growth was recorded predominantly by the 107 low productivity and 26 mid productivity districts mainly located in the central, north-western and eastern region.

The number of districts in the high productivity category that also recorded high growth during 1980-83 to 1990-93 was only 5. One each was located in KER, PB, TN, UP and WB. (Table 4.9).

Of the 107 low productivity districts during 1980-83 that recorded high growth during 1980-83 to 1990-93, 51 were in the states in the central region (29 MP, 21 RJ, 1 MH), 17 in UP, 10 in Orissa, 9 in WB, 6 in AP, 5 each in HAR and KAR, 2 in BH and I each in AS and TN.

Of the 26 mid productivity districts that recorded high growth, 9 were in UP, 4 in TN, 3 each in KAR and PB, 2 each in AP, GJ, and WB and 1 in HR (Table 4.7).

During 1980-83 to 1990-93, 97 districts registered medium growth rates ranging between 1.5 percent to 3.5 percent pa. As many as 61 of these belonged to low productivity category, 21 to medium productivity category and 15 to high productivity category.

Of the 61 low productivity category districts that recorded medium growth, 12 belonged to UP, 12 to MAH, 10 to MP, 6 to GJ and the rest were distributed across many other states. Again out of the 21 mid-productivity districts with medium growth rates, 5 were in UP, 4 in TN, 3 each in AS and PB, 2 each in AP and KAR, and 1 each in MAH and WB..

Finally of the 15 high productivity districts that registered medium growth during 1980-83 to 1990-93, 4 each were in PB and KER, 3 in KAR, 2 in UP and 1 each in KAR and MH (Table 4.9).

Coming to the 46 districts that recorded low growth of less than 1.5 percent pa during 1980-83 to 1990-93, only 5 belonged to high productivity category, 11 to mid-productivity category and as many as 30 to low productivity category.

All the 5 high productivity districts with low growth were in the southern region states.

Out of the 11 mid-productivity districts with low growth, 5 were in GJ, 2 in MH and 1 each in AP, AS, HAR and JK.

During 1980-83, there were 30 districts that belonged to low productivity and registered low growth of less than 1.5 percent during 1980-83 to 1990-93. Of these 30, 18 were located in the in the central region state (8 MAH, 5 GJ, 4 MP, 1 RJ). Of the remaining 12, 8 were in BH, 2 in UP and 1 each in JK and KAR. These 31 districts constituted the hardcore of underdevelopment during 1980-83 to 1990-93.

One of the redeeming features, however, was that the number of low productivity and low growth districts came down from 77 during 1962-65 to 1980-83 to only 30 during 1980-83 to 1990-93.

As discussed earlier, besides continuous good weather for several years, another important reason for the drastic reduction in the hard core low productivity, low growth districts in the rainfed areas in the central plain was because they were able to undertake crop diversification from coarse cereals to oilseeds and to other high value crops. The reverse side of this story is that this has increased the risks tremendously since crop failure due to bad rainfall can lead to huge losses for the cultivators, sometimes driving them to desperation.

Table 4.9
Cross classification of districts by growth of output during 1980-83 to 1990-93 and yield levels during base year 1980-83

Output (Rs/Hc) during 1980-83 (1990-93 prices)	No of district in output growth rate categories: 1980-83 to 1990-93						Total
	More than 3.5percent		1.5percent to 3.5 percent		Less than 1.5percent		
	States	No. districts	States	No. districts	States	No. districts	
More than Rs 10200	KER	1	AP	1	AP	1	
	PB	1	KAR	3	KAR	1	
	TN	1	KER	4	KER	2	
	UP	1	MAH	1	TN	1	
	WB	1	PB	4			
			UP	2			
	Total	5		15		5	25
Rs 6250-10200	AP	2	AP	2	AP	1	
	GJ	2	AS	3	AS	1	
	HR	1	KAR	2	GJ	5	
	KAR	3	MAH	1	HAR	1	
	PB	3	PB	3	JK	1	
	TN	4	TN	4	MAH	2	
	UP	9	UP	5			
	WB	2	WB	1			
	Total	26		21		11	58
Less Rs 6250	AP	6	AP	4	BH	8	
	AS	1	AS	2	GJ	5	
	BH	2	BH	5	JK	1	
	HR	5	GJ	6	KAR	1	
	KAR	5	KAR	4	MP	4	
	MP	29	MP	10	MAH	8	
	MAH	1	MAH	12	RJ	1	
	OR	10	OR	1	UP	2	
	RJ	21	RJ	4			
	TN	1	UP	12			
	UP	17	WB	1			
	WB	9					
	Total	107		61		30	198
Overall		138		97		46	281

Source: As in Table 3.2

Growth rates during 1980-83 to 1990-93 and Movement during 1980-83 to 1990-93

The movement of districts across yield categories was much greater during the second period when agricultural growth rates recorded a significant acceleration. For example, the number of high yield districts increased from only 25 in 1980-83 to as many as 59 during 1990-93.

As many as 18 districts in the medium yield category graduated to the high productivity set as a result of rapid growth exceeding 3.5 per cent p a. One district of WB moved from low productivity to the highest productivity as a result of high growth. Another 13 districts graduated to high yield even though their growth rate was only 1.5 to 3.5 percent p a.

Further, 2 districts graduated to high productivity from the medium yield category even though their growth rate was less than 1.5 per cent per annum. Thus there was a net increase of 34 districts in high yield category by 1990-93, increasing their number from 25 during 1980-83 to 59 by 1990-93. (Table 4.9, Table 4.10 and Table 4.11).

Table 4.10
Output growth during 1980-83 to 1990-93 and movement of districts across yield levels during 1980-83 to 1990-93

Output/Hect. During 1980-83 (1990-3 prices)	Name of district in output growth rate categories: 1980-83 to 1990-93					
	More than 3.5percent		1.5-3.5percent		Less than 1.5percent	
More than Rs 10200						
					N.LAKHIMPUR	AS
Rs 6250-10200	GUNTUR	AP	CHITTUR	AP	KHEDA	GJ
	KARIMNAGAR	AP	KRISHNA	AP	[Moved up to >=10200]	
	SURAT	GJ	JORHAT	AS		
	VALSAD	GJ	MANDYA	KAR		
	AMBALA	HR	GURDASPUR	PB		
	SHIMOGA	KAR	ROPAR	PB		
	AMRITSAR	PB	MADURAI	TN		
	BHATINDA	PB	N.ARCOT	TN		
	FIROZPUR	PB	THANJAVUR	TN		
	CHENGALPATTU	TN	TIRUNELVELI	TN		
	SALEM	TN	MORADABAD	UP		
	SOUTH ARCOT	TN	NAINITAL	UP		
	FARRUKHABAD	UP	RAMPUR	UP		
	KHERI	UP	[Moved up to >=10200]			
	PILIBHIT	UP			[Moved down to < 6250	
	SHAHARANPUR	UP				
	BURDWAN	WB			AMRELI	GJ
	HOWRAH	WB			BHAVNAGAR	GJ
	[Moved up to >=10200]					
Less Rs 6250	BANKURA	WB	BHOJPUR	BH	JALAUN	UP
	[Moved up to >=10200]		CHAMPARAN	BH	[Moved up to 6250-10200	
			MEHSANA	GJ		
	CUDDAPAH	AP	MYSORE	KAR		
	KHAMMAM	AP	BHARATPUR	RJ		
	NALGONDA	AP	ALIGARH	UP		
	SRIKAKULAM	AP	ALLAHABAD	UP		
	WARANGAL	AP	BADAUN	UP		
	NAGAON	AS	BALLIA	UP		
	SARAN	BH	BARABANKI	UP		
	GURGAON	HR	DEHRADUN	UP		
	HISSAR	HR	FATEHPUR	UP		
	JIND	HR	LUCKNOW	UP		
	ROHTAK	HR	[Moved up to 6250-10200]			
	BELGAUM	KAR				
	KOLAR	KAR				
	CHINDWARA	MP				
	GWALIOR	MP				
	INDORE	MP				
	MORENA	MP				
	NARSIMPUR	MP				

	RAIPUR	MP							
	SHAJAPUR	MP							
	GANJAM	OR							
	SAMBALPUR	OR							
	BUNDI	RJ							
	CHITTORGARH	RJ							
	GANGANAGAR	RJ							
	RAMNATH PURAM	TN							
	AGRA	UP							
	AZAMGARH	UP							
	BASTI	UP							
	ETAH	UP							
	GHAZIPUR	UP							
	GORAKHPUR	UP							
	HARDOI	UP							
	JAUNPUR	UP							
	MAINPURI	UP							
	MATHURA	UP							
	PRATAPGARH	UP							
	SITAPUR	UP							
	SULTANPUR	UP							
	VARANASI	UP							
	24 PARGNAS N	WB							
	BIRBHUM	WB							
	MALDAH	WB							
	MIDNAPUR W	WB							
	MURSHIDABAD	WB							
	NADIA	WB							
	W.DINAJPUR	WB							
	[Moved up to 6250-10200]	———							

Source:As in Table 4.1

Cross Classification of Districts according to growth of output during 1980-83 to 1990-93 and yield levels in the terminal year 1990-93

Going by the yield and growth rates cross classification, the number of high yield and high growth districts increased from 5 in 1980-83 to 24 by 1990-93 (Table 4.9, 4.10 and 4.11). This happened as a result of the movement of 18 districts from the mid-yield and 1 from the low yield category. It is interesting to note that the largest number of districts that moved to the high yield category from the mid yield group were UP (4), 3 each from, Punjab and T.N, and 2 each from AP, GUJ and WB, and one from Karnataka.

Table 4. 11
Cross classification of districts by output growth during 1980-83 to 1990-93 and yield levels during terminal year 1990-93

Output (Rs/Hc) during 1990-93 (1990-93 prices)	No of districts in output growth rate categories: 1980-83 to 1990-93						Total
	More than 3.5percent		1.5percent to 3.5 percent		Less than 1.5percent		
	States	No. districts	States	No. districts	States	No. districts	
More than Rs 10200	AP	2	AP	3	AP	1	
	GJ	2	AS	1	AS	1	
	HAR	1	KAR	4	GJ	1	
	KAR	1	KER	4	KAR	1	
	KER	1	MAH	1	KER	2	
	PB	4	PB	6	TN	1	
	TN	4	TN	4			
	UP	5	UP	5			
	WB	4					
	Total	24		28		7	59
Rs 6250-10200	AP	5	AS	2	AP	1	
	AS	1	BH	2	GJ	2	
	BH	1	GJ	1	HAR	1	
	HAR	4	KAR	2	JK	1	
	KAR	4	MAH	1	MAH	2	
	MP	7	PB	1	UP	1	
	OR	2	RJ	1			
	RJ	3	UP	10			
	TN	2	WB	1			
	UP	19					
	WB	7					
	Total	55		21		8	84
Less Rs 6250	AP	1	AP	4	BH	8	
	BH	1	AS	2	GJ	7	
	HAR	1	BH	3	JK	1	
	KAR	3	GJ	5	KAR	1	
	MP	22	KAR	3	MP	4	
	MAH	1	MP	10	MAH	8	
	OR	8	MAH	12	RJ	1	
	RJ	18	OR	1	UP	1	
	UP	3	RJ	3			
	WB	1	UP	4			
			WB	1			
	Total	59		48		31	138
Overall		138		97		46	281

Source: As in Table 3.2

The medium yield-cum-high growth category experienced a movement of districts both ways. There took place an influx of 47 districts from the low yield to mid-yield set because of high growth. However 18 medium yield districts moved form medium to high yield category. Hence the net addition to the high growth cum mid yield category districts was 29 increasing their number from 26 during 1980-83 to 55 during 190-93.

Medium growth rates of 1.5 percent pa to 3.5 percent pa were also instrumental in the upward movement of districts. Thus 13 medium yield districts moved to the high yield category as a result of medium growth. But an equal number of districts moved to medium yield category from low yield set because of medium growth. Consequently, the number of medium yield cum medium growth districts remained unchanged at 21 during both 1980-83 and 1990-93. But, two of the districts belonging to Gujarat moved downwards from medium yield levels to low yield because of negative growth caused by adverse weather conditions.

Consequent to high growth during 1980-83 to 1990-93, as many as 47 of the low yield districts moved to mid yield and one moved to high yield category thereby leading to a net exodus of 48 districts. As a result, the number of low yield came down from 107 during 1980-83 to 59 only during 1990-93.

Medium growth of between 1.5 percent pa to 3.5 percent pa also resulted in movement of 13 low yield districts to medium yield category thereby reducing their number from 61 during 1980-83 to 48 by 1990-93.

Finally coming to the low growth cum low yield set of districts, their number increased from 30 during 1980-83 to 31 during 1990-93. This happened because whereas one district (Jalaun in UP) moved up from low to medium yield category, 2 districts of Gujarat (Amreli and Bhavnagar) moved down from medium to low yield category because of negative growth.

As a consequence of the high growth of output during 1980-83 to 1990-93, there was a general improvement in yield levels by 1990-93. Thus the number of high productivity districts increased from 25 during 1980-83 to 59 by 1990-93. In the mean time, the number of mid-productivity districts increased from 58 to 84. On the other hand, the number of low productivity districts declined from 198 during 1980-83 to only 138 by 1990-93.

Cross Classification of Districts according to their Growth Rates during 1990-93 to 2003-06 and yield levels during 1990-93

There was a deceleration of growth during 1990-93 to 2003-06 as compared with the earlier period 1980-83 to 1990-93. As a result, the number of high growth districts exceeding 3.5 percent pa declined to 61 during 1990-93 to 2003-06 as compared with 138 districts that had registered high growth during 1980-83 to 1990-93.

Out of these 61 high growth districts, as many as 52 belonged to the low productivity category (productivity less than Rs.6250/ ha) and 9 to the mid-productivity category. Interestingly, none of the districts in high yield category registered the high growth exceeding 3.5 percent pa during this period.

During 1990-93 to 2003-06, it was the 52 districts in the lowest productivity category located in the states in the central region that dominated the high growth category exceeding 3.5 percent pa. Out of the 52 low productivity high growth districts, as many as 45 were located in the states in the central region (MP18, RJ 15, GJ 9 and MAH 3). The rest were distributed among many other states (Table4.12).

In addition there were a few (9) mid-productivity districts also that recorded high growth and 4 of these also belonged to the states in the central region. During the earlier period, the growth was regionally more spread out and in addition to the central region, the high growth districts were also distributed over other regions of the country.

Table 4.12
Cross classification of districts by growth of output during 1990-93 to 2003-06 and yield levels during base year 1990-93

Output (Rs/Hc) during 1990-93 (1990-93 prices)	No of district in output growth rate categories:1990-93 to 2003-06								
	≥3.5percent			1.5-3.5percent			<1.5percent		All
More than Rs. 10200				AP	4		AP	2	
				HAR	1		AS	2	
				KAR	5		GJ	3	
				KER	4		KAR	1	
				PB	5		KER	3	
				UP	3		MAH	1	
				WB	3		PB	5	
							TN	9	
							UP	7	
							WB	1	
					25			34	59
Rs. 6250-10200	AP	2		AP	1		AP	3	
	GJ	1		GJ	1		AS	3	
	HAR	1		HAR	4		BH	3	
	MAH	1		KAR	1		GJ	1	
	RJ	2		MP	4		JK	1	
	UP	1		MAH	2		KAR	5	
	WB	1		PB	1		MP	3	
				RJ	2		OR	2	
				UP	12		TN	2	
				WB	6		UP	17	
							WB	1	
		9			34			41	84
Less than Rs. 6250	AP	2		AP	2		AP	1	
	BH	2		AS	1		AS	1	
	GJ	9		BH	3		BH	7	
	HAR	1		GJ	3		JK	1	
	KAR	1		KAR	3		KAR	3	
	MP	18		MP	10		MP	8	
	MAH	3		MAH	7		MAH	11	
	RJ	15		OR	2		OR	7	
	WB	1		UP	4		RJ	7	
				WB	1		UP	4	
		52			36			50	138
Overall		61			95			125	281

Source: Annexure 1(a)-1(e)

During 1990-93 to 2003-06, there were 95 districts that recorded a medium growth ranging between 1.5 percent to 3.5 percent pa. Out of these 36 belonged to the low yield category, 34 to the mid-yield category and 25 to the high yield category.

Unlike the dominance of low productivity districts of the central region in the highest growth districts, no specific region dominated the mid-growth category of districts.

Out of these 36 low yield medium growth districts, 20 belonged to the states in the central region (MP 10, MAH 7, GJ 3), and the rest were spread over all the states.

Out of 34 mid yield medium growth districts, 12 belonged to UP, 6 to WB, and 4 each to MP and HAR and the other were distributed over many states.

Finally, the 25 high yield medium growth districts were mainly spread over the states in north-western and the southern region.

During 1990-93 to 2003-06, 125 districts recorded low growth rate of less than 1.5 percent pa. Out of these 34 were in the high yield category, 41 in the mid yield category and as many as 50 in the low yield category.

The 34 high yield cum low growth category districts mainly belonged to the north-western states (PB 5, UP 7), and the southern states (TN 9, KER 3).

Out of the 41 mid-yield and low growth category districts, 17 were in UP, 5 in KAR and the rest were distributed over several states.

Finally, more than half (26) of the 50 low productivity low growth districts belonged to the states in the central region (MAH 11, MP 8 and RJ 7). Out of the rest 24 districts in low productivity cum low growth category, 15 were from the states in the eastern region (BH 7, OR 7 and AS 1), 4 from UP, 3 from KAR, and one each from JK and AP.

As noted earlier, these 50 low yield cum low growth districts which are manly concentrated in the central and the eastern regions constitute the hard core of agricultural underdevelopment (Table 4.12).

Growth during 1990-93 to 2003-06 and Movement of districts across yield level categories during 1990-93 to 2003-06

Despite a deceleration of growth during the post-reform period 1990-93 to 2003-06, quite a few districts were able to move to higher yield categories because of varying growth rates recorded by them. Consequently, the number of districts in the high productivity range exceeding Rs. 10200/ha increased from 59 during 1990-93 to 94 by 2003-04 (Table 4.7 and 4.10).

Consequent to high growth exceeding 3.5 percent pa, 7 districts moved from the medium yield to the high yield category (exceeding Rs 10,200/hec). Interestingly high growth resulted in the movement of the six districts (four in Gujarat, and one each in Rajasthan and West Bengal) from the low yield category during 1990-93 to high yield category of districts by 2003-06. Similarly, as many as 20 districts in low yield category also recorded high growth and moved from low yield category to mid yield category. Most of these were located in the undeveloped central region states. Interestingly none of the high yield districts was able to record growth rate exceeding 3.5 percent pa during 1990-93 to 2003-06. On the other hand, one district (Thanjavur in Tamil Nadu) slipped from the high to the mid yield category because of the negative growth recorded by it during this period.

By achieving medium growth ranging between 1.5 to 3.5percent p.a. as many as 16 distracts in the mid yield category moved to the high yield category and 14 districts from the low yield category to mid yield group of districts. Thus the number of medium growth mid yield districts came down from 34 during 1990-93 to 32 by 2003-06.

Coming now to low growth districts, 6 districts were able to move up from mid-yield category to high yield group and 9 district in the low yield category moved up to mid yield category. However, 5 districts in the mid- yield category during the base period 1990-93 slipped down to the low yield level (less than Rs. 6250/hect) by 2003-06 because of negative growth.

Table 4.13
Growth during 1990-93 to 2003-06 and movement of districts across yield level categories during 1990-93 to 2003-06

Output/Hect. During 1990-93 (1990-3 prices)	Name of district in output growth rate categories: 190-93 to 2003-06					
	More than 3.5percent		1.5-3.5percent		Less than 1.5percent	
More than Rs 10200					THANJAVUR	TN
			NIZAMABAD	AP	TIRUCHIRAPALLI	TN
Rs 6250-10200	KHAMMAM	AP	HISSAR	HR	BAREILLY	UP
	WARANGAL	AP	JIND	HR	BULLANDSHAHR	UP
	JUNAGARH	GJ	ROHTAK	HR	DEORIA	UP
	KARNAL	HR	RAIGAD	MAH	FAIZABAD	UP
	RATNAGIRI	MAH	HOSHIARPUR	PB	SHAHJAHANPUR	UP
	AGRA	UP	ALIGARH	UP	TIRUCHIRAPALLI	TN
	MURSHIDABAD	WB	ETAH	UP	BAREILLY	UP
	[Moved up to >=10200]		MAINPURI	UP	[Moved up to >=10200]-------	
			MATHURA	UP		
			24 PARGNAS N	WB	[Moved down to<6250]	
			BIRBHUM	WB	SARAN	BH
			MALDAH	WB	KOLAR	KAR
			MIDNAPUR W	WB	RAIPUR	MP
			NADIA	WB	SHAJAPUR	MP
			W.DINAJPUR	WB	GANJAM	OR
			[Moved up to >=10200]			
Less Rs 6250	RAJKOT	GJ	HYDERABAD	AP	KAMRUP	AS
	JAMNAGAR	GJ	MAH.NAGAR	AP	BANGALORE	KAR
	BHAVNAGAR	GJ	GOALPARA	AS	SATARA	MAH
	AMRELI	GJ	KUTCH	GJ	BETUL	MP
	KOTA	RJ	SABARKANTHA	GJ	CUTTACK	OR
	JALPAIGURI	WB	BELLARY	KAR	DHENKANAL	OR
	[Moved up to >=10200]		JALGAON	MAH	MAYURBHANJ	OR
			SEHORE	MP	RAEBARELI	UP
	MEDAK	AP	BALASORE	OR	[Moved up to 6250-10200]	
	ADILABAD	AP	KEONJHAR	OR		
	DUMKA	BH	BAHRAICH	UP		
	HAZARIBAGH	BH	GONDA	UP		
	BHARUCH	GJ	UNNAO	UP		
	SURENDRANAGAR	GJ	PURULIA	WB		
	BANAS KANTHA	GJ	[Moved up to 6250-10200]			
	AHMEDABAD	GJ				
	MAHENDRAGARH	HR				
	WARDHA	MAH				
	DEWAS	MP				
	HOSHANGABAD	MP				
	DHAR	MP				
	RATLAM	MP				
	SHIVPURI	MP				
	RAJGARH	MP				
	SWAI MADHOPUR	RJ				
	ALWAR	RJ				
	JHALAWAR	RJ				
	JAIPUR	RJ				
	[Moved up to 6250-10200]					

Source: As in Table 4.1

Table 4.14
Cross classification of districts by output growth during 1990-93 to 2003-06 and yield levels during the terminal year 2003-06

Output (Rs/Hc) during 2003-06 (1990-93 prices)	No of district in output growth rate categories: 1990-93 to 2003-06						Total
	More than 3.5 percent		1.5 to 3.5 percent		Less than 1.5percent		
	States	No. districts	States	No. districts	States	No. districts	
More than Rs 10200	AP	2	AP	5	AP	2	
	GJ	5	HR	4	AS	2	
	HR	1	KAR	5	GJ	3	
	MAH	1	KER	4	KAR	1	
	RJ	1	MAH	1	KER	3	
	UP	1	PB	6	MAH	1	
	WB	2	UP	7	OR	1	
			WB	9	PB	5	
					TN	9	
					UP	12	
					WB	1	
	Total	13		41		40	94
Rs 6250-10200	AP	2	AP	2	AP	3	
	BH	2	AS	1	AS	4	
	GJ	4	GJ	3	BH	2	
	HR	1	HR	1	GJ	1	
	MAH	1	KAR	2	JK	1	
	MP	6	MP	5	KAR	5	
	RJ	6	MAH	2	MP	2	
			OR	2	MAH	1	
			RJ	2	OR	4	
			UP	11	TN	2	
			WB	1	UP	13	
					WB	1	
	Total	22		32		39	93
Less Rs 6250	GJ	1	BH	3	AP	1	
	KAR	1	GJ	1	BH	8	
	MAH	2	KAR	2	JK	1	
	MP	12	MAH	6	KAR	3	
	RJ	10	MP	9	MAH	10	
			UP	1	MP	9	
					OR	4	
					RJ	7	
					UP	3	
	Total	26		22		46	94
Overall		61		95		125	281

Source: As in Table 3.2

Table 4.13 brings out that even with slow down of growth during 1990-93 to 2003-06, several districts were able to move up the productivity ladder.

The net result was that the number of high yield districts increased from 59 during 1990-93 to 94 by 2003-06. In the meantime, the number of medium yield districts increased from 84 to 93. But what is interesting is that the number of low yield districts declined from 138 during 1990-93 to only 94 by 2003-06.

This decline notwithstanding, even by 2003-06 46 districts belonged to the low growth cum low yield set of districts. More than a half of these least developed and poor growth districts are located in central region states of Maharashtra (10), Madhya Pradesh (9) and Rajasthan (7). Similarly more than a half (8 /15) districts in Bihar falls in this category of least developed and low growth group of districts. Besides these, Anantapur in Andhra Pradesh, Jammu in Jammu and Kashmir, Bijapur, Bangalore and Bidar in Karnataka, Ganjam, Kalahandi, Sundergarh and Phulbani in Orissa , and Banda, Mirzapur and Hamirpur in Uttar Pradesh also fall in this least developed cum low growth set of districts (Table 4.14).

It is obvious that a large proportion of farming community and agricultural workers living in these districts have low productivity and low income levels. That the agricultural growth rates are also low is indicative of the poor plight they are caught in, since the future also does not look bright.

The long term solution to improve their well-being lies in rejuvenating the processes of agricultural growth in these areas with a view to improving the productivity and income levels of the farming community.

Inputs Use and Growth of Output

This section is devoted to an analysis of input use by district arranged according to their output growth rates in order to investigate whether the growth of crop output during different periods was associated with the use of modern inputs.

It is important to underline that to begin with, except for irrigation, the use of other modern inputs was abysmally low in the base year 1962-65. For example, at the all-India level, during 1962-65 fertilizer consumption was 3.7 kg per hectare and there were only 0.4 tractors and 6.5 pump-sets per thousand hectares of area. (Table 4.15). Even in

the case of irrigation, only 18.1 per cent of net sown area was irrigated during that period. The growth rates recorded during 1962-65 to 1980-83 were very much determined by these initial conditions.

That irrigation was a major source of growth during 1962-65 to 1980-83 and afterwards is brought out by the fact that the high growth districts had a relatively much higher share in area under irrigation. The 50 districts that recorded growth rates exceeding 3.5 per cent p.a. during 1962-65 to 1980-83 had 29.9 per cent of net area under irrigation compared with 18.1 per cent of net sown area under irrigation for all the districts.

It can be legitimately postulated that it was the initial advantage in irrigation that enabled these districts to adopt new seed-fertilizer technology (which to begin with was highly biased in favour of irrigated areas) and thereby to record phenomenal increases in yields and output by making relatively much higher use of modern inputs. Thus, the 50 districts that recorded high growth rate above 3.5 per cent per annum during 1962-65 to 1980-83 used 4.3 Kg of fertilisers per hectare during 1962-65 but by 1980-83, these districts were using 60.5 kg of fertiliser per hectare compared with an average of 34.1 Kg for all the 281 districts taken together and 22.7 kg used by the low growth districts. Consequently, the productivity of these very high growth rate districts increased from Rs. 4108 in the base period 1962-65 to Rs. 7424 by the terminal period 1980-83, that is, at a compound annual rate of 3.3 per cent. That for these districts, productivity growth was the major source of output growth is clear from the fact that in their case more than 70 per cent of the growth of output was accounted for by growth of productivity.

4.15 (a)

Distribution of districts by growth of output during 1962-65 to 2003-06 and categories-wise inputs used: 1962-65 and 2003-06

Growth rate of output(percentpa)	Number districts	Yield (Rs./ Hect)		Fertilizer(Kgs/Hc)		Tractors (No/000Hc)		Tubewell (No/000Hc)		% Area Irrigated gia		Agric Workers	
		1962-65	2003-06	1962-65	2003-06	1962-65	2003-06	1962-65	2003-06	1962-65	2003-06	1962-65	2003-06
High >= 3.5 percent	49	3073	10203	1.9	146.3	0.6	27.0	3.9	119.2	18.3	60.2	420	2063
Medium 1.5 - 3.5 percent	169	3803	8582	3.2	96.3	0.3	12.7	4.6	82.2	16.1	39.3	803	1257
Low < 1.5percent	63	4254	6643	5.1	72.0	0.3	5.3	11.0	64.5	27.7	29.3	1412	786
All	281	3804	8522	3.3	97.9	0.3	13.0	5.8	83.5	18.9	40.0	848	1264

Source: As in Table 4.1

Table 4.15 (b)

Distribution of districts by growth of output during 1962-65 to 1980-83 and categories-wise inputs used: 1962-65 and 1980-83

Growth rate of output % pa 1962-65 to1980-83	districts	**Yield (Rs./ Hect)**		**Fertilizer(Kgs/Hc)**		**Tractors (No/000Hc)**		**Tubewell (No/000Hc)**		**percent Area irrigated**		**Agr Workers**	
		1962-65	**1980-83**	**1962-65**	**1980-83**	**1962-65**	**1980-83**	**1962-65**	**1980-83**	**1962-65**	**1980-83**	**1962-65**	**1980-83**
High >= 3.5	50	4108	7224	4.3	60.5	0.9	7.9	6.3	65.2	31.6	51.8	630	805
Medium 1.5 - 3.5	137	3667	5055	3.4	32.4	0.3	2.3	4.6	33.6	16.5	26.5	845	999
Low < 1.5	94	3862	4269	2.9	22.7	0.2	1.3	7.1	40.5	16.8	21.6	997	1200
All	281	3804	5201	3.3	34.1	0.3	3.0	5.8	39.9	18.9	29.3	850	1033

Table 4.15 (c)

Distribution of districts by growth of output during 1980-83 to 1990-93 and categories-wise inputs used: 1980-83 and 1990-93

Growth rate of output % pa 1980-83 to 1990-93	Number districts	Yield (Rs./ Hect)		Fertilizer(Kgs/ Hc)		Tractors (No/000Hc)		Tubewell(No/000Hc)		% Area irrigated		Agr Workers	
		1980-83	1990-93	1980-83	1990-93	1980-83	1990-93	1980-83	1990-93	1980-83	1990-93	1980-83	1990-93
High >= 3.5 %	138	4849	7210	32.8	67.1	3.2	12.0	37.4	53.2	30.4	37.8	997	1092
Medium 1.5 - 3.5 %	97	5634	7016	37.6	72.8	3.2	10.4	42.8	54.9	31.4	34.7	1055	1199
Low < 1.5%	46	5409	5611	30.8	64.1	1.8	7.4	42.1	58.3	21.4	23.9	1104	1311
All	281	5201	6902	34.1	68.5	3.0	10.8	39.9	54.6	29.3	34.6	1033	1161

Table 4.15 (d)

Distribution of districts by growth of output during 1990-93 to 2003-06 and categories-wise inputs used: 1990-93 and 2003-06

Growth rate of output % pa 1990-93 to 2003-06	Number of districts	Yield (Rs./ Hect)		Fertilizer(Kgs/Hc)		Tractors (No/000Hc)		Tubewell(No/000Hc)		percent Area irrigated		Agric Workers	
		1990-93	2003-06	1990-93	2003-06	1990-93	2003-06	1990-93	2003-06	1990-93	2003-06	1990-93	2003-06
High >= 3.5 percent	61	4404	7335	40.3	85.1	9.2	16.5	46.1	108.4	20.8	43.1	846	1639
Medium 1.5 - 3.5 percent	98	7606	9639	64.0	143.5	10.0	17.8	43.9	101.9	30.3	53.3	876	1477
Low < 1.5percent	122	7472	8156	47.8	113.4	6.6	13.7	38.2	95.8	25.4	46.6	913	1697
All	281	6902	8522	52.1	118.0	8.2	15.7	41.5	100.6	26.3	48.2	883	1520

Source: As in Table 4.1

The fact that the high growth districts were using comparatively much larger amounts of modern inputs on a per hectare basis led to the concentration in the use of these inputs in the high growth districts. To begin with, the 50 high growth districts (that recorded a growth rate exceeding 3.5 per cent per annum during 1962-65 to 1980-83) with 14.8 per cent share in area during the sixties had a share of 25.4 per cent in the gross irrigated area (Table 4.2). As suggested earlier, it was the advantage in terms of the irrigated area that enabled these 50 districts to make use of modern inputs in a big way and thereby to achieve very high rates of growth. In the process, both the value of output and the use of modern inputs tended to get concentrated in these districts. Thus by 1980-83, with 17.4 per cent area, these 50 high growth districts accounted for 31.1 per cent of gross irrigated area, 31.3 per cent of fertilisers, 46.8 per cent of all the tractors and 24.8 per cent of output in the country.

Coming now to the 137 medium growth districts, during the base period 1962-65 with a little less than the average level of irrigation, they were using a very small amount of fertilisers and were having proportionately less than the average number of tractors and tubewells. By 1980-83 they were almost able to maintain an average level of irrigation (26.5 per cent as against all India average of 29.3 per cent), and were using nearly the average level of fertilisers at 36.5 Kg./Hect. Consequently, they registered yield growth at a rate of 1.8 per cent p.a. compared with an output growth rate of 2.3 per cent p.a. This underlines the fact that productivity increases were the main source of growth of output. There was an increase in average productivity from Rs. 3667.00 during 1962-65 to Rs. 5055 during 1980-83 (Table 4.2 c).

The 94 low growth districts (including 22 negative growth districts) used relatively much lower inputs in per hectare terms than the other categories. During 1962-65 the use of fertilizer was very low indeed. Even by 1980-83, the low growth districts used only 18.0 kg per hectare of fertilisers compared with 69.8 kg used by very high growth districts and an average consumption of 38.7 kg per hectare. During 1962-65, the percentage of area irrigated in the low growth districts was nearly 16.8 per cent compared with 31.6 per cent for high growth districts. Similar was the story about the use of tractors. Consequently, the low growth districts recorded a productivity growth rate of only 0.6 per cent per annum. Because of the very low input use on a per hectare basis, the

share of modern inputs by low growth districts remained low relative to their share in area even in the terminal year. Thus, during 1980-83, with 33.8 per cent share of area, the low growth districts accounted for only 27.7 per cent of output, 25.2 per cent of gross irrigated area, 22.7 per cent fertilisers and had 15.3 per cent of total tractors in the country.

Period 1980-83 to 1990-93

There was a significant acceleration in growth during 1980-83 to 1990-93 (the eighties) period. This was also associated with much higher use of modern inputs by all categories of districts. However, unlike the earlier period, 1962-65 to 1980-83, there was no worthwhile association between growth rates of output and either levels or growth rates of inputs.

Thus the use of most of the inputs by the 138 high growth districts both in the initial and final triennia was almost proportionate to their area. The only minor exception was irrigation where the use by high growth districts was slightly greater. Furthermore, for the 138 high growth districts that recorded growth rates exceeding 3.5 per cent per annum, the productivity levels were significantly lower than the average productivity levels and the use of inputs was far below their share of area. Thus with a share of 50.3 per cent of area during 1980-83, the 138 high growth districts accounted for 49.1 per cent of fertilisers, 53.3 per cent of gross area irrigated, and 54.3 per cent of tractors. This brings out the fact that a majority of the very high growth districts had relatively low levels of productivity to begin with. The high growth seems to have been because of low base in productivity levels, relatively high irrigation base, use of average level of fertilisers and the influence of good weather and cropping pattern changes.

These differences almost cease to exist for the medium growth districts. For the slow growth districts, except for irrigation, the use of other inputs was in proportion to their area. However, strangely enough, even for negative growth districts the use of inputs was more or less in proportion to their proportion of area indicating that even with average use of inputs, their growth rates were negative. Only the vagaries of weather which can explain this anomaly.

Sources of Agricultural Growth: Econometric Analysis

The tabular analysis undertaken above brings out the relationship between inputs and growth rates of agricultural output. An attempt is made below to supplement the tabular analysis by an econometric analysis of the contribution of individual modern inputs to growth in output during 1980-83 to 1990-93 and 1990-93 to 2003-06. The contribution of various factor inputs to growth in production has been worked out by making use of the partial production elasticities of various inputs estimated in the preceding chapter. Estimates of production elasticities in the preceding chapter were based on the following form of the Cobb-Douglas production;

$$\begin{aligned}\text{Log}_n(\text{Output}) = \beta_0 &+ \beta_1\text{Log}_n(\text{Land}) + \beta_2\,\text{Log}_n(\text{Labour}) + \beta_3\,\text{Log}_n(\text{Fertiser}) + \beta_4\text{Log}_n(\text{Tractors}) \\ &+ \beta_5\text{Log}_n(\text{Tubewells}) + \beta_6\,\text{Log}_n(\text{Irrigation}) + \beta_7\,\text{Log}_n(\text{Roads}) + \\ &\beta_8\,\text{Log}_n(\text{Markets}) + \beta_9\,\text{Log}_n\,(\text{Rainfall}) + \sum_{i=1}^{14}\delta_i DZ_i + \sum_{j=1}^{15}\gamma_j DS_j + \text{U}\end{aligned} \quad (1)$$

Taking per annum partial derivative with respect to time t give the following decomposition of growth by factor inputs is obtained:

$$\begin{aligned}\Delta\,(\text{Output}) = &\,[\beta_1\,\Delta(\,\text{Land})] + [\beta_2\,\Delta\,(\text{Labour})] + [\beta_3\,\Delta(\text{Fertiliser}) + \beta_4\,\Delta(\text{Tractor}) \\ &+ \beta_5\Delta(\text{Tubewells})] + [\beta_6\,\Delta(\text{Irrigation}) + \beta_7\,\Delta(\text{Roads}) + \beta_8\,\Delta(\text{Markets})] \\ &+ [\beta_9\,\Delta(\text{Rain June}) + \Delta\text{U}]\end{aligned} \quad \textbf{(2)}$$

Where β's are the production elasticities estimated in chapter III and Δ is the growth rate. The first term in equation (2) measures the effect of change in area on production growth. Similarly, the second term, the third and the fourth terms capture the impact of labour, modern inputs and infrastructure respectively on growth of output. Finally, the last term represents the residual.

Table 4.16

Contribution of factors to output growth in Indian agriculture, 1980-83 to 2003-06

Factor	1980-83 to 1990-93				1990-93 to 2003-06			
	Output elasticity (β)	Growth rate of input	Contribution to output growth		Output elasticity (β)	Growth rate of input	Contribution to output growth	
			absolute	percentage			absolute	percentage
Land	0.38				0.41			
Net area sown		0.11	0.04	1.08		-0.05	-0.02	-1.11
Cropping intensity		0.48	0.18	4.71		0.38	0.15	8.46
Gross cropped area		0.59	0.22	5.79		0.33	0.13	7.34
Labour	0.15	2.03	0.30	7.93	0.09	0.97	0.08	4.64
Modern Inputs				46.14				47.86
Fertilisers	0.16	7.60	1.22	32.03	0.16	3.12	0.51	27.86
Tractors	0.05	8.95	0.41	10.78	0.05	5.21	0.28	15.46
Tubewells	0.03	5.09	0.13	3.33	0.03	2.58	0.08	4.54
Infrastructure				4.50				7.51
Irrigation	0.04	1.98	0.07	1.89	0.02	1.09	0.03	1.44
Roads	0.05	1.41	0.07	1.77	0.03	1.80	0.06	3.21
Markets	0.05	0.66	0.03	0.84	0.07	0.77	0.05	2.86
Residual (TFPG)			1.14	35.64			0.46	32.66
Total change*			3.82	100.0			1.82	100.0

Note: * Growth rates estimated by adjusting value output to total gross cropped area as input information is for the total crop sector.

Source: As in Table 4.1

Table 4.16 contains the results of the contributions of factors in explaining growth in agricultural production during the periods 1990-93 to 2003-06[3].

The results bring out that in absolute terms, compared with the period 1980-83 to 1990-93, the contribution of various inputs to output growth declined during the post-reform period 1990-93 to 2003-06. The deceleration in growth of output during 1990-93 to 2003-04 compared with the earlier period can be attributed to deceleration in the growth of various inputs.

However in terms of the proportionate contribution of various inputs, the picture is slightly different. The contribution of area to growth of output has increased from 5.79 percent during eighties to 7.34 percent during 1990-93 to 2003-06. Though the growth of

3 The output elasticities for the initial period 1962-65 were not estimated since the use of modern inputs was very low and most of the variations in productivity were because of agro-climatic conditions.

land area under cultivation decelerated from 0.59 per cent per annum during the eighties to 0.33 per cent during later period, there was an increase in the elasticity of land with respect to growth of output. The noteworthy feature of area contribution during the later period is that the entire contribution came via increased intensification of land use as net sown area declined during this period.

Contrary to land, the contribution by labour to growth of output declined from 7.93 per cent during 1980-83 to 1990-93 to 4.64 per cent during 1990-93 to 2003-06. It was the decline in the growth of the labour force in agriculture as well as the decline in the output elasticity of labour which resulted in the reduced contribution of labour to overall growth.

Contrary to these traditional factors of production, the contribution of modern inputs does not show much change overtime. It hovered around 46-48 per cent of the overall growth during both the periods. Interestingly, though the growth rate of modern inputs, fertiliser, tractors and tubewells, declined rapidly during 1990-93 to 2003-06 period, yet their rising output elasticities enabled them to maintain their share in output growth. . However among the modern inputs there were minor variations over time. The share of fertilisers in output growth declined from 32.08 per cent during 1980-83 to 1990-93 to 27.86 per cent during 1990-93 to 2003-06 whereas that of mechanical inputs (tractors and tubewells) increased form 14.11 to 20.00 per cent over the same period. Although the elasticity of output growth with respect to fertilisers remained at the same level, it was rapid decline in the growth rate of fertiliser use that led to a decline in the contribution of fertilisers to output growth during 1990-93 to 2003-06. Contribution of growth of infrastructure to output growth improved from 4.5 per cent during the eighties to 7.51 per cent during 1990-93 to 2003-06.

In the growth accounting framework after taking account of the contribution from changes in factor inputs, the residual in growth is described as **total factor productivity**. Accordingly, the residuals in Table 4.12 measure the contribution of total factor productivity growth (TFPG) to growth of output during two periods. Interpreted in this sense, the TFPG, like overall growth, declined rapidly from 1.14 per cent per annum during 1980-83 to 1990-93 to 0.46 per cent per annum during 1990-93 to 2003-06. This is contrary to expectations that the processes of economic reforms would enhance resource use efficiency by unleashing the forces of growth in agriculture.

However, the TFPG measured this way should be interpreted cautiously since besides measuring technical progress, it also captures the effects of numerous other factors like government policies, socio-economic environment, pests and disease attacks on crops and weather shocks that tend to have a significant bearing on the efficiency of resource usage (Bosworth and Collins, 2008).

Reverses to the TFPG notwithstanding, relative contribution of TFPG to overall growth of agriculture hovered around 33-36 per cent during both the pre- and post-reform periods. On the whole, it seems that policies initiated under economic reforms resulted in a slow down in the use of inputs and TFPG and both these taken together resulted in deceleration in growth in Indian agriculture.

Summary and Conclusions

An analysis of the pattern of agricultural output growth over the period 1962-65 to 2003-06 and its various sub periods namely 1962-65 to 1980-83 (first period), 1980-83 to 1990-93 (second period), and 1990-93 to 2003-06 (the post-reform period) clearly brings out that the adoption of new technology led to a notable acceleration in growth rates of output.

During 1962-65 to 1980-83, the output growth rates were moderate and high growth was confined mainly to the north western and coastal regions of India where the new technology had been adopted. The growth of agricultural output was much more widespread across all the regions of India during 1980-83 to 1990-93. The main reason for this acceleration was the extension of new technology towards the eastern and the

central regions. In addition, there was fairly rapid diversification from coarse cereals towards high value crops mainly oilseeds in the central region and southern region and from coarse cereals to wheat and rice in the north western region and eastern region.

But, there was a deceleration in growth rate of agricultural output during 1990-93 to 2003-06 as compared with the earlier period 1980-83 to 1990-93. It is interesting to note that it was high yield districts in the north-western region that registered a significant slow down in their growth rates.

The spatial distribution of districts according to their growth rates over various periods given in the various maps highlights the tremendous improvement in the regional coverage of growth over the period 1980-83 to 1990-93 and then a slow down during 1990-93 to 2003-06.

Cross-classification of districts according to their yield levels and growth rates of output helps to understand the dynamics of change in Indian agriculture during the post green revolution period. The analysis highlights those districts which have achieved higher levels of productivity as a result of more rapid growth as also those districts that have remained backward with low productivity because of low growth rates of output during various periods.

Policy makers would be specially interested in looking at the 94 districts where yield levels were less than Rs. 6,250 per hectare even during 2003-06. While, 26 of these had high growth and 22 medium rates of output growth of during 1990-93 to 2003-06, 46 of these low productivity districts belong to that set of districts that registered low rates of output growth also during the period 1990-93 to 2003-06.

While 26 of these 46 districts belonged to the states in the central region (Maharashtra 10, Madhya Pradesh 9, and Rajasthan 7), another 8 belonged to Bihar and 4 to Orissa in the eastern region. In addition, 3 each of these were located in UP and Karnataka and I each in AP and JK. These 46 districts constitute the hard core of underdevelopment and need special attention. Interestingly because of slow down of growth during 1990-93 to 2003-06 as compared with the earlier period, the number of hard core low productivity cum low growth districts has increased from 31 during the past decade to 46 at present.

Finally, decomposition of growth brings out that almost a half of growth in output is contributed by modern inputs, namely fertiliser, tractors and tubewells, about 12-14 per cent by increased use of traditional inputs, namely land and labour, 5-8 per cent by growth of rural infrastructure, and remaining about one-third by the growth of total factor productivity growth in Indian agriculture (Bosworth Barry and Susan M. Collins, 2008). All these factors contributed to the recent deceleration of growth in Indian agriculture. The growth of modern inputs used in agriculture in general and fertiliser in particular declined significantly during the reform period and so did TFPG. TFPG decelerated from a high of 1.14 per cent per annum during the eighties to 0.46 per cent per annum during the post-reform period. Realisation of the targeted 4 per cent growth requires polices and programmes aimed at increased use of modern inputs and improvement in TFPG in Indian agriculture.

Finally, decomposition of growth due to increased use of various inputs and services clearly brings out that that increased use of modern inputs and higher availability of infrastructure services contributed a major proportion (almost 80 percent) of growth of crop production in Indian agriculture during the seventies and the eighties. Realisations of gains from use of modern inputs however are constrained by lack of infrastructure in certain regions, the inefficiencies in the farm production as well as by vagaries of weather and disease and pests.

Chapter - V

Changes in Agricultural Labour Productivity: A State and District Level Analysis

Introduction

The main objective of this chapter is to analyse inter-regional variations in the level and growth of agricultural workers productivity (AWP) at the state and district levels during 1962-65 to 2003-06 and its various sub periods namely 1962-65 to 1980-83, 1980-83 to 1990-93 and 1990-93 to 2003-06. The importance of this analysis emanates from the fact that ultimately it is AW productivity that determines the living standard of the working population in agriculture.

Historically speaking in traditional societies, in spite of vast differences in land yields, per worker productivity levels have tended to remain more or less equal over various regions (Boserup, 1965, and Myrdal, 1968). Regional inequalities in productivity levels were kept low through migration, population adjustment and the `suction mechanism'. Whereas fertile lands had generally higher population density, the arid zones with low yields were characterised by sparse population. However, these traditional relationships which also obtained in India, got considerably weakened even during the British period, more so after independence, because of uneven regional patterns of investment in rural infrastructure and in irrigation. Thus, there existed large inter-state variations in labour productivity in India even before the advent of new technology during the mid-sixties.

According to some scholars, high rates of agricultural output are associated with higher growth rates of the agricultural work force and vice versa. This very high labour absorption in fast growing regions was characterised by us as the suction mechanism in an earlier study. (Alagh, Bhalla and Bhaduri, 1978). It is noticed that initially in labour surplus economies, a spurt in agricultural growth leads to increased demand for farm labour and a rise in agricultural wages. This results in an influx of labour into agriculture. This higher degree of labour absorption tends to reduce inter-regional differences in labour productivity. Over time, because of the rapid increase in wages in the advanced agricultural regions, labour starts getting displaced by capital. Further, as non-agricultural activities emerge, the work force starts getting diversified to non-agricultural sectors which tends to increase inter-regional variations in labour productivity.

The regression results bring out that the value of the regression coefficient, which was negative 0.52 during 1962-65 nearly conformed to the rectangular hyperbola pattern envisaged by Ishikawa (Ishikawa, 1967)[1]. But the relationship considerably weakened over time. The regression coefficient came down to negative 0.338 by 1990-93 and came down to only 0.11 by 2003-06 (Table 5.1).

Table 5.1
Land-man ratio and output per hectare, 1962-65 to 2003-06

[$\log_n$ (NSA/agricultural workers) = $\alpha + \beta \log_n$ (output/hectare of NSA)]

Period	R^2	Intercept (α)	Slope coefficient (β)	t-value of slope coefficient(β)
1962-65	0.351	0.805	-0.519	12.254
1980-83	0.225	0.444	-0.357	8.958
1990-93	0.179	0.349	-0.338	7.782
2003-06	0.020	-0.215	-0.109	2.040

Source: Estimated from district level data produced in annexure 1(a) to 1(e).

Another way of putting the same argument is that whereas in traditional agriculture almost the entire increase in yield is brought about through labour absorption, the same is now being increasingly accomplished through the application of capital and other inputs. Thus, with other factors becoming important, labour use has not increased proportionately with increases in output and hence labour productivity has risen along with output increases. Consequently, over time the employment elasticity with respect to the value of output in agriculture has tended to decline (Table 5.2).

Table 5.2
Elasticity's of labour absorption in Indian agriculture, 1962-65 to 2003-06

[$\log_n$ (agricultural workers) = $\alpha + \beta \log_n$ (value output)]

Period	R^2	Intercept (α)	Slope coefficient (β)	t-value of slope coefficient(β)
1962-65	0.534	2.568	0.717	17.867
1980-83	0.334	5.258	0.535	12.091
1990-93	0.302	5.685	0.507	11.091
2003-06	0.134	7.329	0.398	6.556

Source: Estimated from district level data produced in annexure 1(a) to 1(e).

[1]. This relationship between land productivity and land man ratio has been termed as Rectangular Hyperbola hypothesis by Ishikawa.(Ishikawa,1967).

The elasticity of labour absorption with respect to agricultural output, which was 0.717 during 1962-65, declined to 0.535 during 1980-83, and further declined to 0.398 during 2003-06 (Table 5.2).

Excessive population pressure on land exacerbated because of lack of workforce diversification combined with technological backwardness and low yields constitute the two most important structural problems of Indian agriculture. As a consequence, the productivity and income levels of agricultural workers have remained relatively quite low. At the all-India level, during 2004-05, per worker productivity in agriculture was one fifth that in non-agricultural occupations.

It is the per worker productivity levels in agricultural and non-agricultural activities that ultimately determine wages, income and living standards of agricultural workers in the country. Hence, along with levels and growth rates of agricultural output, it is equally important to analyse the spatial pattern of levels and growth of per agricultural worker productivity at the state and district levels.

Coverage

In all our earlier studies, we took male agricultural workers rather than total agricultural workers for working out labour productivity. The reason for this was because there had taken place frequent changes in the census definition of workers because of which the data on the number of female agricultural workers in agriculture is not comparable over various censuses, in particular for 1971. We have now decided to take total agricultural workers based on the censusus of 1961, 1981 and 2001 and ignore the data for 1971 census which as noted above, is not comparable with the earlier or subsequent data set because of changes in the definition of agricultural workers.

Agricultural worker productivity has been obtained by first inflating output by GCA/Area under 44 crops and then dividing the inflated output by the number of agricultural workers.

As discussed in Chapter 1, at the state level, the present study has covered 44 crops as compared with 46 crops covered by the DES. The only crops left out are garlic and onion. The data on area and output of these crops have been collected from published sources.

However, at the district level, the coverage of the study is limited to 35 major crops. The district wise data on crop output of 35 crops have been obtained from the

Directorate of Economics and Statistics (DES) while that on agricultural workers (both male and female and main and marginal) are obtained from the population censuses of 1961, 1981, 1991 and 2001. The census figures of the number of agricultural workers in each district have been estimated for the study trienniums by interpolating /extrapolating the census numbers.

The district wise value of output for 35 crops has been adjusted to the total gross cropped area in the districts to account for the value for output for all crops (total gross cropped area).

Levels and Growth of Agricultural Worker Productivity- a state level Analysis

The introduction of new seed-fertilizer technology during the mid-sixties resulted in raising not only the levels and growth of land yields and agricultural output, but also that of agricultural worker productivity across states.

Two contradictory forces were operating regarding labour absorption in agriculture during the early phase of green revolution. On the one hand, a rapid rise in agricultural output combined with rising intensity of cultivation increased the demand for labour in agriculture in the green revolution areas, but rapid labour absorption in agriculture constrained the fast growth of per worker productivity in agriculture. On the other hand, by the end of the 1970's, a gradual process of capitalization had also started taking place in agriculture in response to rising wages. This resulted in displacement of labour in certain agricultural operations. But since the new technology was spreading from wheat to employment intensive rice, on balance the process of rising labour absorption continued during 1962-65 to 1980-83 and even afterwards.

1962-65 to 1980-83- Initial period of green revolution

During the pre- green revolution period 1962-65, Kerala along with Punjab had the highest level of labour productivity followed by Haryana, Gujarat and Tamil Nadu, in that order (Table 9). Interestingly enough, despite low levels of land productivity, because of low population pressure, all the states in the central region (except to some extent Rajasthan) were able to record medium to high levels of agricultural worker productivity. However, because of higher population density, only medium or low agricultural worker productivity levels obtained in all the states in the eastern region with Bihar recording a very low level of productivity. In the southern

region, while Kerala and Tamil Nadu had high levels of agricultural worker productivity, the other southern states namely Andhra Pradesh and Karnataka had medium levels of productivity (Table 5.3).

During 1962-65 to 1980-83, the initial period of green revolution, the spread of new technology was confined primarily to the north-western states of India. In the high growth states, the introduction of new biological technology in conjunction with limited mechanisation performed the dual role of both raising employment and increasing labour productivity. On the other hand, in many slow growing states and regions increases in output were eaten away by large increases in the work force and agricultural worker productivity did not register an appreciable increase (Table 5.3). Thus, despite significant increases in agricultural output during 1962-65 to 1980-83, the AW productivity did not show rapid increases during this period.

1980-83 to 1990-93 - maturing of green revolution

The period 1980-83 to 1990-93 marks a significant departure in the matter of growth of both agricultural output and agricultural worker productivity. During 1980-83 to 1990-93, while the output growth rate accelerated to 3.82 per cent compared with 2.29 per cent during the earlier period of 1962-65 to 1980-83, the growth rate of agricultural worker productivity more than doubled having risen to 1.72 per cent during 1980-83 to 1990-93 compared with 0.88 per cent during the earlier period, 1962-65 to 1980-83.

During 1980-83 to 1990-93, as compared with 1962-65 to 1980-83, there took place an acceleration in the growth rate of agricultural worker productivity in all the regions except the north-western region where productivity growth recorded a small deceleration. Within the north-western region, all states except Jammu and Kashmir and Uttar Pradesh recorded accelerated growth in their agricultural worker productivity-the growth rates being exceptionally high in Punjab and Haryana. All the states in the eastern region except Assam recorded a remarkable acceleration in their growth rate of AWP. West-Bengal recorded an exceptionally high annual growth rate of 4.73 per cent per annum in agricultural worker productivity during 1980-83 to 1990-93 where an unprecedented output growth rate of 6.51 per cent per annum was associated with a growth rate of 1.70 per cent per annum in the number of agricultural workers. Again, in the central region, all states except Gujarat recorded acceleration in their growth rates of agricultural worker productivity. Again all the states in the

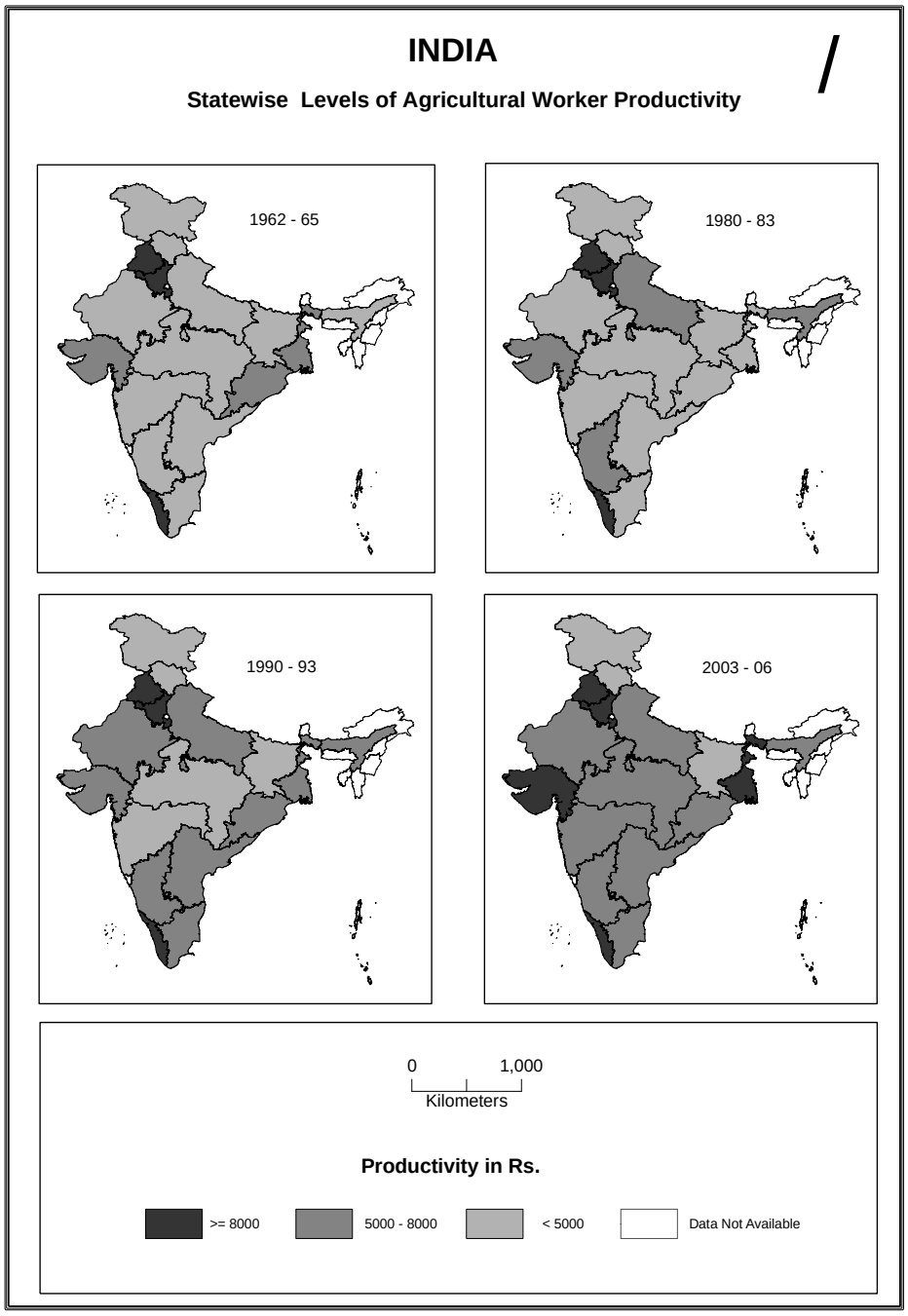
southern region registered high to very high growth rates in their agricultural worker productivity during 1980-83 to 1990-93. Both Tamil Nadu and Kerala registered a complete revival of growth during 1980-83 to 1990-93 as compared with the earlier period -1962-65 to 1980-83.

Table 5.3
State- and Region-wise Level and Growth of Agricultural Workers Productivity: 1962-65 to 2003-06

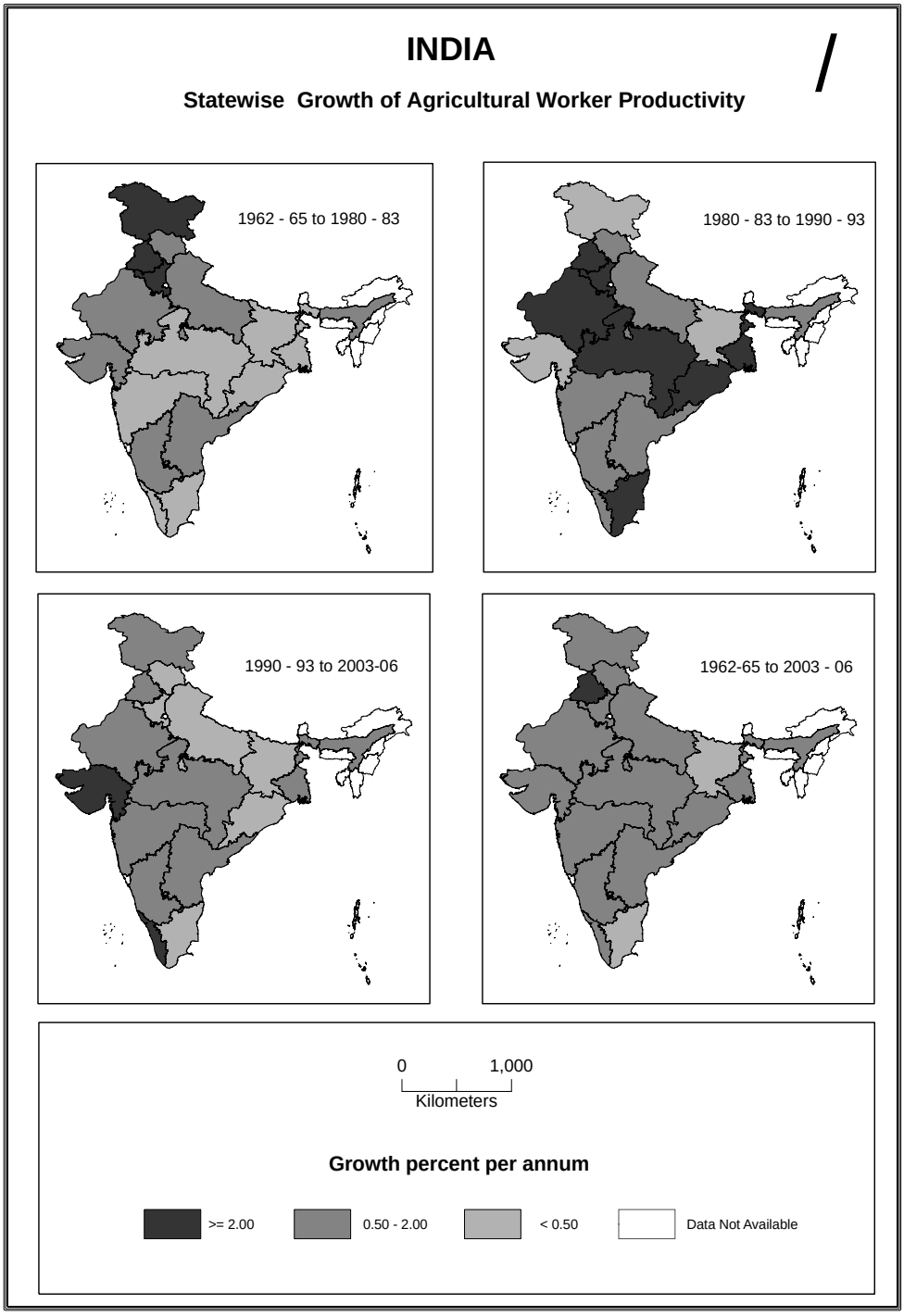
S. No	States	Agricultural workers Productivity (Rs per agricultural worker)				Growth Rate (percent per annum)			
		1962-65	**1980-83**	**1990-93**	**2003-06**	**1980-3/ 1962-65**	**1990-3/ 1980-3**	**2003-6 / 1990-3**	**2003-6 / 1962-5**
1	Haryana	7634.61	10864.74	16405.21	14185.88	1.98	4.21	-1.11	1.52
2	Himachal Pradesh	1966.70	2555.49	2834.71	2366.25	1.47	1.04	-1.38	0.45
3	Jammu & Kashmir	2018.07	2813.25	2847.95	3245.54	1.86	0.12	1.01	1.17
4	Punjab	10603.04	18019.97	24596.27	30626.98	2.99	3.16	1.70	2.62
5	Uttar Pradesh	4459.05	5998.75	6330.14	6388.23	1.66	0.54	0.07	0.88
	North-West Region	4946.17	7234.48	8343.69	8564.50	2.13	1.44	0.20	1.35
6	Assam	4887.02	5746.56	5575.62	6956.30	0.90	-0.30	1.72	0.86
7	Bihar	2586.82	2235.57	2205.61	1696.55	-0.81	-0.13	-2.00	-1.02
8	Orissa	4113.42	4406.28	5014.29	4419.87	0.38	1.30	-0.97	0.18
9	West Bengal	5032.17	4528.18	6296.99	7641.87	-0.58	3.35	1.50	1.02
	Eastern Region	3628.03	3555.99	4073.14	3913.16	-0.11	1.37	-0.31	0.18
10	Gujarat	5484.42	6328.14	5543.56	9833.35	0.80	-1.31	4.51	1.43
11	Madhya Pradesh	3452.37	3600.71	4481.60	4972.68	0.23	2.21	0.80	0.89
12	Maharashtra	3793.12	4194.28	4153.59	4997.54	0.56	-0.10	1.43	0.67
13	Rajasthan	3150.10	4131.13	5405.65	6093.08	1.52	2.73	0.93	1.62
	Central Region	3806.54	4316.07	4717.58	5917.27	0.70	0.89	1.76	1.08
14	Andhra Pradesh	3731.33	4365.12	5075.59	6090.53	0.88	1.52	1.41	1.20
15	Karanataka	4204.00	5054.73	5929.14	6175.43	1.03	1.61	0.31	0.94
16	Kerala	11013.88	9356.95	10128.16	17034.90	-0.90	0.80	4.08	1.07
17	Tamil Nadu	4879.69	4341.89	5497.51	4910.12	-0.65	2.39	-0.87	0.02
	Southern Region	4678.81	4903.89	5760.51	6220.16	0.26	1.62	0.59	0.70
	All India	4255.97	4949.37	5588.32	6136.09	0.84	1.22	0.72	0.90
	Coefficient of variation	53.46	66.62	80.20	86.47				

Note: Agricultural workers are (male + females) and (Main + Marginal)
Source: Projected from Census of India, 1961, 1981, 1991and 2001

Map. 5.2


INDIA
Statewise Levels of Agricultural Worker Productivity
1962 - 65
1980 - 83
1990 - 93
2003 - 06
0
1,000
Kilometers
Productivity in Rs.
>= 8000
5000 - 8000
< 5000
Data Not Available

Map. 5.3


INDIA
Statewise Growth of Agricultural Worker Productivity
1962 - 65 to 1980 - 83
1980 - 83 to 1990 - 93
1990 - 93 to 2003-06
1962-65 to 2003 - 06
0
1,000
Kilometers
Growth percent per annum
>= 2.00
0.50 - 2.00
< 0.50
Data Not Available

1990-93 to 2003-06-the post-reform period

The post-reform period 1990-93 to 2003-06 is characterised by a sharp deceleration in both the growth rates of output as well as in the growth rates of agricultural worker productivity. As compared with a growth rate of 3.37 per cent during 1980-83 to 1990-93, output growth decelerated to 1.74 per cent per annum during the post-reform period 1990-93 to 2003-06. Concurrently during the same period, the growth rate of agricultural worker productivity decelerated from 1.72 per cent per annum to only 0.85 per cent per annum.

The growth rate of agricultural worker productivity decelerated in all regions of India except the central region. The maximum deceleration took place in the highly developed north-western region. In this region, all the states except Jammu and Kashmir recorded a significant deceleration in their growth rates of agricultural worker productivity–the deceleration was the greatest for Punjab and Haryana. In the eastern region, all states except Assam recorded a very sharp deceleration in their growth rates of agricultural worker productivity-West Bengal having recorded the sharpest deceleration from 4.73 per cent per annum during 1980-83 to 1990-93 to only 0.88 per cent per annum during 1990-93 to 2003-06.

Table 5.4
State and Region-wise Growth of Output # and Agricultural Workers: 1962-65 to 2003-06

Sl. No.	States	1962-5 to 1980-3			1980-3 to 1990-3			1990-3 to 2003-6			1962-5 to 2003-6		
		Output	**AW**	**AWP**	**Output**	**AW**	**AWP**	**Output**	**AW**	**AWP**	**Output**	**AW**	**AWP**
1	Haryana	3.72	1.3	2.42	4.97	1.8	3.17	2.3	3.33	-1.03	3.57	2.06	1.51
2	Himachal Pradesh	1.92	0.53	1.39	3.15	1.68	1.47	1.03	2.43	-1.4	1.94	1.41	0.53
3	Jammu & Kashmir	4.55	2.33	2.22	0.28	-0.2	0.48	0.86	-0.14	1	2.32	0.92	1.4
4	Punjab	4.97	2.46	2.51	4.44	0.91	3.53	1.6	0.08	1.52	3.76	1.32	2.44
5	Uttar Pradesh	2.77	0.92	1.85	4.11	2.46	1.65	1.52	1.24	0.28	2.69	1.4	1.29
	North-West Region	**3.41**	**1.12**	2.29	**4.23**	**2.12**	2.11	**1.64**	**1.32**	0.32	**3.04**	**1.43**	1.61
6	Assam	2.84	1.15	1.69	2.5	1.96	0.54	0.75	-0.86	1.61	2.09	0.71	1.38
7	Bihar	-0.22	1.08	-1.3	2.25	2.34	-0.09	0.13	2.18	-2.05	0.49	1.73	-1.24
8	Orissa	1.33	1.54	-0.21	3.91	1.45	2.46	0.42	0.33	0.09	1.66	1.13	0.53
9	West Bengal	1.55	1.96	-0.41	6.51	1.7	4.81	2.69	1.79	0.9	3.1	1.84	1.26
	Eastern Region	**1.1**	**1.37**	-0.27	**4.11**	**1.98**	2.13	**1.31**	**1.47**	-0.16	**1.89**	**1.55**	0.34
10	Gujarat	2.93	1.72	1.21	1.39	2.15	-0.76	5	0.81	4.19	3.2	1.54	1.66
11	Madhya Pradesh	1.78	1.35	0.43	4.53	2.29	2.24	2.46	1.65	0.81	2.66	1.67	0.99
12	Maharashtra	1.65	1.34	0.31	2.58	1.96	0.62	2.62	0.71	1.91	2.19	1.29	0.9
13	Rajasthan	2.74	1.42	1.32	5.64	2.59	3.05	3.22	2.16	1.06	3.59	1.94	1.65
	Central Region	**2.17**	**1.42**	0.75	**3.45**	**2.22**	1.23	**3.25**	**1.34**	1.91	**2.82**	**1.59**	1.23
14	Andhra Pradesh	2.4	1.53	0.87	3.61	1.73	1.88	2.37	0.42	1.95	2.69	1.22	1.47
15	Karanataka	2.6	1.43	1.17	3.43	2.01	1.42	1.3	0.6	0.7	2.39	1.31	1.08
16	Kerala	1.31	2.18	-0.87	2.06	0.4	1.66	-0.38	-4.34	3.96	0.95	-0.36	1.31
17	Tamil Nadu	0.89	1.53	-0.64	4.66	1.32	3.34	-0.93	-0.6	-0.33	1.21	0.8	0.41
	Southern Region	**1.85**	**1.55**	0.3	**3.61**	**1.58**	2.03	**0.95**	**-0.07**	1.02	**1.99**	**1.04**	0.95
	All India	**2.29**	**1.4**	0.89	**3.82**	**2.06**	1.76	**1.82**	**0.97**	0.85	**2.51**	**1.42**	1.09

Notes: # Output in this table = value of output 44 crops * GCA / Area under 44 crops
Source: As in Table 9

The central region was the only one that recorded acceleration in its growth rate of agricultural worker productivity during the post-reform period. While agricultural worker productivity (AWP) accelerated in Gujarat and Maharashtra, it recorded a significant deceleration in Madhya Pradesh and Rajasthan. In Gujarat, it was the exceptionally high growth in output of 5.0 per cent pa that pushed the growth rate in AW productivity to a high level of 4.16 per cent a year during 1990-93 to 2003-06. Large increases in area under high yielding Bt cotton made a major contribution to the increase in agricultural output as well as agricultural worker productivity in the state.

Finally in the southern region as a whole, the growth rate of agricultural worker productivity decelerated during the post-reform period 1990-93 to 2003-06 as

compared with the pre-reform period 1980-83 to 1990-93. However, there was a significant acceleration in the growth rate of agricultural worker productivity in Kerala from 1.65 per cent per annum in the pre-reform, 1980-83 to 1990-93 period, to 4.14 per cent per annum in the post-reform period, 1990-93 to 2003-06, even though there took place a notable deceleration in output growth during this period. This happened primarily because there was a big decline in the number and growth rate of agricultural workers in this state during this period[i]. Andhra Pradesh also recorded some acceleration but there was a big deceleration in growth rates of agricultural worker productivity in Tamil Nadu and Karnataka- mainly because of the sharp decline in the growth rate of output. Actually Kerala is one among three states along with Assam and Tamil Nadu where the actual numbers of agricultural workers were lower in 2003-06 as compared with 1990-93.

The spatial distribution of states according to their growth rates of agricultural workers productivity during the period 1962-65 to 2003-06 (and its sub-periods) is given in (Map. 5.2 and Map. 5.3).

Unlike in the case of land productivity where the inter-state disparities have come down over time, there has taken place an increase in disparity in the levels of agricultural worker productivity across states over time. The coefficient of variation (C.V.) of agricultural worker productivity increased from 60.25 per cent during 1962-65 to 71.66 per cent in 1980-83, to 83.33 per cent during 1990-93 and further to 87.17 per cent during 2003-06.

To sum up, in the initial period of the green revolution, most of the regions and states only derived limited benefits in the matter of increase in yield levels as well as the levels of agricultural labour productivity. Accelerated growth of agriculture during 1980-83 to 1990-93 as compared with 1962-65 to 1980-83 brought about major increases in both the yield and output levels as well as the levels of agricultural worker productivity across all the regions and the majority of states in India. The most important development was that the benefits of the green revolution remained no longer confined to the north-western region; these had percolated far and wide to both the densely populated eastern and southern states and also to the sparsely populated and rainfed states in central India.

But there took place retrogression both in the matter of levels and growth of output as well as that of agricultural worker productivity during the post-reform period 1990-93 to 2003-06. The post reform period is generally associated with rapid

growth of GDP as well as of per capita income. It should be a matter of great concern for the policy makers that in this optimistic scenario, the agricultural sector should face a deceleration its growth rates of yield and output of major crops s well as aggregate output. And more serious matter is that agricultural workers, who constitute 58 per cent of the total workforce, should be facing deceleration in the growth rates of productivity and income during the post-reform period.

Another noteworthy point is that although the inter-state variations in land productivity have tended to decline over time, the inter-state variations in agricultural worker productivity have tended to increase after the advent of green revolution. Thus whereas the coefficient of variation of yield levels declined from 54.19 in 1962-65 to 43.95 by 2003-06, that of agricultural worker productivity increased from 60.25 per cent in 1962-65 to 87.17 per cent in 2003-06.

Table 5.5

	Coefficient of Variation			
	1962-65	1980-83	1990-93	2003-06
Yield Levels (output per Hectare in Rs.)	50.13	42.75	42.59	36.98
Agricultural workers Productivity (Rs. per agricultural worker)	60.25	71.66	82.23	87.17

Source: Table 2.3 and Table 5.3

Growth of Agricultural Labour Productivity: A District level Analysis

The state level analysis above has highlighted the main trends in the levels and growth of agricultural worker productivity during 1962-65 to 2003-06 at the state and regional levels.

The district level analysis undertaken below gives a more disaggregated picture of these trends.

1962-65 to 2003-06 The Long View

Taking the overall period 1962-65 to 2003-06, it is discovered that 46 districts recorded a high growth rate of AW productivity exceeding 2.0 percent p a (Table 5.5). This rapid growth was achieved as a result of high growth of output of 3.6 p.a. and growth rates in AW of 1.3 percent p.a.

Table 5.5
Growth Rate of Agricultural Workers Productivity, Agricultural Workers and Output in districts, 1962-65 to 2003-06.

Growth rate of Agricultural Workers productivity (percent per year)	1962-65 to 1980-83					1980-80 to 1990-93				
	No. of districts	Growth rate (percent pa)			percent share in total Agrl. Workers	No. of districts	Growth rate (percent pa)			percent share in total agrl. workers
		Agrl Labour productivity	Agricul--tutal workers	Crop Output			Agrl Labour productivity	Agricul--tutal workers	Crop Outp ut	
High Growth >2.0 percent	49	3.1	1.2	4.3	13.5	109	4.1	0.8	4.9	41.9
Medium Growth 0.5-2.0 percent	99	1.5	1.3	2.8	31.3	74	1.2	2.0	3.2	25.6
Low Growth <= 0.5 percent	133	-0.7	1.9	1.2	55.2	98	-1.1	2.5	1.3	32.5
0.0 – 0.5 percent	41	0.3	1.6	1.9	14.7	19	0.2	2.4	2.6	5.4.0
<0.0 percent (Negative)	92	-1.1	2.1	0.9	40.5	79	-1.4	2.5	1.0	27.1
Total	281	0.6	1.6	2.2	100.0	281	1.7	1.7	3.5	100.0

Table 5.5 (Contd.)

Growth rate of Agricultural Workers productivity (percent per year)	1990-93 to 2003-06					1962-65 to 2003-06				
	No. of districts	Growth rate (percent pa)			percent share in total Agrl. Workers	No. of districts	Growth rate (percent pa)			percent share in total agrl. workers
		Agrl Labour productivity	Agricul--tutal workers	Crop Output			Agrl Labour productivity	Agricul--tutal workers	Crop Output	
High Growth >2.0 percent	91	3.7	0.1	3.8	27.6	46	2.3	1.3	3.6	9.4
Medium Growth 0.5-2.0 percent	80	1.2	0.6	1.8	27.5	149	1.3	1.4	2.7	50.0
Low Growth <=0.5 percent	110	-0.9	1.6	0.7	44.9	86	-0.1	1.5	1.4	40.6
0.0 – 0.5 percent	26	0.1	0.8	0.9	11.3	43	0.4	1.3	1.7	18.9
<0.0 percent (Negative)	84	-1.3	1.9	0.6	33.5	43	-0.7	1.6	0.9	21.7
Total	281	1.0	1.0	2.0	100.0	281	1.0	1.4	2.4	100.0

Source: Compiled from district level data

However, the weight of these high growth districts was very small and these districts accounted for only 9.4 percent of total workers during the base year.

Again during 1962-65 to 2003-06, more than a half (149) of districts recorded medium growth rates ranging between 0.5 percent and 2.0 percent p.a. in AW productivity. Their weight was quite large as these accounted for a half of total workers during the base year.

Finally, during this period, 86 districts accounting for two fifths (40.6 percent) total agricultural workers (AW) recorded low or negative growth in agricultural worker productivity (AWP) below 0.5 percent p.a. This brings out the dismal performance of labour productivity growth during the over all period 1962-65 to 2003-06. Further, as many as 43 out of the 86 low growth districts that accounted for 21.7 percent of agricultural workers during 1962-65 had negative growth rates in AW productivity during 1962-65 to 2003-06. This indicates that the output growth rate in these districts could not even keep pace with the growth rate of work force in the agricultural sector. Decline in productivity of these about one-fifth of the workers for more than four decades is of serious concern as it ultimately gets reflected in their well-being and living standards.

Spatial Pattern 1962-65 to 2003-06

The 46 districts that recorded high growth in their agricultural worker productivity during 1962-65 to 2003-06 were mainly located in Punjab (9), Rajasthan (9), Gujarat (6), Kerala (4) and Andhra Pradesh (4) (Table 5.4 & Map 5.3 to 5.6).

The 146 districts with medium growth rate in AW productivity were evenly distributed in all regions. Finally, the 86 low growth districts were mainly concentrated in the central (36) and the eastern (23) regions. Across the states, Punjab and Haryana in the north western, West Bengal in the eastern, Gujarat and Rajasthan in the central and Andhra Pradesh and Kerala in the southern region performed comparatively better than other states with respect to growth of AW productivity during 1962-65 to 2003-06.

A sub division of the period 1962-65 to 2003-06 into three sub periods namely 1962-65 to 1980-83, 1980-83 to 1990-93 and 1990-93 to 2003-06 gives a more revealing picture.

1962-65 to 1980-83

During 1962-63 to 1980-83, only 49 districts accounting for 13.5 percent of total agricultural workers recorded growth rates exceeding 2.0 percent p.a. The number of districts which recorded medium growth rates ranging between 0.5 percent to 2.0 percent p.a. was 99 and these accounted for 31.3 percent of total AW during the base year. On the other hand, as many as 133 districts accounting for 55.2 percent of total workers in the country during the base year recorded low growth rates (less than 0.5 percent). Out of these, as many as 92 districts that account for 40.5 percent of the total agricultural work force in the country registered a decline in their AW productivity (negative growth) during this period. In these districts the growth rate of output could not keep pace even with the growth rate of agricultural workers thereby leading to involution.

Table 5.6 (a)
Spatial Distribution of Districts in Different States by growth rate of per agricultural worker productivity - 1962-65 to 1980-83

Growth rate of Agricultural Workers productivity (percent per year)	North Western region					Eastern region					Central region					Southern region					All India
1962-65 to 1980-83	HAR	J&K	PB	UP	ALL	ASS	BH	OR	WB	ALL	GJ	MP	MAH	RJ	ALL	AP	KAR	KER	TN	ALL	
High Growth >2.0 percent	4	2	7	15	28	0	0	0	0	0	4	6	0	5	15	3	3	0	0	6	49
Medium Growth 0.5-2.0 percent	2	0	3	27	32	4	3	1	2	10	7	16	10	7	40	7	9	0	1	17	99
Low Growth <=0.5 percent	1	0	1	6	8	3	12	10	12	37	7	21	15	14	57	7	7	7	10	31	133
0.0 – 0.5 percent	0	0	0	5	5	3	0	2	3	8	3	8	7	4	22	1	4	0	1	6	41
Negative <0.0 per cent	1	0	1	1	3	0	12	8	9	29	4	13	8	10	35	6	3	7	9	25	92
Total	7	2	11	48	68	7	15	11	14	47	18	43	25	26	112	17	19	7	11	54	281

Table 5.6 (b)
Spatial Distribution of Districts in Different States by growth rate of per agricultural worker productivity - 1980-83 to 1990-93

Growth rate of Agricultural Workers productivity (percent per year)	North Western region					Eastern region					Central region					Southern region					All India
1980-83 to 1990-93	HAR	J&K	PB	UP	ALL	ASS	BH	OR	WB	ALL	GJ	MP	MAH	RJ	ALL	AP	KAR	KER	TN	ALL	
High Growth >2.0 percent	5	0	9	15	29	0	2	9	9	20	4	18	1	14	37	8	5	3	7	23	109
Medium Growth 0.5-2.0 percent	1	1	2	13	17	0	2	2	4	8	1	13	11	8	33	4	5	3	4	16	74
Low Growth <=0.5 percent	1	1	0	20	22	7	11	0	1	19	13	12	13	4	42	5	9	1	0	15	98
0.0 – 0.5 percent	0	0	0	8	8	2	0	0	0	2	1	2	1	0	4	2	2	1	0	5	19
Negative	1	1	0	12	14	5	11	0	1	17	12	10	12	4	38	3	7	0	0	10	79
Total	7	2	11	48	68	7	15	11	14	47	18	43	25	26	112	17	19	7	11	54	281

Table 5.6 (c)
Spatial Distribution of Districts in Different States by growth rate of per agricultural worker productivity – 1990-93 to 2003-06

Growth rate of Agricultural Workers productivity (percent per year)	North Western region					Eastern region					Central region					Southern region					All India
1990-93 to 2003-06	HAR	J&K	PB	UP	ALL	ASS	BH	OR	WB	ALL	GJ	MP	MAH	RJ	ALL	AP	KAR	KER	TN	ALL	
High Growth >2.0 percent	1	0	5	8	14	5	3	1	8	17	12	4	10	11	37	9	5	7	2	23	91
Medium Growth 0.5- 2.0 percent	1	2	5	14	22	2	3	4	3	12	4	17	5	7	33	3	6	0	4	13	80
Low Growth <=0.5 percent	5	0	1	26	32	0	9	6	3	18	2	22	10	8	42	5	8	0	5	18	110
0.0 – 0.5 percent	0	0	0	4	4	0	0	2	0	2	0	5	4	3	12	2	3	0	3	8	26
Negative	5	0	1	22	28	0	9	4	3	16	2	17	6	5	30	3	5	0	2	10	84
Total	7	2	11	48	68	7	15	11	14	47	18	43	25	26	112	17	19	7	11	54	281

Table 5.6 (d)
Spatial Distribution of Districts in Different States by growth rate of per agricultural worker productivity – 1962-65 to 2003-06

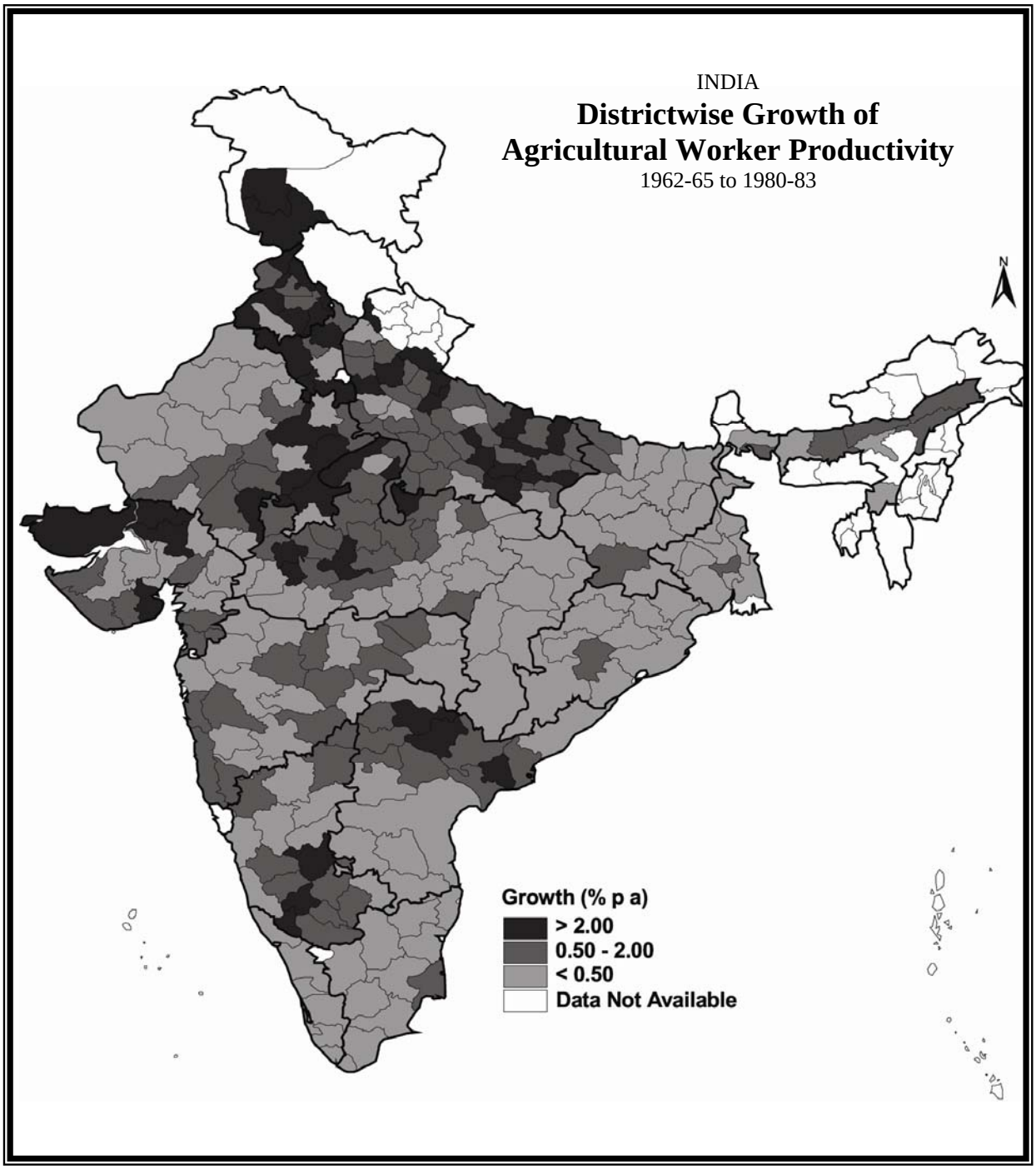
Growth rate of Agricultural Workers productivity (percent per year)	North Western region					Eastern region					Central region					Southern region					All India
1962-65 to 2003-06	HAR	J&K	PB	UP	ALL	ASS	BH	OR	WB	ALL	GJ	MP	MAH	RJ	ALL	AP	KAR	KER	TN	ALL	
High Growth >2.0 percent	2	0	9	1	12	0	0	1	3	4	6	3	1	9	19	4	2	4	1	11	46
Medium Growth 0.5-2.0 percent	5	2	2	37	46	6	0	5	9	20	8	24	12	13	57	8	10	3	5	26	149
Low Growth <=0.5 percent	0	0	0	10	10	1	15	5	2	23	4	16	12	4	36	5	7	0	5	17	86
0.0 – 0.5 percent	0	0	0	8	8	1	1	4	1	7	3	6	5	2	16	3	6	0	3	12	43
Negative	0	0	0	2	2	0	14	1	1	16	1	10	7	2	20	2	1	0	2	5	43
Total	7	2	11	48	68	7	15	11	14	47	18	43	25	26	112	17	19	7	11	54	281

Source: Compiled from district level data

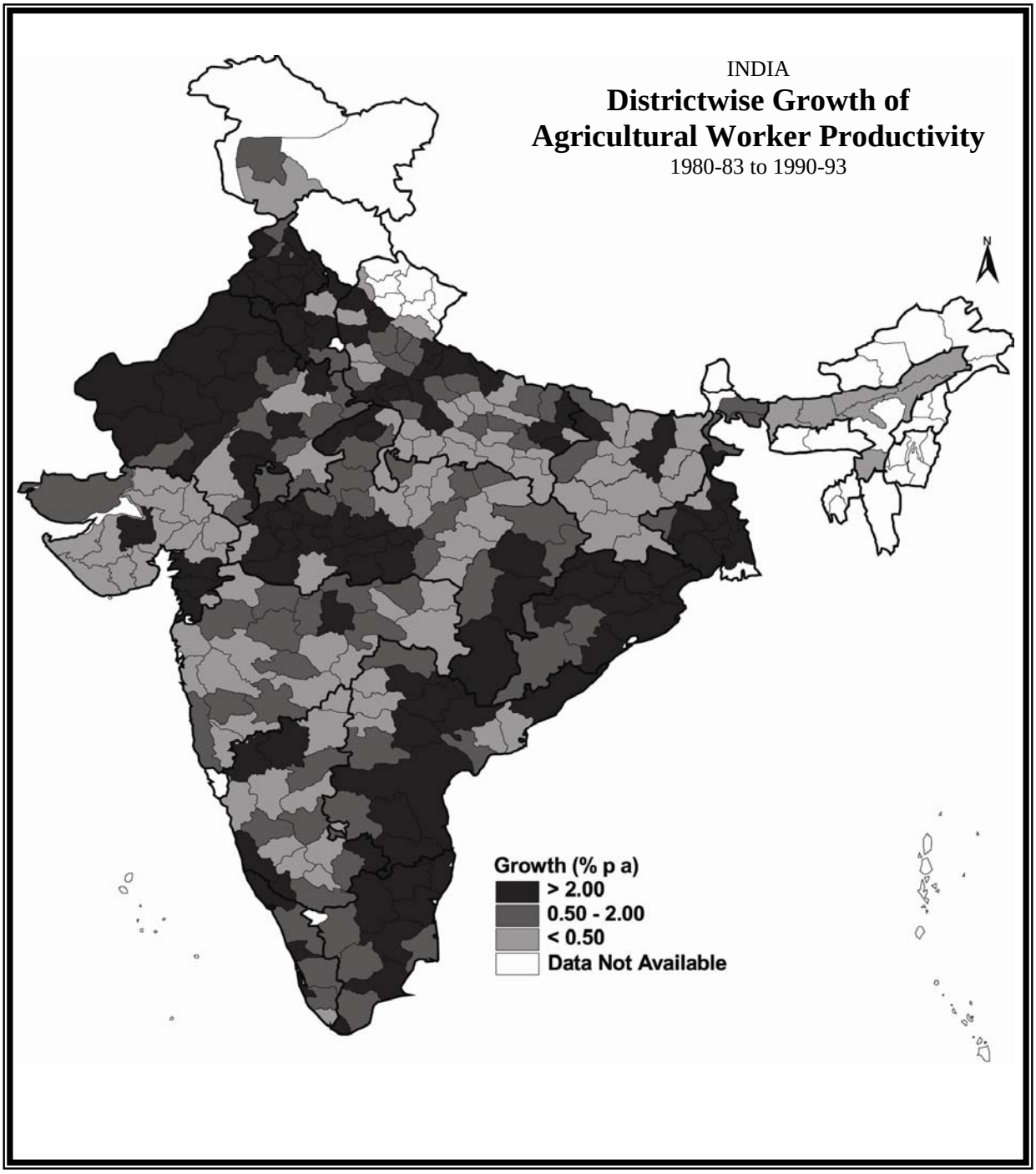
Spatial Pattern during 1962-65 to 1980-83

During 1962-65 to 1980-83, as many as 28 of the 49 high growth districts belonged to the north western region (with Uttar Pradesh and Punjab having 15 and 7 high growth districts respectively), 15 to the central region and 6 to the southern region. None of the districts in eastern region recorded high growth in per agricultural worker productivity. The 99 medium growth (growth between 0.5 to 2.0 percent p.a.) districts were also concentrated in the central region (40), followed by the north western region (32), the southern region (17) and the eastern region (10). Finally, the 133 low and negative growth districts were mainly concentrated in the central region having 57 districts followed by the eastern region having 37 and the southern region having 31 districts. The north western region had only 8 such low growth districts which were mainly located in Uttar Pradesh. Among the states, Bihar, Orissa, and West Bengal in the eastern region and Kerala and Tamil Nadu performed poorly in growth of their AW productivity during this period. About three-fourth of the districts in each of these states recorded low growth (less than 0.5 percent p.a.) in their AW productivity over almost two decades.

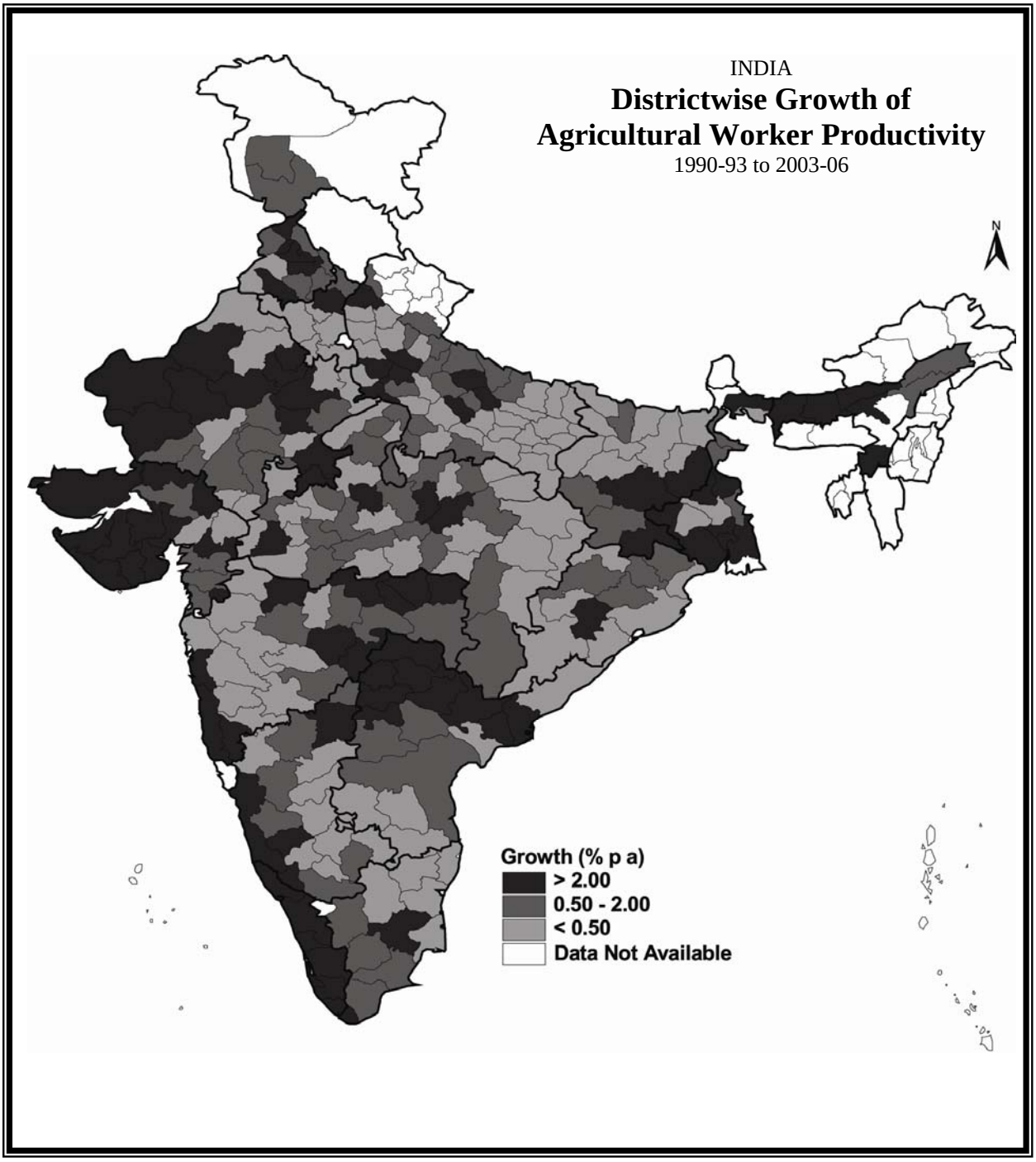
Map 5.3


INDIA
Districtwise Growth of
Agricultural Worker Productivity
1962-65 to 1980-83
N
Growth (% p a)
> 2.00
0.50 - 2.00
< 0.50
Data Not Available

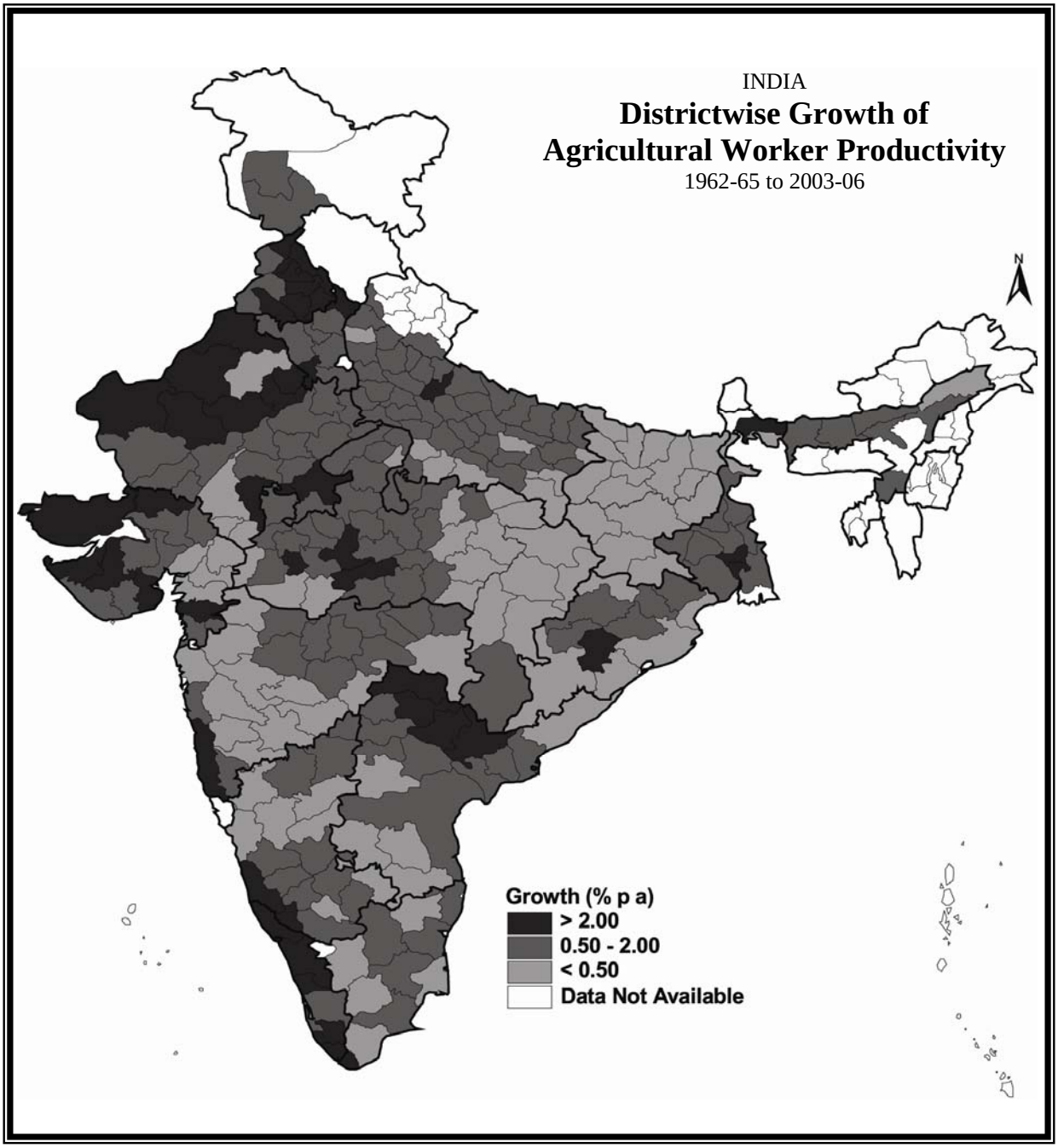
Map 5.4


INDIA
Districtwise Growth of
Agricultural Worker Productivity
1980-83 to 1990-93
N
Growth (% p a)
> 2.00
0.50 - 2.00
< 0.50
Data Not Available

Map 5.5


INDIA
Districtwise Growth of
Agricultural Worker Productivity
1990-93 to 2003-06
N
Growth (% p a)
> 2.00
0.50 - 2.00
< 0.50
Data Not Available

Map 5.6


INDIA
Districtwise Growth of
Agricultural Worker Productivity
1962-65 to 2003-06
N
Growth (% p a)
> 2.00
0.50 - 2.00
< 0.50
Data Not Available

Growth during 1980-83 to 1990-93

The period 1980-83 to 1990-93 is characterised by a notable acceleration in agricultural production in most regions of India. The same is reflected in growth of AW productivity as well. The number of districts that recorded high growth rates exceeding 2.0 percent p.a. more than doubled to 109 during this period from 49 during the earlier period (1962-65 to 1980-83). These districts accounted for 41.9 percent of total workers in the country during 1980-83. During 1962-65 to 1980-83, the 49 high growth districts had accounted for only 13.5 percent in workers during 1962-65. Thus, more than two fifths of the total workers during the base year were able to record high growth in their productivity levels exceeding 2.0 percent p.a. Seventy four districts accounting for 25.6 percent of total workers during 1980-83 recorded growth rates between 0.5 percent to 2.0 percent p.a. At the other extreme, the number of districts which recorded growth less than 0.5 percent p.a. declined sharply from 133 during 1962-80 to 1980-83 to 98 during 1980-83 to 1990-93 and these accounted for only 32.5 percent of total workers during 1980-83. But, it is significant to note that even during 1980-83 to 1990-93, when overall growth rates were quite robust, as many as 79 out of the 98 low growth districts accounting for 27.1 percent of total agricultural workers during 1980-83 recorded negative growth in their agricultural worker productivity.

Spatial Pattern during 1980-83 to 1990-93

One of the important features of growth during 1980-83 to 1990-93 was that like the agricultural growth, the gains in agricultural workers productivity were spread out across all the regions. Unlike the earlier period 1962-65 to 1980-83, when 28 out of 49 high AW productivity growth districts were located in the north western region, none in the eastern region, 15 in the central region and only 6 in the southern region, high growth district were spread throughout all regions during 1980-83 to 1990-93. Thus out of the 109 high growth districts during 1980-83 to 1990-93, 29 belonged to the north-western region, 20 to the eastern region, 37 to the central region and 23 to the southern region. Similarly unlike the earlier period, the low productivity growth districts were also evenly spread across regions. However, unlike other regions where a substantial number of districts shifted from low to medium or higher AWP growth categories, 14 districts in Uttar Pradesh in the north western region shifted from

medium growth category during 1962-65 to 1980-83 to low growth category during 1980-83 to 1990-93.

Despite the widespread growth of agricultural production and workers productivity across regions during 1980-83 to 1990-93, many districts in Assam, Bihar, Gujarat, Karnataka, Madhya Pradesh, Maharashtra, and Uttar Pradesh performed poorly in terms of growth in their AWP. Many districts in these states are not only marked by low levels of agricultural growth and development, but also characterised by a large concentration of the rural population in poverty.

The growth rate of per agricultural worker in 98 low productivity districts was pulled down because of a combination of low growth of output with high growth of agricultural workers.

For example while the 98 low growth districts recorded output growth rates of only 1.3 per cent pa compared with a growth rate of 4.9 percent pa recorded by the 109 high growth districts, the growth rate of agricultural workers in these low AWP growth districts was more than three times (2.5 percent p.a.) the growth rate of agricultural workers in the high AWP growth districts (0.8 percent p.a.).

Agricultural worker productivity (AWP) growth during 1990-93 to 2003-06

As discussed in Chapter 4, the growth rate of agricultural output recorded a notable deceleration during 1990-93 to 2003-06 compared with period 1980-83 to 1990-93.The slow down in growth of agricultural production was also reflected in the slow down in growth of AW productivity during the post-reform period 1990-93 to 2003-06. This happened although the period also experienced a perceptible slow down in the growth of agricultural workers from 1.7 percent during 1980-83 to 1990-93 to 1.0 percent p.a. only during 1990-93 to 2003-06.

Because of slow down in the growth rate of AWP, the number of districts in the high growth category declined to 91 during 1990-93 to 2003-06 from 109 during the earlier period 1980-83 to 1990-93. The proportion of the agricultural workers in the districts with high growth of AWP districts declined from 41.9 per cent in the earlier period (1980-83 to 1990-93) to only 27.6 per cent during the post-reform period. The number of districts recording medium AW productivity growth increased marginally from 74 during 1980-83 to 1990-93 to 80 during 1990-93 to 2003-06.

The number of slow growth districts increased to 110 during 1990-93 to 2003-06 as compared with 98 during 1980-83 to 1990-93. These 110 low growth districts accounted for 44.9 per cent of total workers during 1990-93. During the earlier period 1980-83 to 1990-93, the 98 low growth districts had accounted for only 32.5 percent of agricultural workers in 1980-83.

Out of the 110 low growth districts as many as 84 districts that accounted for 33.5 percent of agricultural workers in 1990-93 recorded a negative growth in their agricultural worker productivity. It is notable that this is a period when the per capita income for the country as a whole rose by more than 6 per cent per annum.

Spatial Pattern of AWP growth during 1990-93 to 2003-06

One of the important features of spatial pattern of the AW productivity growth during the 1990-93 to 2003-06 period is that the slow down mainly hit the north western region. While the number of districts in the high AW productivity growth category remained the same in the central and southern regions, it decreased marginally in the eastern region while it declined sharply in the north western region from 29 during the earlier period to 14 only during 1990-93 to 2003-06. Similarly, the number of low AWP growth districts increased to 32 from 22 during 1980-83 to 1990-93 in the north western region whereas the number of low AWP growth districts almost remained the same in rest of the three regions. Thus the slow down in the AW productivity growth during the post-reform period seems to have mainly affected the green revolution belt in the north western region. Besides the north western region, the majority of the districts in Bihar and Orissa in the eastern region, Madhya Pradesh in the central region also experienced low or negative growth in agricultural worker productivity during 1990-93 to 2003-06. Low/negative growth of agricultural worker productivity (AWP) in Uttar Pradesh, Bihar, Orissa, and Madhya Pradesh over almost one and a half decades is of serious concern as it may have dealt a setback to poverty alleviation and employment generation programmes in these states that account for more than two thirds of the rural poor in the country. The rejuvenation of agricultural growth and the shift of work force out of agriculture may be the only methods of stemming the reverses to agricultural workers productivity and hence income generation efforts in these states.

Having discussed the regional patterns of growth of agricultural worker productivity at the district level during 1962-65 to 2003-06 and the various sub-periods, the next section is devoted to a discussion of levels of agricultural worker productivity during the overall period 1962-65 to 2003-6 and various sub-periods and the changes brought about therein as a result of differential rates of growth recorded by various districts.

Levels of Agricultural Workers Productivity –a district level analysis

For analysis all the districts have been divided into three broad categories according to their levels of AW productivity. These are:

A. *High AW Productivity*- districts having productivity exceeding Rs.8000/AW.

B. *Medium AW Productivity*- districts having productivity between Rs.5000-8000/AW.

C. *Low AW Productivity*-districts having productivity less than Rs.5000/AW.

To begin with during 1962-65, there were only 35 high productivity districts, in the country with per agricultural worker productivity (AWP) exceeding Rs. 8000. These accounted for only 6.8 per cent of the total AW in the country. There were as many as 69 mid productivity districts which counted for 24.2 per cent of total AW in the country. Finally, more than two-thirds (69.0 percent) of the total agricultural workers located in 177 districts were contributing to about half (51.8 percent) of agricultural production from 63.4 percent of the area under their cultivation. Consequently they recorded low level of AW productivity less than Rs. 5000/AW during the early sixties (Table 5.5).

Indian agriculture underwent a notable change and experienced higher levels and growth of output with the adoption of new technology during the mid-sixties and its extension to new areas by 1980-83. Despite an output growth rate of 2.2 percent pa registered during 1962-65 to 1980-83, the agricultural worker productivity did not register a notable improvement. As noted earlier (Table 5.3) much of the growth in output during 1962-65 to 1980-83 was eaten away by the rapid expansion of agricultural work force that grew at a very rapid rate of 1.6 percent pa during this period. Consequently AW productivity that grew at only 0.6 percent p.a. was able to make only a marginal improvement in the distribution of districts by their AW

productivity levels. About two-thirds of the work force in Indian agriculture was still trapped in low level of AW productivity by 1980-83.

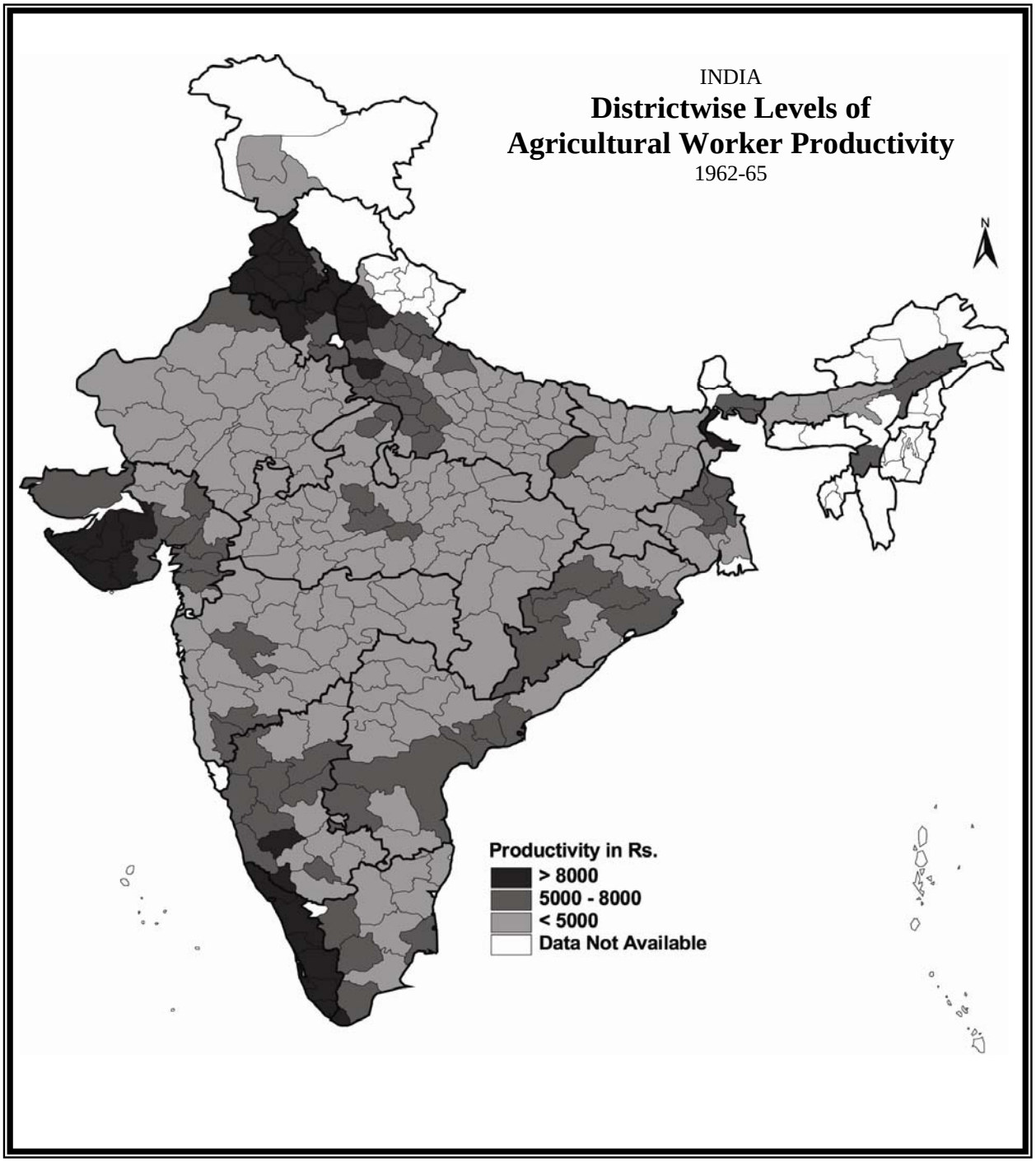
But a real change came by the end of 1990-93. By 1990-93, there was a big increase in the number of high productivity (exceeding Rs. 8000) districts and a sharp decline in that of low productivity districts. During 1990-93, the number of high productivity districts increased to 70 compared with 45 in 1980-83. These high AWP districts now accounted for nearly one-sixth (15.2 percent) of total workers compared with 10.0 percent in 1980-83. The number of mid productivity districts increased from 83 to 91.

Table 5.7
Distribution of Districts and their Share in Total Agricultural workers and Output, by Levels of Agricultural Productivity

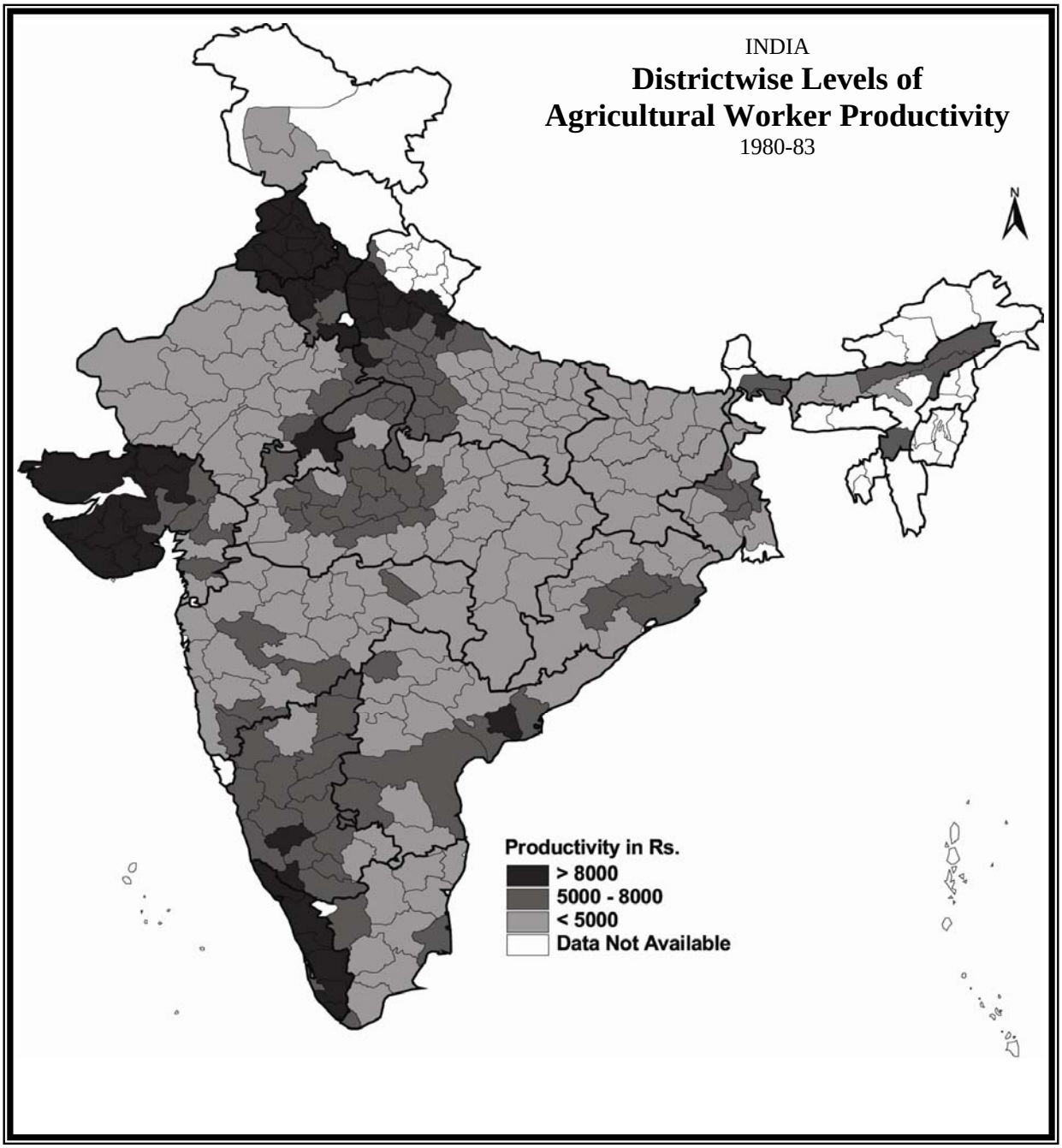
Agricul. workers Productivity (Rs. per workers)	Number of districts	Output per worker	Per cent share in Total		
			Area	Workers	Output
1962-65					
High	35	11195	10.2	6.8	16.9
Medium	69	5796	26.4	24.2	31.2
Low	177	3369	63.4	69.0	51.8
Overall	**281**	**4487**	**100.0**	**100.0**	**100.0**
1980-83					
High	45	12801	14.1	10.0	25.7
Medium	83	6208	28.3	25.0	31.1
Low	153	3316	57.6	65.0	43.2
Overall	**281**	**4989**	**100.0**	**100.0**	**100.0**
1990-93					
High	70	13274	20.0	15.2	34.1
Medium	91	6251	33.8	33.5	35.3
Low	120	3535	46.2	51.3	30.6
Overall	**281**	**5925**	**100.0**	**100.0**	**100.0**
2003-06					
High	96	13824	30.7	23.8	48.7
Medium	88	6425	34.1	30.4	28.9
Low	97	3312	35.2	45.7	22.4
Overall	**281**	**6763**	**100.0**	**100.0**	**100.0**

Note: High ≥ Rs 8000 Medium: Rs. 5000-8000 Low < Rs 5000
Sources: Estimated form Annexure 1(a) to 1(e).

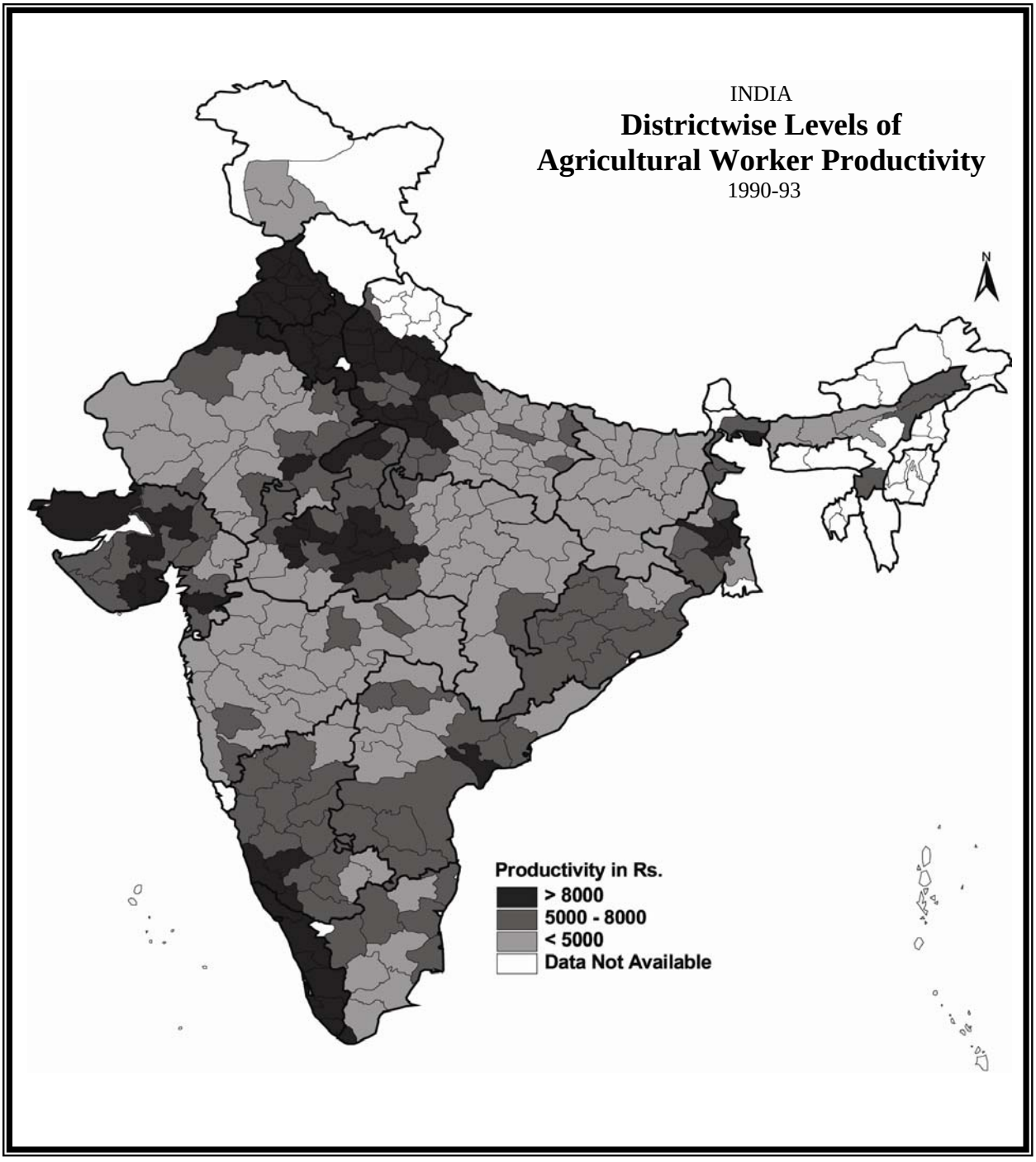
Map 5.7


INDIA
Districtwise Levels of
Agricultural Worker Productivity
1962-65
N
Productivity in Rs.
> 8000
5000 - 8000
< 5000
Data Not Available

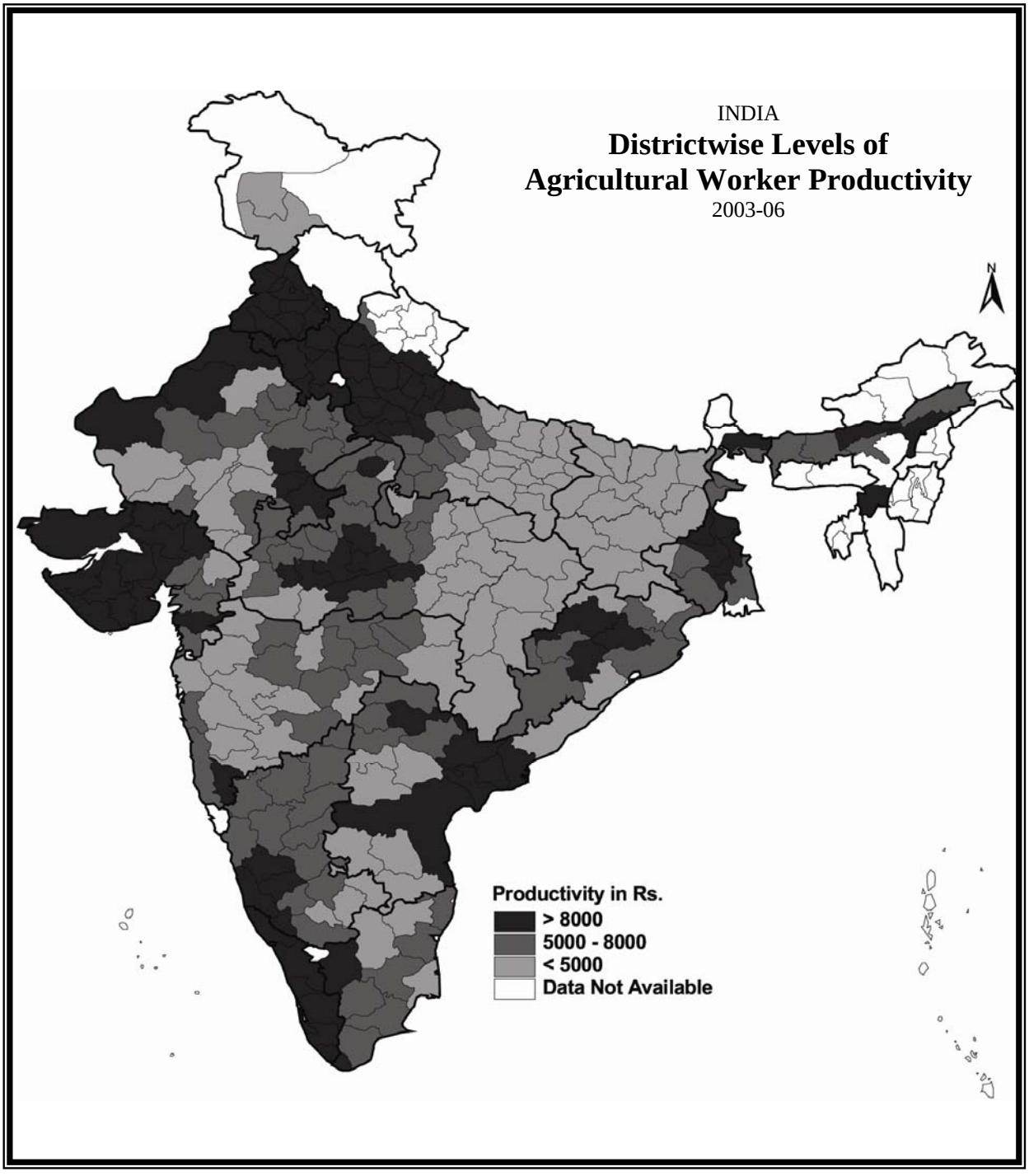
Map 5.8


INDIA
Districtwise Levels of
Agricultural Worker Productivity
1980-83
N
Productivity in Rs.
> 8000
5000 - 8000
< 5000
Data Not Available

Map 5.9


INDIA
Districtwise Levels of
Agricultural Worker Productivity
1990-93
N
Productivity in Rs.
> 8000
5000 - 8000
< 5000
Data Not Available

Map 5.10


INDIA
Districtwise Levels of
Agricultural Worker Productivity
2003-06
N
Productivity in Rs.
> 8000
5000 - 8000
< 5000
Data Not Available

The number of low productivity districts (with AW productivity less than Rs. 5000/MAW) declined from 153 during 1980-83 to 120 by 1990-93 and these accounted for 51.3 percent of agricultural workers during 1990-93. During 198083, 153 low productivity districts had accounted for 65 percent of total agricultural workers.

Consequently, 13.7 percent of the total agricultural workers in the low productivity category during 1980-83 graduated to medium and high productivity levels as the share of the workers with low productivity declined from 65.0 percent in 1980-83 to only 51.3 percent during 1990-93. Despite the commendable performance of the agricultural growth during 1980-83 to 1990-93, more than a half of the agricultural workers (51.3 per cent) continued to have low levels of productivity even during 1990-93 (also see Map 5.2).

The momentum of gains in the workers productivity however slowed down in the post-reform period. Only 5.6 percent of the total agricultural workers moved from low productivity (less than Rs 5000/ AW) to medium and high levels during 1990-93 to 2003-06 compared with the 13.7 percent of the workers that had moved up the scale in the earlier period. Despite this movement, 45.7 percent of the workers in Indian agriculture belonged to the category of low level of agricultural worker productivity during 2003-06 with an average level of productivity as low as Rs 3312 per worker (at 1990-93 prices)[2]. These 45.7 percent workers residing in 97 districts contribute only 22.4 percent to agricultural production from 35.2 percent of the land area cultivated by them.

It may be noted that it is net value added and not value of output that determines the income of agricultural workers from crop production. Furthermore, agricultural workers also derive substantial income from work in allied and non-agricultural occupations. Nevertheless, income from crop production constitutes an important proportion of their total income. Hence, raising agricultural worker productivity through rejuvenation of agricultural growth in these districts will go a long way in improving their income levels.

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2 . It may be noted that it is net value added and not value of output that determines the income of agricultural workers from crop production. Furthermore, agricultural workers also derive substantial income from work in allied and non-agricultural occupations..

Spatial Distribution 1962-65

During 1962-65, only 35 districts had recorded high levels of AWP exceeding Rs. 8000 per agricultural worker. Another 69 districts had medium per agricultural worker productivity levels ranging between Rs. 5000 to Rs. 8000 and as many 177 districts had per agricultural worker productivity levels of less than Rs. 5000.

The spatial distribution of districts during 1962-65 brings out that the 35 high productivity districts were mainly concentrated in the north western and southern regions. Thus, whereas 19 high productivity districts belonged to the north-western and 10 to the southern region, only 5 were located in the central and only 1 in the eastern region.

The 69 mid-productivity districts were evenly spread out across all the four regions of India. On the other hand, most of the backward districts were concentrated in the eastern and central regions.

By 1980-83, the spatial distribution had undergone a change. The number of high productivity districts increased from 35 to 45 but north western region states were the main beneficiaries. As mentioned earlier, these states were initially better placed and further consolidated their gains by earlier adoption of the green revolution technology. On the contrary, the situation had not undergone any major change by 19880-83 in the remaining three regions (Fig 5.3).

There was a major increase in the number of high labour productivity districts by 1990-93 and a big dent had been made in the number of low labour productivity districts. The number of high productivity districts rose from 45 in 1980-83 to 70 in 1990-93. The 70 high productivity districts were located in the north-western region (36), the central region (18), the southern region (12) and only 4 were located in the eastern region.

Interestingly enough, despite a major breakthrough recorded in output growth during the ‘eighties, not a single district in the states of Jammu & Kashmir, Assam, Bihar, Orissa and Maharashtra recorded high AW productivity exceeding Rs. 8000/AW. In some of the states like West Bengal, the AW productivity has also risen sharply along with rapid growth in output.

During 1990-93, there were 120 low productivity districts with productivity less than Rs. 5000/AW. Half (60) of these was concentrated in the dry central region, mainly in Maharashtra, Madhya Pradesh and Rajasthan. The spatial pattern clearly

brings out that the eastern region is still not out of the woods, as even during 1990-93, in addition to all the 15 districts in Bihar, 4 out of 7 districts in Assam, 2 out of 11 in Orissa and 3 out of 14 in West Bengal were still trapped in low levels of AW productivity. Although the output growth rate has been fairly high in the eastern region except for Bihar, but this is counteracted by very high population density and high growth of agricultural workers.

Table 5.8
Distribution of Districts in Different States by Level of Agricultural Workers Productivity during 1960s, 1980, 1990s and 2000s

Agricultural workers Productivity(Rs/worker)		North Western region					Eastern region					Central region					Southern region					All India
1962-65		**HAR**	**J&K**	**PB**	**UP**	**ALL**	**ASS**	**BH**	**OR**	**WB**	**ALL**	**GJ**	**MP**	**MAH**	**RJ**	**ALL**	**AP**	**KAR**	**KER**	**TN**	**ALL**	
High	≥ 8000	4	0	10	5	**19**	0	0	0	1	**1**	5	0	0	0	**5**	0	2	7	1	**10**	**35**
Medium	5000-8000	2	0	1	16	**19**	3	1	5	7	**16**	8	5	3	1	**17**	5	8	0	4	**17**	**69**
Low	< 5000	1	2	0	27	**30**	4	14	6	6	**30**	5	38	22	25	**90**	12	9	0	6	**27**	**177**
All		7	2	11	48	**68**	7	15	11	14	**47**	18	43	25	26	**112**	17	19	7	11	**54**	**281**
		North Western region					**Eastern region**					**Central region**					**Southern region**					**All**
1980-83		**HAR**	**J&K**	**PB**	**UP**	**ALL**	**ASS**	**BH**	**OR**	**WB**	**ALL**	**GJ**	**MP**	**MAH**	**RJ**	**ALL**	**AP**	**KAR**	**KER**	**TN**	**ALL**	**India**
High	≥ 8000	5	0	11	10	**26**	0	0	0	0	**0**	9	0	0	1	**10**	1	2	6	0	**9**	**45**
Medium	5000-8000	2	0	0	15	**17**	4	0	3	6	**13**	5	17	5	3	**30**	5	14	1	3	**23**	**83**
Low	< 5000	0	2	0	23	**25**	3	15	8	8	**34**	4	26	20	22	**72**	11	3	0	8	**22**	**153**
All		7	2	11	48	**68**	7	15	11	14	**47**	18	43	25	26	**112**	17	19	7	11	**54**	**281**

Table 5.8 (contd..)

Agricultural workers Productivity(Rs/worker)		North Western region					Eastern region					Central region					Southern region					All India
1990-93		**HAR**	**J&K**	**PB**	**UP**	**ALL**	**ASS**	**BH**	**OR**	**WB**	**ALL**	**GJ**	**MP**	**MAH**	**RJ**	**ALL**	**AP**	**KAR**	**KER**	**TN**	**ALL**	
High	≥ 8000	7	0	11	18	**36**	0	0	0	4	**4**	6	10	0	2	**18**	1	3	7	1	**12**	**70**
Medium	5000-8000	0	0	0	12	**12**	3	0	9	7	**19**	9	13	4	8	**34**	9	12	0	5	**26**	**91**
Low	< 5000	0	2	0	18	**20**	4	15	2	3	**24**	3	20	21	16	**60**	7	4	0	5	**16**	**120**
All		7	2	11	48	**68**	7	15	11	14	**47**	18	43	25	26	**112**	17	19	7	11	**54**	**281**
		North Western region					**Eastern region**					**Central region**					**Southern region**					**All**
2003-06		**HAR**	**J&K**	**PB**	**UP**	**ALL**	**ASS**	**BH**	**OR**	**WB**	**ALL**	**GJ**	**MP**	**MAH**	**RJ**	**ALL**	**AP**	**KAR**	**KER**	**TN**	**ALL**	**India**
High	≥ 8000	7	0	11	19	**37**	3	0	3	7	**13**	12	8	1	6	**27**	6	4	7	2	**19**	**96**
Medium	5000-8000	0	0	0	10	**10**	4	0	5	6	**15**	4	15	11	11	**41**	4	12	0	6	**22**	**88**
Low	< 5000	0	2	0	19	**21**	0	15	3	1	**19**	2	20	13	9	**44**	7	3	0	3	**13**	**97**
All		7	2	11	48	**68**	7	15	11	14	**47**	18	43	25	26	**112**	17	19	7	11	**54**	**281**

Source: Compiled from district level data produced in Annexure 1(a) - 1(e)

The post-reform period 199093 to 2003-06

As noted earlier, the post-reform period saw a slow down in growth of AWP in Indian agriculture. However, the experience differs spatially. For the first time since 1962-65, the continuous improvement in the AWP in the north western region halted during the post-reform period, while workers productivity improved substantially in the hitherto lagging states in the eastern and central region. In the eastern region, the number of districts in the high productivity category increased from 4 in 1990-93 to 13 during 2003-06. Productivity levels rose in a number of districts in all the states in the eastern region the only exception being Bihar. Bihar is the only state having all its districts trapped at low levels of productivity of less than Rs. 5000/ AW.

Again, in the central region, the number of districts in the high productivity category increased from 18 in 1990-93 to 27 during 2003-06. Gujarat was a major beneficiary where the number of districts in the high productivity range increased from 6 in 1990-93 to 12 in 2003-06.

It is notable that in addition to Bihar, Madhya Pradesh and Maharashtra in the central region and Uttar Pradesh in the northern region still have a substantial number of their districts trapped in low levels of AW productivity. Special attention needs to be given to revive agricultural growth in these districts to raise the productivity and incomes of agricultural workers located there.

Development and Inter-Districts Disparities in Agricultural Worker Productivity

An attempt has been made in the present section to measure regional inequality in per agricultural worker productivity in the process of agricultural growth by using several measures, namely the coefficient of variation, Gini coefficients, the Lorenz curve, and the differences in productivity levels between top and bottom quintiles in total output for the periods 1962-65, 1970-73, 1980-83, 1990-93 and 2003-06 (Table 5.9).

Table – 5.9
Changes in inter-district inequality in agricultural workers productivity

Measures	1962-65	1980-83	1990-93	2003-06
Gini Coefficient of Inequality	0.286	0.343	0.363	0.450
Coefficient of Variation (%)	56.11	77.75	85.44	136.65
Av worker productivity of bottom quintile	2435	2319	2568	2605
Av worker productivity of middle quintiles	4390	4802	5588	6491
Av worker productivity of top quintile	9283	11767	14680	19363
Ratio AWP of top/bottom quintiles	3.81	5.07	5.72	7.43

Sources: as in table 5.1

Chapter 3 brought out the fact that regional inequality in terms of yield per hectare which recorded an increase from 1962-65 to 1970-73 continuously declined thereafter. This indicates that over time, as new technology was able to spread to most regions and that its adoption on a large scale resulted in narrowing the differences in yield per hectare across various parts of India. Another major development that resulted in raising the yield levels in the low productivity rainfed states of India in the central, southern and eastern regions was crop diversification from low value coarse cereals to high value oilseeds and cotton in the central and southern regions and to rice and wheat in the north-western and eastern regions.

These developments were responsible for reducing inter-state and inter-district disparities in yield levels. For example, at the state level the coefficient of variation of yield per hectare after increasing slightly from 50.13 percent in 1962-65 to 50.19 percent in 1970-73, consistently declined afterwards to 42.75 in 1980-83 and to as low as 36.96 by 2003-06 (Table 2. 2).

The inter-district disparities in yield levels also declined over a period of time. The coefficient of variation of yield per hectare at the district level increased from 49.9 in 1962-65 to 56.0 percent in 1970-73, but declined thereafter. It was 51.2 percent in 1980-83 and declined to 50.8 percent by 2003-06 (Table 3. 3).

A disturbing development is that the trend is just the opposite with respect to agricultural worker productivity- the main determinant of incomes of agricultural workers. It comes out that both the inter-state and inter-district disparities in agricultural worker productivity have tended to increase over time. The coefficient of variation of agricultural worker productivity at the state level increased from 60.25

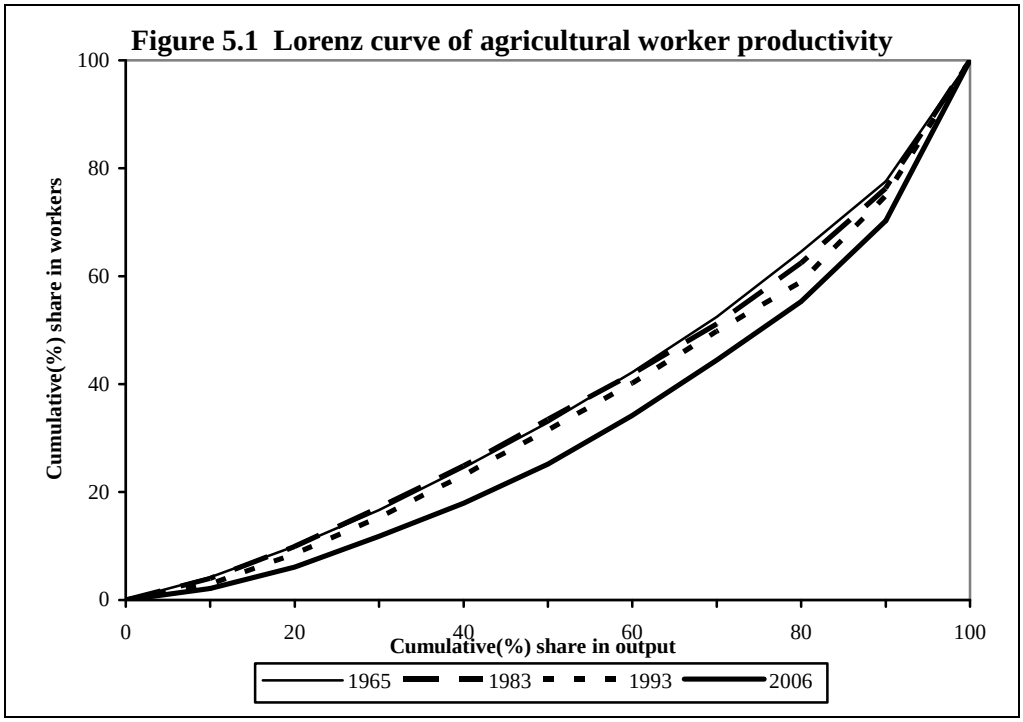
percent in 1962-65 to 71.66 percent by 1980-83, 82.23 percent by 1990-93, and finally to 87.17 percent by 2003-06 (Table 5.3).

The inter-district disparities in agricultural worker productivity are far higher than the inter-state variations. Thus the coefficient of variation in inter-district levels of agricultural worker productivity increased from 56.11 percent during 1962-65 to 77.75 percent by 1980-83, 85.44 by 1990-93 and further to as much as 136.65 percent by 2003-06. In the meantime, the Gini coefficient of inequality increased from 0.286 in 1962-65 to as much as 0.450 by 2003-06 (Table 5.9).

That the inter-regional differences in agricultural worker productivity are very large and are growing over time is dramatically brought out by the range of differences among the states with the highest and that with the lowest agricultural worker productivity. Thus agricultural worker productivity in Punjab which was 12.5 times that in Bihar during 1962-65, rose to as much as 19.6 times by 2003-06 (Table 5.3).

At the district level, the ratio of AWP of the top and bottom quintiles rose from 3.81 during 1962-65 to as much as 7.43 times by 2003-6 (Table 5. 9). The Lorenz curve given below confirms that the 2003-06 curve is much farther from the line of equality as compared with curves for the earlier years.

Figure 5.1 Lorenz curve of agricultural worker productivity



The levels of agricultural worker productivity are determined by the relative share of output in relation to workers. Thus during 2003-06, the 96 high agricultural worker productivity districts with 30.7 percent of area accounted for 48.7 percent of total output but had only 23.8 percent of total agricultural workers. The picture was just the opposite for the 97 low agricultural worker productivity districts, which accounted for 35.2 percent of total area, 22.4 percent only of total output and 45.7 percent of the total workers (Table 5.7). Increasing, inequality in agricultural worker productivity is because regions with the low levels of agricultural worker productivity are characterised by both low levels of yields and concentration of labour force and vice-versa for the districts with high level of agricultural worker productivity (Table 5.3). Table 5.1 brought out clearly that there existed an inverse relationship between output per hectare of net sown area (NSA) and number of workers per hectare during all the periods.

The growth rates of agricultural worker productivity are the net result of the growth in agricultural production and that in agricultural workers. Once again, the high growth districts during all the periods are characterised by high growth of agricultural output combined with relatively much lower growth of agricultural workers. The opposite is true about low growth districts which are characterised by both low growth of output combined with high growth of agricultural workers during all the periods (Table 5.5).

To sum up, all indicators of inequality bring out the widening inter-district gaps in the productivity of agricultural workers employed in Indian agriculture. Unlike the disparities in the yield levels that after initial rise during 1962-65 to 1970-73, declined thereafter, inequalities in agricultural worker productivity have continuously risen over about the last four decades. The post- reform period witnessed a major widening of gaps in agricultural workers productivity across various states and districts of India. High and ever increasing population pressure on land in the backwards districts seems to be the major contributor to the ever widening disparities.

This means that high productivity districts are characterised by low population pressure and the opposite holds true for low productivity districts. One of the intuitive reasons for this is that in general, higher yields and incomes in agriculture generate higher income and employment in the non-agricultural sectors through the operation of input, output and consumption linkages (Mellor, 1976 and Hazell, et.al, 1983). On

the other hand, most of the workers in low yield districts are more or less completely dependent on agriculture for their livelihood.

There is an urgent need for rejuvenation of agricultural growth and shift of agricultural work force to non-farm employment activities in the underdeveloped regions for raising the levels of agricultural worker productivity and for reversing the trend of widening gap in productivity of agricultural workers.

Labour Productivity and Modern Inputs: Econometric Analysis

The regression analysis undertaken aims to quantitatively estimate the contribution of various explanatory variables to the levels of agricultural worker productivity during various periods and in various regions of the country.

An attempt has been made to examine the relationship if any between the level of agricultural worker (AW) productivity and the use of inputs per AW during various periods. The two variables that determine AW productivity are the levels of output and the number of AWs. While the level of per worker agricultural output is determined by the level of use of modern inputs per worker, the number of AW depends on several complex demographic and socio-economic variables including levels and growth of agricultural output. (Bhalla, Alagh & Bhaduri , 1978, also see Ishikawa, 1967). For a cross sectional analysis like the present one, it can be safely assumed that the number of agricultural workers is exogenously determined and AW productivity is hypothesised to depend on per worker use of inputs.

The relationship between per worker and modern inputs has been analysed by employing the restricted form of the Cobb-Douglas production function used in chapter 3. By assuming constant return to scale in production, the corresponding labour productivity function can be expressed as:

$$\begin{aligned}\text{Log(Output/worker)} = {} & \beta_0 + \beta_1 \text{Log(Land/worker)} + \beta_2 \text{Log(Fert/worker)} + \\ & \beta_3 \text{Log(Tract/worker)} + \beta_4 \text{Log(Tubewells/worker)} + \beta_5 \\ & \text{Log(irrigation)} + \beta_6 \text{Log(Roads/worker)} \\ & + \beta_7 \text{Log(Markets/worker)} + \beta_8 \text{Log(literacy)} + \beta_9 \\ & \text{Log(Rainfall)} \\ & + \sum_{i=1}^{14} \delta_i DZ_i + + \sum_{j=1}^{15} \gamma_j DS_j + \text{U}\end{aligned}$$

Where,

Output /worker = Gross value of output per agricultural worker at 1990-93 prices

Land/worker = Total gross cropped area in hectares per agricultural worker

Fert/ worker = Chemical fertilisers (Tons of NPK) fertilisers per Agriculture worker

Tract/ worker = Number of tractors per agriculture worker

Tubewells/ worker = Number of energized tubewells per Agriculture worker

Irrigation = percentage of total cropped area under irrigation

Roads/ worker = Road length per agriculture worker

Markets/ worker = Number of regulated markets per agriculture worker

Literacy = percentage of population literate in the district

Rainfall = Total rainfall in the district during the year

DZ_i = Agro-climatic specific dummies

DS_j = State specific dummies

β = Regression parameter, labour productivity elasticity of the input

δ, γ = Coefficients of zonal and state dummies respectively.

U = Stochastic error term

The ridge regression procedure has been employed to estimate the labour productivity function as explained in chapter 3 because it successfully overcome the problem of multicollinearity. The estimates are obtained for all 281 districts for the four triennia, 1970-73, 1980-83, 1990-93 and 2003-06 are detailed in Table 5.7.

All 281 districts

The estimates of the labour productivity function summarised in Table 5.7 indicate that the availability of area cultivated per worker is the single most important factor explaining inter-district differences in workers productivity in Indian agriculture. The increased availability of cultivable area per worker leads to higher productivity of workers in agriculture. The coefficient of land area is statistically significant and its magnitude increases consistently overtime from 0.364 during 1970-73 to 0.405 during 1980-83 to 0.433 during 1990-93 and finally to 0.531 during 2003-06. Results suggest that in the terminal triennium 2003-06, more than a half of the labour productivity resulted from differences in area per workers.

Increasing area coefficient may be due to increasing population pressure on land as despite accelerated growth of GDP during the eighties and the nineties, very little shift of workers took place from agriculture to non-agriculture.

With virtually no scope for expanding the net sown area in the country, existing inter district gaps in worker productivity in Indian agriculture can be bridged

by more intensive utilisation of land sources through multiple cropping and making existing land more productive by public and private investment in land improvement programmes.

Among the remaining factors, literacy levels turn out to be the second most important variable explaining inter-district variations in labour productivity. The literacy variable capturing quality characteristics of the work force, suggests that per worker productivity would increase when an illiterate worker is replaced by a literate worker in agricultural production.

An interesting finding of our results is that the response of agricultural worker productivity to literacy increased three times from 0.102 during 1970-73 to 0.319 during 2003-06. As education is by far and large being funded by the state in India, this variable indirectly captures the impact of public investment in education on agricultural production in India. This seems to be one of most desirable routes in enhancing labour productivity in lagging regions as unlike land there are hardly any binding barriers to expansion of rural education.

The results provided in Table 5.7 also bring out that in addition to land and literacy, higher use of modern inputs, fertilisers and tractors, and greater availability of infrastructure services in the form of roads and markets are associated with higher productivity of labour employed in Indian agriculture. However, the estimates of two irrigation variables namely, tubewells and proportion of area under irrigation does not show consistent behaviour overtime. But, when estimated on pooled samples, the coefficient of irrigation turned out to be statistically significant.

Besides land and education, the number of agricultural markets is another variable that not only turned out to be significant statistically but its magnitude also increased over time from -0.004 during to 1970-73 to 0.092 during 2003-06. This indicates the increasing importance of agricultural markets in bridging labour productivity differentials in Indian agriculture. In fact, the availability of more markets not only provides better access by farmers to modern input markets but also leads to greater efficiency in the output market by enhancing buyers' competition.

Furthermore, increased agricultural markets also indicate greater access to non-farm employment work opportunities that not only ease pressure on land resources but also tends to augment the earnings of farm workers through making available direct employment in urban/semi-urban jobs. Opening of rural areas through rural road networks plays a crucial role in efficient functioning and utilisation of such

rural-urban markets and employment linkages. This is also confirmed by our results as the road variable turned out to be significant statistically for all the years. Therefore inter-district labour productivity gaps in Indian agriculture can also be bridged by development of rural road network and agricultural markets in the agriculturally lagging regions.

Table 5. 9
Sources of Inter-District Variations in Agricultural Worker Productivity: Ridge Regressions, All India

Variables	Regression Coefficients			
	1970-73	**1980-83**	**1990-93**	**2003-06**
Area	0.364* (.031)	0.405* (.031)	0.433* (.035)	0.531* (.029)
Fertilizer	0.101* (.011)	0.096* (.010)	0.153* (.016)	0.207* (.017)
Tractors	0.068* (.009)	0.045* (.008)	0.069* (.011)	0.039* (.011)
Tubewells	0.028* (.008)	0.041** (.018)	0.042* (.012)	0.026** (.011)
Irrigation	0.014 (.010)	0.039* (.013)	0.017 (.014)	0.004 (.015)
Roads	0.039** (.017)	0.041* (.018)	0.007 (.023)	0.064* (.016)
Markets	-0.006 (.012)	0.001 (.003)	0.050* (.014)	0.068* (.018)
Literacy	0.102* (.030)	0.096* (.030)	0.087* (.028)	0.319* (.077)
Rainfall	0.054** (.024)	0.054** (.025)	0.067* (.027)	0.114* (.030)
Climatic Dummies (14) Number significant	9	9	8	9
State Dummies (15) Number significant	8	8	8	11
Constant term	8.880 (.288)	8.611 (.274)	9.332 (.288)	8.789 (.447)
R^2	0.85	0.86	0.87	0.88
Number of Observations	281	281	281	281

Note: 1. All explanatory variables are in per capita terms except irrigation, rainfall and literacy .
2. Asterisk *, ** and *** indicate coefficients significant at 1 percent, 5 percent and 10 percent level of significant respectively for two tailed t-test.

The results provided in Table 5.7 also bring out that in addition to land, literacy and increased access to roads and agricultural markets, higher use of modern

inputs like fertilisers and tractors are also associated with higher productivity of labour employed in Indian agriculture. However, the estimates of two irrigation variables namely, tubewells and proportion of area under irrigation do not show any consistent behaviour over time. When estimated on pooled samples, the coefficient of irrigation turned out to be statistically significant.

To sum up, it becomes clear that besides the expansion of area under cultivation through intensification of land use, improving education and skill levels of the rural labour force, development of rural infrastructure and agricultural markets tend to improve agricultural workers productivity in Indian agriculture. Similarly, wide inter-district differentials in labour productivity can also be bridged by modernisation of agriculture through use of better inputs like fertiliser and HYV seeds, tractors and tubewells and development of irrigation facilities in the hitherto identified low labour productivity lagging districts in the country.

Accounting for Labour Productivity Differences

Information on state wise labour productivity in Table 5.2 brings out the extremely wide differences in the labour productivity across states in India. Agricultural output per workers in Bihar is approximately one-twentieth of that in Punjab. With the sole exception of Kerala, no other state could attain productivity levels that were even half of as high as those in Punjab. Moreover, the inter-state comparison also brings out that the gap in agricultural worker productivity across states is widening over time.

Very low levels of labour productivity, a slow down of agricultural growth in many regions and widening disparities pose serious challenges for achieving the goals of balanced region development, poverty alleviation, and inclusive economic growth envisaged in the eleventh Five Year Plan. The econometric exercise in the previous section identified the sources of differentials in per worker productivity across states. On the basis of the elasticity estimates of the labour productivity function, an attempt is made in this section to account for the observed differences in productivity between the advanced and other states /regions during the triennium 2003-06.

The explanatory variables are grouped into five broad categories, (a) physical endowment (land), (b) technology embodied in factors of production (fertiliser and machinery), (c) intensification of resource (land) used, (d) human resources in the

form of rural literacy, and (e) agricultural infrastructure in the form of markets, irrigation and rural roads.

On taking Taylor expansion up to the first term, the labour productivity function (Kawageo et al. 1985) (1) can be approximated by:

$$\begin{aligned}\Delta^{01}\text{ (Output/worker)} &= [\beta_1 \Delta^{01}(\text{Land/worker})] + [\beta_2 \Delta^{01}(\text{Fert/ worker}) + \beta_3 \text{Log}\Delta^{01}(\text{Tract/worker}) \\ &\quad + \beta_4\Delta^{01}(\text{Tubewells/ worker})] + [\beta_1\Delta^{01}(\text{Cropping intensity})] \\ &\quad +[\beta_5 \Delta^{01}(\text{Irrigation}) + \beta_6 \Delta^{01}(\text{Roads/ worker}) + \beta_7 \Delta^{01}(\text{Markets/ worker})] \\ &\quad + [\beta_8 \Delta^{01}(\text{Literacy})] + \text{Residual} \qquad (2)\end{aligned}$$

Where Δ^{01} is the percent differences in respective factors between the base state (denoted by subscript 0) and a state/region to be compared (denoted by subscript 1). The first term on the right hand side of equation (2) represents the contribution of difference in land endowment (net area sown) per worker to the percent difference in output per agricultural worker, the second term represents the contribution of modern technology (fertiliser, tubewells and tractors), the third term captures is contributions of agricultural intensification through multiple cropping (cropping intensity), the fourth term represents the contribution of rural infrastructure, the fifth term captures the differences due to human resource in the form of level of rural literacy and the residual includes the differences due to state specific idiosyncrasies and agricultural policies and other factors not included in the in the workers productivity function.

To estimate the contribution of various factors to differences in productivity, the elasticity coefficients (β'_s) of the worker productivity function estimated on district wise data for 2003-06 and reported in Table 5.9 are used. This is mainly because of an inadequate number of districts in some states for estimating state-specific productivity function (1). The estimated elasticity coefficients are multiplied by the percentage differences between Punjab and other states/regions to measure the contribution of each factor to differentials in agricultural worker productivity.

To account for worker productivity differences, states and four broad regions are compared with Punjab. Punjab was chosen as the base category not only for its highest rank in agricultural worker productivity among Indian states but also because the state is a leader in the matter of assimilation of modern technology in the country. The results of the percent contribution of various factors to the inter-state differences in agricultural worker productivity are summarised in Tables 5.10.

Table 5.10
Percent Contribution of various Factors to the Inter state Differences in Agricultural Worker productivity

State/Region	Per cent contribution of factors to differences (Punjab vs. others)					
	Physical endowment	Technology	Intensifi--cation	Infrast-ructure	Human resources	Residual
Haryana	37.25	25.63	-0.19	15.58	2.30	19.43
Himachal Pradesh	45.58	28.88	0.66	10.63	9.96	4.28
Jammu & Kashmir	38.61	28.50	4.85	0.26	0.00	27.78
Uttar Pradesh	41.00	26.81	4.02	15.05	7.39	5.73
Northern region*	**40.88**	**26.91**	**3.58**	**14.76**	**3.61**	**10.25**
Assam	34.50	32.76	7.62	12.69	3.51	8.93
Bihar	44.47	27.36	2.90	13.72	11.48	0.07
Orissa	31.12	31.58	12.01	12.68	4.27	8.35
West Bengal	47.15	30.44	1.60	15.58	3.12	2.11
Eastern region	**42.28**	**29.03**	**4.34**	**13.88**	**3.28**	**7.18**
Gujarat	21.44	32.74	25.62	17.64	5.88	-3.32
Madhya Pradesh	24.64	28.46	10.11	14.26	4.77	17.77
Maharashtra	23.33	28.43	13.58	8.52	-1.66	27.80
Rajasthan	10.47	29.06	15.60	13.82	7.55	23.49
Central region	**20.81**	**29.08**	**14.14**	**12.82**	**3.53**	**19.62**
Andhra Pradesh	40.03	28.02	8.88	13.87	7.28	1.93
Karnataka	23.32	28.19	13.30	14.41	3.51	17.27
Kerala	10.79	52.14	40.78	5.12	-27.71	18.87
Tamil Nadu	43.80	28.35	7.77	8.85	-0.98	12.22
Southern region	**36.04**	**28.62**	**10.36**	**12.47**	**3.61**	**8.90**
India*	**33.62**	**28.54**	**8.68**	**13.16**	**3.47**	**12.53**

Note : *- Northern region and All-India exclude Punjab.
Land- is in net sown area per agricultural worker
Technology- includes fertilizer, tractors and tubewells.
Intensification- is cropping intensity (ratio of gross cropped area to net area sown)
Infrastructure- includes rural roads, markets, and irrigation.
Residual- is the differences after accounting for contribution of differences due to land, technology, infrastructure and literacy.

Our decomposition exercise indicates that the five set of factors mentioned above together account for approximately 90 per cent of the differences in agricultural worker productivity in Indian agriculture. Physical endowment in the form of per agricultural worker availability of the Net Sown Area (NSA) turned out to be the single most important factor accounting for more than one-third of the (33.63 per cent) of the differentials in per worker productivity between Punjab and other

states/regions. The contribution of per worker land is particularly high in almost all the states in northern and eastern regions and Andhra Pradesh and Tamil Nadu in the Southern region. However the differences in labour productivity due to land endowment are modest between Punjab and states in the central region and Kerala in the south. With the exhaustion of cultivable land frontier in almost all the regions, the structural transformation of the rural labour force from agriculture to non-farm activities is the only route to reduce excessive population pressure on land resources and hence to improve productivity and living conditions of agricultural workers in the country.

Technology turned out to be the second important contributor to differentials in labour productivity between the most advanced and other states in the country. On the whole, it accounts for 28.54 per cent of the gap between Punjab and other states/regions. Interestingly there are not much inter-state differentials in the contribution of technology to agricultural worker productivity across states. Kerala is the only exception in this pattern. More than half of the differences between Kerala and Punjab are due to technology. This however needs to be interpreted carefully due to the unique cropping pattern in Kerala. As noted earlier in Chapter-2, field crops like foodgrains and oil seeds are marginal contributors (7.9 per cent) to total agricultural production in Kerala. A major proportion of total agricultural production is contributed by plantation crops, condiments and spices. For these crops, the elements of technology like fertiliser, tractors and tubewells included here are not as important as in the case of field crops like foodgrains.

The included elements of technology, fertiliser, tractors and tubewells, represent the agro-industrial inputs. Therefore, unlike land, there is no limit on augmenting their supply to low use regions. What is urgently required is the need to develop and supply area specific biological (new seeds and fertiliser) and mechanical innovations through collaborative efforts and investments by the public and private research systems. Equally important in technological upgradation is to strengthen the extension network with a view to bridging the prevailing wide gap in knowledge and awareness of the farmers regarding use and availability of modern agricultural inputs; services and agricultural markets (Per Pinstrup-Andersen, et al, 2006). Equally important is the access to timely, affordable and adequate availability of institutional credit as the use of modern inputs is found to have very high association with credit

availability (Table 3.10). Like rural credit, access to other rural infrastructure also plays an important complementary role in the adoption of modern technology.

Besides its complementary role in technological upgradation, the development of rural infrastructure is also crucial in bridging the prevailing productivity gap in Indian agriculture. About one-seventh (13.16 per cent) of agricultural worker productivity differences between Punjab and other states are due to low levels of rural infrastructure in other states/region as compared with that in Punjab. With the exception of Himachal Pradesh and Jammu and Kashmir in the northern region, Maharashtra in the central region and Kerala and Tamil Nadu in the southern region, differences in labour productivity due to infrastructure hovered around 15 per cent in the rest of the states/regions. Another 3.47 per cent of the labour productivity differences were contributed by prevailing differences in human resources denoted by the level of rural literacy.

Differences due to intensive land use, measured by cropping intensity, account for 8.68 per cent of the gap in per agricultural worker productivity between Punjab and the other states/regions. The differences in labour productivity due to intensification are marginal in the northern states and in West Bengal in the east but are quite substantial in the central region states. It indicates a big scope for improvement in agricultural worker productivity through intensive land use in these areas. Both the development of new short duration varieties and the expansion of the irrigation base play crucial roles in this context. The unusually high differences in Kerala again need to be interpreted carefully due to high rainfall and the dominance of perennial cropping patterns in the state. Intensive land use in the form of multiple cropping is not that relevant for Kerala.

It is an interesting coincidence that the present results regarding contribution of modern inputs came so close to the estimates of by Kawageo, Hayami and Ruttan (1985) for inter-country differences in labour productivity. They also found that technical inputs (fertilisers and machinery) account for one-fourth of differences in male workers productivity between USA and seven of nine countries at different levels of development including India. Similarly, our estimate of 3.47 per cent differences due to general literacy is close to 5 percent estimated in the cross- country comparison by Kawageo, et.al. On the other hand, land accounts for comparatively less (about 8 percent) in the above mentioned cross-country study as compared with

our results whereas a one-third of differences in agricultural worker productivity in Indian agriculture are due to differences in per worker availability of arable land.

Our results suggest that population pressure on land resources, low use of modern technology inputs, underdeveloped rural infrastructure, and low human resource development taken together accounts for about 90 percent of the differences in agricultural worker productivity between highest productivity state, Punjab, and the other regions in the country. Easing of population pressure on land through a shift of labour to non-agricultural sectors is a long drawn process. This no doubt will make a significant contribution to raising per agricultural worker productivity across various regions of India. In the interim, significant scope exists in improving workers productivity in agriculture by investment in irrigation and research thorough development of region specific short duration high yielding crops that facilitate multiple cropping and contribute substantially to improving the productivity level of both physical and human resources in Indian agriculture.

Summary and Conclusions

An analysis of agricultural worker productivity is important since it is ultimately labour productivity which determines the level of wages, incomes and hence levels of living and well-being of the population employed in this sector.

In the initial period of green revolution, most of the regions and states only derived limited benefits in the matter of increase in yield levels as well as the levels of agricultural worker productivity. This is because the growth in agricultural yields and output was not that high and also because most of the growth in output was eaten away by rapid growth in the number of agricultural workers. Accelerated growth of agriculture during 1980-83 to 1990-93 as compared with 1962-65 to 1980-83 brought about major increases in both the yield and output levels as well as the levels of agricultural worker productivity. Consequently, the benefits of the green revolution in terms of higher yields and higher agricultural worker productivity remained no longer confined to the states in the north-western region, these had percolated far and wide to both the densely populated eastern and southern states and also to the sparsely populated and the rainfed states in central India.

But there took place retrogression both in the matter of levels and growth of output as well as that of agricultural worker productivity during the post-reform period 1990-93 to 2003-06.

An analysis of both the levels and growth of agricultural workers productivity at the district level over various periods confirms the above trends namely the slow growth of agricultural worker productivity during1962-65 to 1980-83 and its rapid growth during 1980-83 to 1990-93 and a deceleration of growth during the post-reform period.

Thus, during 1962-65 to 1980-83, only 49 districts with only 13.5 percent of total AW had growth in AW productivity exceeding 2.0 percent p.a. and as many as 133 districts accounting for 55.2 percent of AW had low growth levels below 0.5 percent p.a. Gains in growth of workers productivity during this period were mainly confined to the north western regions. It was only during 1980-83 to 1990-93, that a real breakthrough occurred and growth rates of AW productivity accelerated in almost all the regions of India. Thus, the number of high growth districts increased from 49 during the previous period to 109 during 1980-83 to 1990-93 and their share in workers increased from 13.5 percent during 1962-65 to 41.9 percent in 1980-83. Moreover, unlike in the earlier period, the gains of agricultural growth were more inclusive and widely shared across all the regions.

The post-reform period 1990-93 to 2003-06 is characterised by a slow down in agricultural growth as well as in the growth rate of agricultural worker productivity. Consequently the number of districts and proportions of workers in high growth category declined and that in low growth increased during this period. The slow down marked all the regions but it was more pronounced in the green revolution north western states.

As a result of high growth, significant changes also took place in the levels of workers productivity during 1962-65 to 2003-06. Thus the number of high AW productivity districts rose from 35 in 1962-65 to 96 by 2003-06 and their share of the total agricultural work force rose from 6.8 percent to 23.8 percent during the same period. More important, the number of low agricultural workers productivity districts declined from 177 during 1962-65 to 97 by 2003-06 and in the meantime their share in agricultural workers declined from 69.0 percent to 45.7 percent. Four decades of significant development in Indian agriculture notwithstanding, 45.7 percent of the agricultural workers are still trapped in the areas of low levels of labour productivity. Spatially, the low agricultural worker productivity districts are mainly concentrated in Bihar, Madhya Pradesh, Maharashtra and eastern Uttar Pradesh. These regions are not only marked by low level of agricultural development but also the majority of the

rural poor in the country inhabit these regions. Improving agricultural labour productivity in these lagging regions would not only help to meet the goal of inclusive growth envisaged in the Eleventh Five Year Plan, but would also go a long way in making a dent in the endemic poverty prevailing in these areas.

The regression estimates suggests that the prevailing inter-district differentials in per worker productivity in Indian agriculture can be bridged by expanding per worker cultivable land by promoting of more intensive use of land resources, improving education and skill level of the rural labour force, and the development of rural infrastructure like rural roads and agricultural markets in the hitherto lagging regions. Similarly, wide inter-district differentials in labour productivity can also be bridged by modernisation of agriculture through use of better inputs like fertiliser and HYV seeds, tractors and tubewells and development of irrigation facilities low labour productivity backward districts.

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[i] Actually Kerala is one among three states along with Assam and Tamil Nadu where the actual numbers of agricultural workers were lower in 2003-06 as compared with 1990-93.

Chapter - VI

Conclusions and Policy Recommendations

Indian agriculture recorded a significant acceleration in growth and productivity after independence as compared with the pre-independence period. The main factors which were instrumental in accelerating agricultural growth after independence included implementation of land reforms and large planned investments in irrigation and other rural infrastructure. The introduction of the Borlaug seed-fertiliser technology during the mid-sixties which resulted in notable increases in yield and output levels of major cereals in many parts of the country was a major technological breakthrough and marked a new chapter in the history of agricultural development in India. But the gains of new technology were not equitably distributed across various regions.

The main objective of the present study was to analyse the variations in regional patterns of levels and growth of agricultural output as well as that of agricultural worker productivity at the state, region and district levels in India during 1962-65 to 2003-06 and the various sub-periods namely, 1962-65 to 1980-83, (the initial period of green revolution), 1980-83 to 1990-93 (the maturing of green revolution) and 1990-93 to 2003-06 (the post-reform period). The focus of the analysis was to compare the performance of agriculture at the state and district levels during the post-reform period 1990-93 to 2003-06 with the immediate pre-reform period 1980-83 to 1990-93.

A review of agricultural development in India during the post-green revolution period beginning in the mid-sixties brings out, firstly, that the introduction of new seed-fertiliser technology during the mid-sixties resulted in significant increases in the yield and output of wheat and later rice thereby promoting growth of agricultural output and raising agricultural worker productivity in most of the states and regions that had adopted the new technology. But during the initial period of the 1960’s and 1970’s, the spread of new technology was rather slow and was confined to wheat and rice in the irrigated states in the north-western region of India.

The proliferation of new technology gathered momentum during 1980-83 to 1990-93 when it spread to more areas in the eastern, southern and central states and encompassed more crops. Yet another important improvement during 1980-83 to 1990-

93 was significant changes in the cropping pattern with a visible increase in crop diversification away from low value and low yield coarse cereals towards more valuable oilseeds crops in the rainfed states of central India, and towards rice and wheat in the north western and eastern states. Crop diversification towards oilseeds and rice and wheat helped in raising the productivity levels of many low yield districts in the country thereby promoting growth and making it more widespread. The result was that during 1980-83 to 1990-93, crop output recorded an unprecedented annual growth rate of 3.40 per cent compared with a growth rate of 2.24 per cent during 1962-65 to 1980-83. There was a decelerating in growth rate of output and yield during the post-reform period 1990-93 to 2003-06, but despite this many low yield districts were able to climb up to higher levels of productivity.

The initiation of economic reforms in India in 1991 which consisted of trade liberalisation and exchange rate adjustments was expected to end discrimination against agriculture and thereby promote agricultural growth and foster exports.

Our analysis brings out that the objective of accelerating agricultural growth has not been achieved. The state wise analysis shows that except for Gujarat and to some extent Maharashtra, the growth rates of total crop output and yields decelerated in all the states during 1990-93 to 2003-06 as compared with the 1980's. It also comes out that the post-reform period was characterised by a slow down in diversification towards oilseeds or wheat and rice as compared with the immediate pre-reform period 1980-83 to 1990-93. The only exceptions were the states in the central region and to some extent in the northern parts of the southern region where diversification continued from coarse cereals to cotton, oilseeds and remaining crops even during the post-reform period.

The district level analysis confirms that high growth in yields and output achieved during 1980-83 to 1990-93 was followed by a slow down of growth during the subsequent period 1990-93 to 2003-06. Firstly, for all the 281 districts taken together, growth of output decelerated from 3.5 percent pa during 1980-83 to 1990-93 to only 2 percent pa during the post-reform period 1990-93 to 2003-06. In the meantime, the number of high growth districts declined from 138 to 61 and their share in total area declined from about 50 percent during the base period 1980-83 to only 20.2 percent

during 1990-93. On the other hand, the number and weight of low growth districts increased substantially.

The spatial distribution brings out that the slow down was spread to all the regions of India. The worst affected were the high productivity (and hitherto high growth) districts located in the irrigated states of north-western region. Thus none of the districts belonging to the high productivity category during 1990-93 recorded high growth exceeding 3.5 percent pa during the post-reform period 1990-93 to 2003-06. Furthermore, the yield levels in these parts are being sustained only as a result of intensive use of modern costly inputs that tend to erode profitability and damage the environment.

In addition to districts in the north-western states, many districts in the eastern and southern region also registered a perceptible slow down in their growth. Thus 40 out of 47 districts in the eastern and 40 out of 54 districts in the southern regions registered a deceleration in their growth during the post-reform period.

However, many of the districts located in the states in the rainfed central region went unscathed–in fact after 1990-93 many districts in Gujarat registered a distinct acceleration in their growth rates because of large scale adoption of Bt. Cotton. Consequently, many of the hitherto low productivity districts in Gujarat graduated to the mid or even high productivity category by 2003-06. Similarly, there was a modest increase in growth rates in some districts in Maharashtra.

Over time, crop diversification and shifts from low value-low yield coarse cereals to high value and relatively higher yield oilseeds, pulses and remaining crops, has enabled many districts and areas in the rainfed central region to improve their performance, but it needs to be emphasised that even this success has been achieved as a result of significant expansion of irrigated area made possible because of irrigation projects like the Sardar Sarovar Project (SSP) and the *Narmada* Sagar Project (NSP). The result was that except for Maharashtra all the other states registered a significant increase in their irrigated area (Table 2.5). But despite this progress, except for Gujarat, the both land and labour productivity levels continue to be much lower in most of the districts and states in the rainfed central region than those in irrigated regions.

The continuation of growth in the central region is a welcome exception. The diversification away from low value low yield coarse cereals and pulses towards oilseeds,

cotton and remaining crops has no doubt benefited the resource poor farmers in the states in the dryland central region. But, diversification has also tended to increase their vulnerability and risks to vagaries of weather and price fluctuations. This is because crop output in these rainfed areas are subject to wide climate induced volatility. This increases the risk of farmers in these states. These risks get aggravated because subsequent to trade liberalisation, large fluctuations in international prices quickly get transmitted to domestic markets. These risks pose a serious problem for the livelihoods of oilseed and cotton farmers in the central region and can drive them to desperation in those cases where they have undertaken heavy loans from private sources for financing their production operations. There is a need to take measures like crop and income insurance to mitigate these risks.

One of the solutions suggested for minimising the adverse impact of weather borne fluctuations is crop insurance. But the experience so far is that crop insurance has not bestowed the expected benefits in terms of stability of incomes of the farmers. This is because of many structural problems inherent in the scheme

Trade liberalisation has no doubt benefited the farmers growing plantation crops, cardamom and spices and other fruit crops in the southern region. However, large scale diversion of area to export crops has also tended to increase the risks faced by the farmers in the southern region and has posed a serious challenge for the maintenance of competitiveness of these crops.

This requires development of appropriate mechanism for protecting these farmers from large fluctuations in world prices of plantation crops through flexible policy of changes in import and export duties or treating some crops as ‘special products’. However, it has to be ensured that any such policy measures are consistent with the provisions of WTO agreement on agriculture (AoA).

Inter-regional disparities in agricultural development, yield levels and agricultural worker productivity

The analysis undertaken in this book brings out that to begin with the new technology was heavily biased towards irrigated regions and the gains were therefore not equitably distributed across various regions.

But over time, the new technology has spread over all the regions of India including the rainfed areas and the districts in all the regions of India have increased the use of modern inputs. The expansion of irrigation in the rainfed states in the central region through large projects like Narmada Valley Project, Indira Gandhi canal etc has not only helped in raising productivity but also tended to reduce year to year seasonal fluctuations and thereby impart a measure of stability to agricultural output.

One of the important consequences of the spread of new technology to all the areas, widespread use of modern inputs, and diversification from low value coarse cereals to high value oilseeds in the dryland central and southern regions and rice and wheat in the eastern region, has been that yields have improved across all the districts and regions of India. This has tended to reduce inter-state and inter-district disparities over time.

The result is that coefficient of variation of yield per hectare has registered a decline over time both at the state and district levels. At the state level, the coefficient of variation which slightly increased from 50.13 during 1962-65 to 50.19 during 1970-73 consistently declined afterwards to 42.75 in 1980-83 and to as low as 36.96 by 2003-06. Again, after initially increasing from 49.9 in 1962-65 to 56.0 percent in 1970-73, the coefficient of variation of yield per hectare at the district level recorded a sharp decline thereafter. It was 51.2 percent in 1980-83 and declined to 50.8 percent by 2003-06 (Table 3.4).

But a disturbing development is that the trend is just the opposite with respect to agricultural worker productivity- the main determinant of incomes of agricultural workers. The analysis brings out that both the inter-state and inter-district disparities in agricultural worker productivity have tended to increase over time. The Gini coefficient of inequality also showed a similar trend (Table 5.8).

The main reason for increasing inequality in agricultural worker productivity is that regions and districts with high level of agricultural worker productivity have relatively lower density of agricultural workers. On the other hand, the regions with low levels of agricultural worker productivity are characterised by concentration of agricultural workers (Table 5.7).

The growth rates of agricultural worker productivity are the net result of the growth in agricultural production and that in agricultural workers. Once again, the high

growth districts during all the periods are characterised by rapid growth of agricultural output combined with relatively much lower growth of agricultural workers. The opposite is true about low growth districts which are characterised by both slow growth of output combined with high growth rates of agricultural workers during all the periods (Table 5.5).

Increasing inter-state and inter-district disparity in per worker productivity the main determinant of income of agricultural workers, poses a serious challenge to policy makers. As discussed in detail in Chapter 5, raising yield levels in agriculture and relieving the population pressure on agriculture by creating productive jobs in the non-farm sector are the only solutions of raising productivity levels in under-developed regions and districts. Our analysis brings out that rapid agricultural growth is one of the important instruments for promoting growth and employment in the non-agricultural sectors.

Despite considerable progress after the introduction of economic reforms, there were 46 districts during 1990-93 that belonged to the hard core underdeveloped set of low productivity cum low growth districts. It is interesting to note that during all the periods, the largest number of districts that belong to the set of low productivity cum low growth belong to the states in the dry land central region followed by the states in the eastern region (mainly Bihar and Orissa).

Special efforts have to be made to foster growth in these districts. The first priority should be development of irrigation and investment in other rural infrastructure followed by timely availability of institutional credit[1]. There is a need to initiate a special rehabilitation package on the lines of the Prime Minister's Relief Package that was announced for 31 distress prone districts in July 2006.

The slow down of agricultural output and yields has many adverse implications:

First, as is brought out by an analysis of levels and growth of agricultural worker productivity, the deceleration in the growth rates of agricultural output and yields during the post reform period 1990-93 to 2003-06 as compared with the period 1980-83 to 1990-

[1] For a comprehensive discussion of these issues see, GOI (2007), *Report of the Expert Group on Agricultural Indebtedness*, Ministry of Finance.

93 is accompanied by a slow down in agricultural worker productivity growth both at the state and district levels. This is a serious development that is likely to have an adverse impact on the income of a vast section of workers engaged in agriculture. The worst affected will be the small and marginal farmers.

Second, a step down in the growth rates of agricultural output and yields in the high productivity and food surplus states in north-western India is a serious matter since it adversely affects the food security of India. Furthermore, the yield levels in these states are being sustained only as a result of very intensive use of costly modern inputs. This has resulted in raising costs and eroding profitability. Excessive draught of underground water has resulted in serious depletion of the water table in many irrigated regions and disproportionate use of chemical inputs has impoverished the soils and damaged the environment. All of this is posing a serious challenge to the sustainability of agriculture in these states.

Third, the slow down in production of coarse cereals and pulses and large scale diversification away from these crops towards non-food crops has an adverse impact on food security. The decline in production of coarse cereals is also likely to have a deleterious impact on the availability of animal feed which is emerging as one of the important requirements for large scale diversification of the food basket to milk, meat and other animal husbandry products consequent to rapid growth in per capita income.

Fourth, the highly populated districts and states in the eastern region had registered a notable increase in their productivity and income during 1980-83 to 1990-93. A reversal of that process has serious implications for the livelihood of a large percentage of farmers living there. The same more or less holds true for the districts in the southern states.

Fifth, the growth rates in agricultural output during the period 1990-93 to 2003-06 was sustained primarily because of rise in productivity recorded by the low yield rainfed districts in the central states of Gujarat, Madhya Pradesh, Maharashtra and Rajasthan, northern parts of Karnataka, Andhra Pradesh and Uttar Pradesh. This is no doubt a welcome development. But as noted earlier, this growth is highly unstable and subject to weather induced fluctuations.

Sixth, increasing inter-state and inter-district disparity in per worker productivity, the main determinant of income of agricultural workers, poses a serious challenge to policy makers. This requires firstly rejuvenating agriculture in underdeveloped regions and secondly promoting the creation of non-farm jobs there with a view to relieving population pressure on agriculture.

To sum up, it is becoming increasingly important for the initiation of policy measures for reversing the trend towards deceleration of agricultural growth and rejuvenating agriculture in different regions of India. Although there is a need for devising region specific policies, but it would be important to increase public investment in irrigation and other rural infrastructure in particular in agricultural research and extension in all parts of India.

For reversing the deceleration in growth in the high productivity north-western region, it is important to heavily invest in agricultural and bio-technology research with a view to developing cost reducing and water saving technology for wheat and particularly rice. The trend towards decline in input use efficiency needs to be reversed as soon as possible with a view to increasing profitability. Simultaneously urgent steps are needed for reducing environmental damage.

In the eastern region, large investments in infrastructure like irrigation and particularly in flood control are essential to enable the farmers to improve their productivity though adoption of new technology. Specific measures should be taken for closing the high yield gap between the north-western and eastern states. In addition, in some of the states like Bihar land relations continue to be outdated and large scale occupancy tenancy continues to prevail. This requires the initiation of appropriate land reforms measures.

The policy makers ought to devise appropriate region specific policy packages for reversing the trend of deceleration in agricultural growth registered in the post-reform period with a view to making a large proportion of workforce in agriculture share the benefits of high growth achieved by the economy after economic liberalisation and make the growth process more inclusive. This can only be done through according higher priority to agriculture and undertaking large public and private investments in rural

infrastructure like power, roads and communications and above all in research and extension.

This is likely not only to raise productivity and income in agriculture but also in generating more income and employment in the non-farm sector through input-output and consumption linkages. This in turn, is likely to counteract the tendency of increasing inter-regional inequality in per agricultural worker productivity.

Appendix 1.1
Formation of District Units

District Unit in 1971	Comparable Unit in 2003-06
Andhra Pradesh	
Adilabad	Adilabad
Anantpur	Anantpur
Chittoor	Chittoor
Cuddapah	Cuddapah
East Godavari	East Godavari
Guntur	Guntur + Prakasham + Nellore + Kunoll
Hyderabad	Hyderabad + Rangareddy
Karimnagar	Karimnagar
Khammam	Khammam
Krishna	Krishna
Mahaboob Nagar	Mahaboob Nagar
Medak	Medak
Nalgonda	Nalgonda
Nizamabad	Nizamabad
Srikakulam	Srikalulum + Vizianagram + Visakhaptnam
Warangal	Warangal
West Godavari	West Godavari
Assam	
Cachar	Silchar (Cachar) + Hailakandi + Karimganj
Darrang	Darang + Sonitpur
Goalpara	Goalpara + Dhubri + Kakrajhar + Bongaigaon
Jorhat	Johrat + Golaghat + Sibsagar
Kamrup	Kamrup + Nalbari + Barpeta
Karbi-Anglong	Kabri Anglong + N.C.Hills
Lakhimpur	Lakhimpur + Dhemji + Dibrugarh + Tinsukia
Nagaon	Nagaon + Morigon
Bihar & Jharkhand	
Begusarai	Begusrai + Monghyr + Khagri + Saharsa + Madhepura + Saupal + Lakhisria + Jamui + 75% of Shekhpura
Bhagalpur	Bhagalpur + Banka
Sahabad	Bhojpur + Rohtas + Bhubha + Buxar
Champaran	Champran East + Champran West
Darbhanga	Dharbhanga + Madhubani + Samastipur
Santhal Pargnas	Dumak + Jamtara + Godda + Deoghar + Sahebganj + Pakur
Singhbhum	East Singhbhum +West Singhbum + Seraikela
Gaya	Gaya + Jhanabad + Nawadha + Aurangabad + Arval
Hazaribag	Hazaribag + Giridh + Dhanbad + Bokaro + Chatra + Koderma
Muzaffarpur	Muzaffarpur + Sitamari + Shivhar + Vaishali
Palamu	Palamau + Garwa + Latehar
Patna	Patna + Nalanda + 25% of Shekhpura
Purnea	Purnea + Katihar + Kishnganj + Araria
Ranchi	Ranchi + Lohardaga + Gumla + Simdega
Saran	Saran + Siwan + Gopalganj

District Unit in 1971	Comparable Unit in 2003-06
Gujarat[	
Ahmedabad	Ahmedabad + 40% of Ganghinagar
Amreli	Amreli
Banaskantha	Banaskantha + 17.6% of Patan
Bhavnagar	Bhavnagar
Broach	Broach + 86.4% of Narmada
Dangs	Dangs
Jamnagar	Jamnagar
Junagadh	Junagadh + Porbandhar
Kheda	Kheda + Anand
Kutch	Kutch
Mehsana	Mehsana + 60% of Gandhinagar + 82.4% of Patan
Panch mahals	Panch Mahals + Dohad
Rajkot	Rajkot
Sabarkantha	Sabarkantha
Surat	Surat
Surendranagar	Surendranagar
Vadodara	Vadodara + 13.6% of Narmada
Valsad	Valsad + Navsari
Haryana	
Ambala	Ambala + 89.55% of Yamuna Nagar + Panchkula
Gurgaon	Gurgoan + Faridabad + 83.06% of Rewari
Hissar	Hissar + Sirsa + Fatehabad + 62% of Bhiwani
Jind	97.0% of Jind
Karnal	Karnal + Kaithal + Panipat + Kurukshetra + 10.45% of Yamuna Nagar + 3% of Jind
Mahendragarh	Mahendargarh + 34.50% of Bhiwani
Rohtak	Rohtak + Sonepat + Jhajjar + 16.94% of Rewari + 3.5% of Bhiwani
Himachal Pradesh	
Himachal Pradesh	All Districts
Jammu & kashmir	
Jammu	Jammu + Doda + Udhampur + Kathua + Rajouri + Poonch
Leh	Leh + Kargil
Srinagar	Srinangar + Anantnag + Baramula + Pulwama + Kupwara + Budgam
Karnataka	
Bangalore	Bangalore Rural + BangloreUrban
Belgaum	Belgaum
Bellary	Bellary + 38.6% of Davangere
Bidar	Bidar
Bijapur	Bijapur + Bangalkot
Chikmagalur	Chikmagalur
Chitradurga	Chitradurga + 34.7% of Danangere
Dakshinakannada	Dakshinakannada + Udipi

Cont….

District Unit in 1971	Comparable Unit in 2003-06
Dharwad	Dharwad + Gadag + Haveri
Gulbarga	Gulbarga
Hassan	Hassan
Kodagu(coorg)	Kodagu(Coorg)
Kolar	Kolar
Mandya	Mandya
Mysore	Mysore + Chamarajannagar
Raichur	Raichur + Koppal
Shimoga	Shimoga + 26.7% of Danangere
Tumkur	Tumkur
Uttarakannada	Uttarakannada
Kerala	
Alappuzha	Alappuzha + 17.75% of Pathanamthitta
Ernakulam	Ernakulam + Kottayam + Idduki + 1.67% of Pathanamthitta
Kannur	Kannur + Kasargod + 35.08% of Wynad
Kollam	Kollam + 80.58% of Pathanamthitta
Kozhikode	Kozhikode + Palakkad + Malappuram + 64.92% of Wynad
Thrissur	Thrissur
Trivandrum	Trivandrum
Madhya Pradesh & Chattisgarh	
Balaghat	Balaghat
Bastar	Bastar + Dantewara + Kanker
Betul	Betul
Bhind	Bhind
Bhopal	Bhopal + Sehore
Bilaspur	Bilaspur + Janjgir-Champa + Korba + 32.4% of Kawardha
Chhatarpur	Chhatarpur
Chindwara	Chindwara
Damoh	Damoh
Datia	Datia
Dewas	Dewas
Dhar	Dhar
Durg	Durg + Raj Nandgaon + 67.6% of Kawardha
East Nimar	Khandwa + Burhanpur
Guna	Guna + Ashok Nagar
Gwalior	Gwalior
Hoshangabad	Hoshangabad + Harda
Indore	Indore
Jabalpur	Jabalpur + Katni
Jhabua	Jhabua
Mandla	Mandla + Dindori
Mandsaur	Mandsaur + Neemach
Morena	Morena + Sheopur Kala
Narsimpur	Narsimpur
Panna	Panna
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Cont….

District Unit in 1971	Comparable Unit in 2003-06
Raigarh	Raigarh + Jashpur
Raipur	Raipur + Dhamtari + Mahasmund
Raisen	Raisen
Rajgarh	Rajgarh
Ratlam	Ratlam
Rewa	Rewa
Sagar	Sagar
Satna	Satna
Seoni	Seoni
Shahdol	Shahdol + Annupur + Umaria
Shajapur	Shajapur
Shivpuri	Shivpuri
Sidhi	Sidhi
Surguja	Surguja + Koriya
Tikamgarh	Tikamgarh
Ujjain	Ujjain
Vidisha	Vidisha
West Nimar	Khargaon + Barwani
Maharashtra	
Ahmednagar	Ahmednagar
Akola	Akola + Washim
Amravati	Amravati
Aurangabad	Aurangabad + Jalna
Beed	Beed
Bhandara	Bhandara + Gondia
Buldhana	Buldhana
Chandrapur	Chandrapur + Gadchiroli
Dhule	Dhule + Nandurbar
Jalgaon	Jalgaon
Kolhapur	Kolhapur
Nagpur	Nagpur
Nanded	Nanded
Nasik	Nasik
Osmanabad	Osmanabad + Latur
Parbhani	Parbhani + Hingoli
Pune	Pune
Raigad	Raigad
Ratnagiri	Ratnagiri + Sindhudurg
Sangli	Sangli
Satara	Satara
Solapur	Solapur
Thane	Thane
Wardha	Wardha
Yavatmal	Yavatmal

Cont….

District Unit in 1971	Comparable Unit in 2003-06
Orissa	
Balasore	Balasore + Bhadrak + Kendrapara
Bolangir	Bolangir + Sonepur
Cuttack	Cuttack + Puri + Jagatsingpur + Jajpur + Khurda + Nayagarh
Dhenkanal	Dhenkanal + Angul
Gajapatti	Gajapatti + Gangam
Kalahandi	Kalahandi + Koraput + Rayagada + Malkangiri + Naworangpur + Nawapara
Keonjhar	Keonjhar + Boudh
Mayurbhanj	Mayurbhanj
Phulbani	Kendharmal
Sambalpur	Sambalpur + Buragarh + Deogarh + Jharsugda
Sundargarh	Sundargarh
Punjab	
Amritsar	Amritsar
Bhatinda	Bhatinda + Faridkot + Mansa
Ferozpur	Ferozpur + Moga + Mukatsar
Gurdaspur	Gurdaspur
Hoshiarpur	Hoshiarpur + 28.41% of Nawan Sahar + 2.46% of Ropar
Jalandhar	Jalandhar + 71.59% of Nawan Sahar
Kapurthala	Kapurthala
Ludhiana	Ludhiana + 8.46% of Fatehgarh Sahib
Patiala	97.64% of (Patiala + 89.34% of Fatehgarh Sahib)
Ropar	97.54% of (Ropar + 2.2% of Fatehgarh Sahib)
Sangrur	Sangrur + 2.36% of Patiala
Rajasthan	
Ajmer	Ajmer
Alwar	Alwar
Banswara	Banswara
Barmer	Barmer
Bharatpur	Bharatpur + Dholpur
Bhilwara	Bhilwara
Bikaner	Bikaner
Bundi	Bundi
Chittorgarh	Chittorgarh
Churu	Churu
Dungarpur	Dungarpur
Ganganagar	Ganganagar + Hanumangarh
Jaipur	Jaipur + Dausa
Jaisalmer	Jaisalmer
Jalore	Jalore
Jhalawar	Jhalawar
Jhunjhunu	Jhunjhunu
Jodhpur	Jodhpur
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Cont….

District Unit in 1971	Comparable Unit in 2003-06
Kota	Kota + Baren
Nagaur	Nagaur
Pali	Pali
Sawai Madhopur	Sawai Madhopur + Karauli
Sikar	Sikar
Sirohi	Sirohi
Tonk	Tonk
Udaipur	Udaipur + Rajsamand
Tamil Nadu	
Chingalepu	Chingalepu + Thiruvallur
Coimbatore	Coimbatore + Erode
Kanya Kumari	Kanya Kumari
Madurai	Madurai + Dindigul + Theni
North Arcot	North Arcot + Vellore
Ramanathapuram	Ramanathapuram + Sivagangai + Virudunagar
Salem	Salem + Nammakal + Karur + Dharmapuri + Krishnagiri
South Arcot	Cuddalore + Villupuram
Thanjavur	Thanjavur + Nagapattinam + Thiruvarur + 33% of Pudukottai
The Nilgiris	The Nilgiris
Tiruchirapalli	Tiruchirapalli + Perambalur + 67% of Pudukkottai
Tirunelveli	Tirunelveli + Thoothukudi
Uttar Pradesh & Uttaranchal	
Agra	Agra + 32.94% of Firozabad
Aligarh	Aligarh + 64.3% of Hatharas
Allahabad	Allahabad + Kaushambi
Almora	Almora + Chamoli + Champawat + Pauri Garwal + Pithoragarh + Rudraprayag + Tehri Garwal + Uttar Kashi + Vageshwar
Azamgarh	Azamgarh + 25% of Ambedkar Nagar + 80% of Mau
Badaun	Badaun
Bahraich	Bahraich + Shivasti
Ballia	Ballia + 11.64% of Mau
Banda	Banda + Chitrakut
Barabanki	Barabanki
Bareilly	Bareilly
Basti	Basti + Sant Kabir Nagar + Siddharth Nagar
Bijnor	Bijnor + 6.64% of Haridwar
Bullandshahr	Bullandshahr + 54% of Gautam Budha Nagar
Dehradun	Dehradun
Deoria	Deoria + Kushi Nagar
Etah	Etah
Etawah	Etawah + Auraiya
Faizabad	Faizabad + 75% of Ambedkar Nagar
Farrukhabad	Farrukhabad + Kannauj
Fatehpur	Fatehpur

Cont….

District Unit in 1971	Comparable Unit in 2003-06
Ghazipur	Ghazipur + 46% of Gautam Budha Nagar
Gonda	Gonda + Balrampur
Gorakhpur	Gorakhpur + Maharahganj
Hamirpur	Hamirpur + Mahoba
Hardoi	Hardoi
Jalaun	Jalaun
Jaunpur	Jaunpur
Jhansi	Jhansi + Lalitpur
Kanpur	Kanpur Dehat + Kanpur City
Kheri	Kheri
Lucknow	Lucknow
Mainpuri	Mainpuri + 67.06% of Firozabad
Mathura	Mathura + 35.7% of Hatharas
Meerut	Meerut + Ghaziabad + Bagpat
Mirzapur	Mirzapur + Sonbhadra
Moradabad	Moradabad + Jyotir Bai Phule Nagar
Muzaffarnagar	Muzaffarnagar + 6.36% of Haridwar
Nainital	Nainital + Udham Singh Nagar
Pilibhit	Pilibhit
Pratapgarh	Pratapgarh
Raebareli	Raebareli
Rampur	Rampur
Saharanpur	Saharanpur + 87 % of Haridwar
Shahjahanpur	Shahjahanpur
Sitapur	Sitapur
Sultanpur	Sultanpur
Unnao	Unnao
Varanasi	Varanasi + Chandauli + Sant Ravi Das Nagar
West Bengal	
24 Parganas	24 Parganas (North + South)
Bankura	Bankura
Birbhum	Birbhum
Burdwan	Burdwan
Cooch-Behar	Cooch-Behar
Darjeeling	Darjeeling
Hooghly	Hooghly
Howrah	Howrah
Jalpaiguri	Jalpaiguri
Malda	Malda
Midnapur	Midnapur (East + West)
Murshidabad	Murshidabad
Nadia	Nadia
Purulia	Purulia
West Dinajpur	Dinajpur (South + North)

Appendix 1.2

Crop wise prices during triennium 1990-93 (Rs. per ton)

Sr. No.	Crop	Crop Code	Price (Rs./Ton)
1	Rice	1	4316.91
2	Wheat	2	3232.97
3	Jowar	3	3184.78
4	Maize	4	2773.62
5	Bajra	5	2791.78
6	Ragi	6	2394.22
7	Barley	7	2646.27
8	Gram	8	6707.41
9	Tur(Arhar)	9	8765.09
10	Groundnut	10	8828.47
11	Sesamum	11	11106.93
12	Rapeseed & Mustard	12	8702.71
13	Linseed	13	10257.85
14	Castor	14	6424.08
15	Jute	15	4362.24
16	Mesta	16	2825.35
17	Kapas	17	31119.78
18	Sugarcane	18	425.63
19	Tobacco	19	18640.33
20	Small millets & other Cereals	20	2242.83
21	Other Pulses	21	6047.02
22	Safflower	22	8219.65
23	Niger Seed	23	7828.47
24	Coconut	24	3037.36
25	Sannhemp	25	4594.18
26	Tea	26	17674.32
27	Coffee	27	32961.88
28	Rubber	28	16113.05
29	Black Pepper	29	27437.06
30	Chillies	30	29185.77
31	Dry Ginger	31	14060.12
32	Turmeric	32	17053.01
33	Arecanut	33	36305.73
34	Coriander	34	10374.89
35	Cardamom	35	185409.25
36	Potato	36	1700.64
37	Tapioca	37	1355.82
38	Sweet Potato	38	2017.05
39	Banana	39	2585.97
40	Cashewnut	40	15946.81
41	Gvarseed	41	5562.26
42	Sunflower	46	9683.27
43	Soyabeen	47	6848.78

Appendix 2.1

Cropping Pattern Changes : State and Region wise: 1962-65 to 2003-05 (Percentage of the Gross Cropped Area)

o	State /Region	Triennum	Rice	Wheat	coarse cereals	Pulses	Food grains	Oil seeds	Fibres	cotton	sugar cane	Plantation crops	condmint & spices	Remaining crops	GCA 000'HC
1	Haryana	1962-5	3.7	15.2	27.0	31.9	78.0	4.8	3.5	3.4	2.8	0.0	0.1	10.7	4549
		1970-3	5.6	23.5	25.9	22.5	77.5	3.5	4.6	4.6	2.7	0.0	0.2	11.4	5064
		1980-3	8.8	28.7	20.7	14.9	73.1	4.2	6.3	6.3	2.5	0.0	0.2	13.7	5531
		1990-3	11.6	32.4	13.9	9.2	67.0	10.6	8.8	8.8	2.6	0.0	0.1	10.8	5780
		2003-6	16.1	36.1	11.4	3.0	66.6	10.9	9.0	9.0	2.2	0.0	0.0	11.3	6504
2	Himachal Pradesh	1962-5	11.4	34.9	36.6	5.3	88.3	3.3	0.1	0.1	0.4	0.0	0.2	7.7	868
		1970-3	10.9	34.6	36.5	7.6	89.5	2.3	0.1	0.1	0.4	0.4	0.3	7.0	914
		1980-3	10.2	37.5	37.3	5.5	90.6	2.2	0.1	0.1	0.3	0.4	0.3	6.1	951
		1990-3	8.5	38.2	36.9	4.1	87.7	2.1	0.0	0.0	0.2	0.0	0.3	9.7	979
		2003-6	8.3	37.1	35.5	3.2	84.1	1.7	0.0	0.0	0.3	0.2	0.7	12.9	940
3	Jammu & Kashmir	1962-5	26.6	21.0	36.4	5.8	89.9	4.5	0.3	0.2	0.3	0.0	0.1	4.8	853
		1970-3	25.4	21.1	37.3	5.5	89.2	4.3	0.2	0.1	0.2	0.0	0.1	6.1	875
		1980-3	27.2	20.7	32.5	5.2	85.5	5.5	0.1	0.1	0.1	0.0	0.1	8.7	985
		1990-3	25.4	23.0	31.2	3.5	83.2	7.0	0.1	0.0	0.0	0.0	0.1	9.7	1074
		2003-6	23.2	23.0	32.2	2.7	81.1	5.4	0.0	0.0	0.0	0.0	0.1	13.3	1090
4	Punjab	1962-5	5.3	30.8	11.4	16.8	64.3	4.3	10.0	9.8	2.3	0.0	0.5	18.6	4987
		1970-3	7.6	40.6	13.4	6.8	68.4	5.6	8.0	7.9	1.9	0.0	0.3	15.8	5778
		1980-3	18.9	44.1	7.2	4.4	74.6	3.3	10.4	10.3	1.4	0.0	0.2	10.3	6636
		1990-3	27.3	43.4	3.2	1.6	75.4	2.3	9.1	9.1	1.4	0.0	0.0	11.8	7524
		2003-6	32.8	43.2	2.3	0.5	78.8	1.1	6.3	6.3	1.2	0.0	0.1	12.5	7945
5	Uttar Pradesh	1962-5	19.7	18.0	24.2	21.0	82.9	16.3	0.8	0.4	5.9	0.0	0.1	-6.0	22079
		1970-3	19.8	26.2	22.9	15.6	84.4	16.5	0.5	0.2	5.7	0.0	0.1	-7.2	23053
		1980-3	21.3	32.7	16.1	12.0	82.0	14.7	0.3	0.1	6.5	0.0	0.1	-3.6	24685
		1990-3	21.4	33.9	12.1	11.5	79.0	6.7	0.1	0.1	7.3	0.0	0.1	6.8	25662
		2003-6	22.2	36.4	9.5	10.6	78.7	4.3	0.0	0.0	8.2	0.1	0.2	8.4	26341
	North-West Region	**1962-5**	**15.4**	**20.1**	**23.3**	**21.1**	**79.8**	**12.3**	**2.5**	**2.2**	**4.6**	**0.0**	**0.2**	**0.6**	**33336**
		1970-3	**15.7**	**28.2**	**22.5**	**14.7**	**81.1**	**12.2**	**2.3**	**2.1**	**4.4**	**0.0**	**0.2**	**-0.1**	**35684**
		1980-3	**19.0**	**33.9**	**16.1**	**10.8**	**79.7**	**10.7**	**2.9**	**2.8**	**4.7**	**0.0**	**0.1**	**1.8**	**38788**
		1990-3	**20.9**	**35.2**	**11.8**	**8.9**	**76.9**	**6.3**	**3.0**	**2.9**	**5.2**	**0.0**	**0.1**	**8.4**	**41019**
		2003-6	**23.0**	**37.3**	**9.6**	**7.2**	**77.1**	**4.6**	**2.5**	**2.5**	**5.6**	**0.1**	**0.2**	**9.8**	**42820**

Appendix 2.1 (contd.)

No	State /Region	Triennum	Rice	Wheat	coarse cereals	Pulses	Foodgrains	Oil seeds	Fibres	cotton	sugarcane	Plantation	spices	Remaining crops	GCA 000'HC
6	Assam	1962-5	75.3	0.2	1.1	3.2	79.8	5.5	6.3	0.6	1.2	6.5	0.4	0.3	2527
		1970-3	69.0	2.0	0.6	3.1	74.7	5.4	5.1	0.2	1.2	6.3	0.4	6.9	2901
		1980-3	65.7	3.0	0.8	3.4	72.9	7.4	3.7	0.1	1.4	5.9	0.5	8.2	3470
		1990-3	65.5	2.0	0.8	2.9	71.3	8.4	2.8	0.1	1.0	6.0	0.5	10.1	3837
		2003-6	63.2	1.6	0.7	2.8	68.3	7.1	1.7	0.0	0.6	7.4	1.8	13.1	3763
7	Bihar	1962-5	44.0	5.7	13.3	18.7	81.7	2.5	2.2	0.0	1.3	0.0	0.4	11.9	11987
		1970-3	48.0	16.3	14.0	14.5	92.8	2.3	1.7	0.0	1.4	0.0	0.3	1.6	10697
		1980-3	49.1	16.3	12.1	12.4	89.9	2.3	1.7	0.0	1.2	0.0	0.2	4.7	10473
		1990-3	48.9	19.8	9.0	10.8	88.4	2.3	1.6	0.0	1.4	0.0	0.1	6.1	9996
		2003-6	46.6	21.2	9.1	9.3	86.3	1.7	1.6	0.0	1.1	0.0	0.1	9.2	9504
8	Orissa	1962-5	60.5	0.2	2.1	12.8	75.6	3.7	1.1	0.1	0.5	0.0	0.5	18.7	7205
		1970-3	66.3	0.4	6.2	12.9	85.8	5.2	1.2	0.0	0.4	0.0	0.8	6.6	6857
		1980-3	48.1	0.8	8.7	19.9	77.4	9.2	1.2	0.1	0.6	0.0	1.3	10.3	8599
		1990-3	46.5	0.2	4.5	17.2	68.4	9.6	0.9	0.1	0.4	0.0	1.5	19.2	9608
		2003-6	51.7	0.0	2.0	8.3	62.0	3.7	1.0	0.5	0.2	0.0	1.6	31.5	8710
9	West Bengal	1962-5	69.8	0.7	1.8	11.7	84.0	2.2	8.8	0.0	0.5	1.3	0.2	3.0	6518
		1970-3	69.7	5.3	1.9	8.4	85.4	2.2	6.6	0.0	0.5	1.2	0.1	3.9	7178
		1980-3	69.3	3.5	1.5	6.0	80.2	4.6	7.5	0.0	0.3	1.3	0.4	5.7	7338
		1990-3	66.6	3.1	1.0	3.3	74.0	6.2	6.2	0.0	0.2	1.2	0.8	11.4	8623
		2003-6	61.1	4.2	0.8	2.4	68.5	7.0	6.3	0.0	5.8	1.2	0.8	10.4	9533
	Eastern Region	**1962-5**	**57.0**	**2.6**	**6.7**	**14.2**	**80.5**	**3.0**	**3.8**	**0.1**	**0.9**	**0.9**	**0.3**	**10.6**	**28237**
		1970-3	**60.4**	**8.0**	**7.5**	**11.3**	**87.2**	**3.3**	**3.2**	**0.0**	**0.9**	**1.0**	**0.4**	**4.0**	**27633**
		1980-3	**55.7**	**7.1**	**7.2**	**11.9**	**81.9**	**5.5**	**3.2**	**0.0**	**0.8**	**1.0**	**0.6**	**7.0**	**29881**
		1990-3	**54.9**	**7.3**	**4.5**	**9.8**	**76.5**	**6.3**	**2.8**	**0.0**	**0.7**	**1.0**	**0.8**	**11.9**	**32063**
		2003-6	**54.3**	**8.0**	**3.7**	**6.2**	**72.3**	**4.5**	**2.8**	**0.1**	**2.2**	**1.3**	**1.0**	**16.1**	**31510**

Appendix 2.1 (contd.)

No	State /Region	Triennum	Rice	Wheat	coarse cereals	Pulses	Foodgrains	Oil seeds	Fibres	cotton	sugarcane	Plantation	spices	Remaining crops	GCA 000'HC
10	Gujarat	1962-5	5.4	4.1	32.7	5.0	47.2	23.0	17.2	17.2	0.3	0.0	0.2	12.2	9999
		1970-3	4.4	4.9	32.8	3.9	46.0	18.9	16.7	16.7	0.4	0.0	0.2	17.9	10410
		1980-3	4.5	6.2	26.2	6.0	42.8	23.7	14.2	14.1	0.8	0.0	0.1	18.4	10848
		1990-3	5.3	5.4	20.7	8.5	39.9	26.4	10.0	10.0	1.1	0.0	0.2	22.4	10729
		2003-6	6.0	7.1	14.7	6.9	34.8	26.7	16.2	16.2	1.7	0.0	0.7	19.9	11304
11	Madhya Pradesh	1962-5	22.8	17.3	23.0	20.4	83.5	10.0	4.4	4.2	0.3	0.0	0.4	1.4	18704
		1970-3	21.7	16.6	22.8	20.8	82.0	9.3	3.5	3.3	0.3	0.0	0.4	4.5	20720
		1980-3	22.3	15.7	22.1	22.2	82.2	9.5	2.9	2.7	0.2	0.0	0.4	4.8	21791
		1990-3	21.7	15.6	16.0	20.2	73.5	18.6	2.4	2.3	0.2	0.0	0.6	4.8	23630
		2003-6	21.0	15.9	10.0	21.0	67.8	22.9	2.4	2.3	0.2	0.0	0.9	5.7	25354
12	Maharashtra	1962-5	7.1	4.7	43.2	12.3	67.2	9.7	14.9	14.5	0.7	0.0	0.9	6.4	19118
		1970-3	7.4	4.8	42.0	11.9	66.1	8.9	14.7	14.3	1.0	0.0	0.9	8.5	17944
		1980-3	7.7	5.5	44.2	13.8	71.1	10.2	14.0	13.6	1.5	0.0	0.8	2.3	19622
		1990-3	7.5	3.5	39.5	15.3	65.7	12.2	12.8	12.6	2.1	0.0	0.7	6.6	20991
		2003-6	6.8	3.5	30.2	15.4	55.9	14.6	12.8	12.7	1.9	0.0	0.5	14.3	22556
13	Rajasthan	1962-5	0.7	7.9	45.5	21.7	75.9	7.6	1.7	1.5	0.2	0.0	0.6	14.0	14933
		1970-3	0.8	8.9	45.3	21.1	76.0	7.0	1.9	1.8	0.2	0.0	0.7	14.2	16533
		1980-3	0.8	10.1	40.0	19.2	70.1	6.9	2.1	2.1	0.2	0.0	0.7	20.0	18114
		1990-3	0.7	10.1	35.7	17.3	63.8	17.3	2.5	2.4	0.1	0.0	0.9	15.3	19213
		2003-6	0.5	9.7	32.9	17.0	60.0	21.2	2.0	2.0	0.0	0.0	1.0	15.7	21699
	Central Region	**1962-5**	**10.0**	**9.1**	**36.1**	**15.8**	**70.9**	**11.4**	**9.0**	**8.8**	**0.4**	**0.0**	**0.6**	**7.7**	**62754**
		1970-3	**9.8**	**9.6**	**35.3**	**15.8**	**70.4**	**10.1**	**8.3**	**8.1**	**0.5**	**0.0**	**0.6**	**10.1**	**65607**
		1980-3	**9.9**	**9.9**	**33.5**	**16.6**	**70.0**	**11.2**	**7.5**	**7.4**	**0.6**	**0.0**	**0.6**	**10.1**	**70375**
		1990-3	**9.9**	**9.3**	**28.4**	**16.4**	**64.0**	**17.6**	**6.4**	**6.3**	**0.8**	**0.0**	**0.6**	**10.6**	**74564**
		2003-6	**9.5**	**9.6**	**22.3**	**16.4**	**57.9**	**20.7**	**7.1**	**7.0**	**0.8**	**0.0**	**0.8**	**12.7**	**80913**

Appendix 2.1 (contd.)

No	State /Region	Triennum	Rice	Wheat	coarse cereals	Pulses	Foodgrains	Oil seeds	Fibres	cotton	sugarcane	Plantation	spices	Remaining crops	GCA 000'HC
14	Andhra Pradesh	1962-5	26.8	0.1	36.9	11.0	74.9	12.4	3.8	3.0	0.9	0.0	2.0	6.0	12783
		1970-3	24.8	0.2	34.7	10.8	70.4	16.7	3.2	2.5	1.0	0.0	2.6	6.0	12771
		1980-3	29.0	0.1	29.7	11.4	70.2	15.3	4.3	3.5	1.3	0.0	2.5	6.4	12699
		1990-3	29.6	0.1	14.6	12.4	56.7	24.5	6.2	5.5	1.4	0.1	2.5	8.5	13046
		2003-6	26.9	0.1	11.8	15.5	54.2	22.5	8.6	8.2	1.7	0.2	2.6	10.2	13362
15	Karnataka	1962-5	10.0	2.8	45.8	11.3	69.9	11.2	9.9	9.6	0.7	0.7	1.3	6.3	10802
		1970-3	10.2	2.9	38.9	11.0	63.1	11.0	9.3	9.2	1.0	0.7	1.4	13.6	10762
		1980-3	10.2	3.0	37.8	13.5	64.5	12.1	9.1	8.9	1.6	1.2	1.9	9.7	11013
		1990-3	10.3	1.7	33.3	13.8	59.0	22.7	5.1	5.0	2.2	1.2	1.6	8.2	12188
		2003-6	10.9	2.0	31.6	16.4	60.8	21.4	3.4	3.4	1.7	1.9	1.1	9.6	13027
16	Kerala	1962-5	32.6	0.0	0.5	1.8	34.9	1.1	0.3	0.3	0.4	8.7	6.0	48.6	2466
		1970-3	29.6	0.0	0.4	1.3	31.2	0.9	0.3	0.3	0.3	8.9	5.8	52.6	2959
		1980-3	27.7	0.0	0.2	1.1	29.0	0.9	0.2	0.2	0.3	11.9	6.2	51.5	2876
		1990-3	18.0	0.0	0.3	0.8	19.1	0.8	0.3	0.3	0.2	17.7	8.1	53.7	3029
		2003-6	9.7	0.0	0.1	0.1	9.9	0.1	0.1	0.1	0.1	20.4	9.6	59.6	2986
17	Tamil Nadu	1962-5	36.6	0.0	28.4	5.6	70.6	14.9	5.6	5.5	1.0	0.7	1.6	5.6	7219
		1970-3	36.2	0.0	25.3	7.2	68.7	16.9	4.1	4.1	1.7	0.9	1.7	6.1	7575
		1980-3	33.9	0.0	22.4	9.4	65.8	16.5	3.4	3.4	2.9	1.3	2.2	7.9	6469
		1990-3	29.8	0.0	15.9	11.6	57.3	18.6	3.7	3.7	3.3	1.3	1.7	14.0	6892
		2003-6	37.1	0.0	14.8	9.9	61.8	12.6	2.2	2.2	4.5	1.7	2.1	15.0	6033
	Southern Rgion	**1962-5**	**23.9**	**1.0**	**35.2**	**9.2**	**69.4**	**11.7**	**5.9**	**5.5**	**0.8**	**1.0**	**2.0**	**9.2**	**33270**
		1970-3	**23.1**	**1.0**	**31.0**	**9.2**	**64.3**	**13.6**	**5.1**	**4.8**	**1.1**	**1.2**	**2.3**	**12.5**	**34067**
		1980-3	**23.6**	**1.0**	**28.4**	**10.8**	**63.9**	**13.2**	**5.4**	**5.0**	**1.6**	**1.7**	**2.6**	**11.7**	**33058**
		1990-3	**21.9**	**0.6**	**20.1**	**11.7**	**54.4**	**20.7**	**4.8**	**4.5**	**2.0**	**2.2**	**2.5**	**13.4**	**35155**
		2003-6	**21.2**	**0.8**	**18.5**	**13.5**	**53.9**	**18.4**	**4.9**	**4.7**	**2.1**	**2.9**	**2.6**	**15.2**	**35408**
	All India	**1962-5**	**22.8**	**8.6**	**28.0**	**15.3**	**74.7**	**9.8**	**6.1**	**5.1**	**1.5**	**0.4**	**0.6**	**6.9**	**157651**
		1970-3	**22.7**	**11.5**	**26.7**	**13.3**	**74.3**	**10.1**	**5.4**	**4.7**	**1.5**	**0.4**	**0.8**	**7.5**	**164376**
		1980-3	**22.8**	**13.0**	**23.9**	**13.2**	**73.0**	**10.4**	**5.3**	**4.6**	**1.8**	**0.5**	**0.9**	**8.2**	**173953**
		1990-3	**23.0**	**13.0**	**18.6**	**14.4**	**68.9**	**13.3**	**4.7**	**4.1**	**2.0**	**0.6**	**0.9**	**9.6**	**184561**
		2003-6	**22.4**	**13.9**	**15.5**	**12.0**	**63.8**	**13.8**	**4.9**	**4.4**	**2.1**	**0.8**	**1.0**	**13.6**	**192611**

Source: Calculated from Annexure 1 (a) to 1 (e).

Appendix 2.2

Cropping Pattern Changes : State and Region wise: 1962-65 to 2003-05 (%age of the Value of output)

No	State /Region	Triennum	Rice	Wheat	coarse cereals	Pulses	Food grains	Oil seeds	Fibres	cotton	sugar cane	Plantation crops	condmint & spices	Remaining crops
1	Haryana	1962-5	5.2	15.5	7.7	32.8	61.2	6.2	8.3	8.2	12.6	0.0	0.8	11.0
		1970-3	8.1	29.2	10.3	18.1	65.7	3.4	8.8	8.8	10.0	0.0	0.9	11.2
		1980-3	15.7	36.0	6.2	7.5	65.4	3.9	11.1	11.1	6.6	0.0	0.8	12.2
		1990-3	14.2	38.6	3.7	4.7	61.2	10.8	12.3	12.3	5.9	0.0	0.3	9.5
		2003-6	17.6	39.4	3.6	1.3	61.8	10.5	12.0	12.0	4.9	0.0	0.0	10.8
2	Himachal Pradesh	1962-5	15.3	26.6	39.4	4.9	86.2	3.0	0.3	0.2	0.3	0.1	0.5	9.6
		1970-3	13.2	30.8	38.3	5.6	87.8	1.8	0.1	0.1	0.5	0.5	0.4	8.8
		1980-3	11.4	37.8	38.5	2.3	90.0	1.5	0.1	0.1	0.5	0.3	0.5	7.1
		1990-3	9.1	38.0	36.7	1.6	85.3	1.2	0.0	0.0	0.2	0.0	0.4	12.8
		2003-6	8.8	33.8	33.1	1.6	77.3	1.4	0.0	0.0	0.4	0.2	4.9	16.0
3	Jammu & Kashmir	1962-5	39.9	12.9	27.7	5.3	85.9	6.4	0.5	0.4	0.3	0.0	1.7	5.2
		1970-3	40.7	12.8	28.0	4.6	86.1	6.0	0.3	0.2	0.2	0.0	1.1	6.3
		1980-3	42.4	12.1	23.3	3.5	81.3	9.6	0.1	0.1	0.2	0.0	0.3	8.6
		1990-3	39.8	17.6	23.7	2.2	83.4	6.7	0.0	0.0	0.1	0.0	0.2	9.6
		2003-6	33.0	20.2	21.5	1.3	76.1	7.6	0.0	0.0	0.0	0.0	0.6	15.7
4	Punjab	1962-5	4.8	24.1	5.8	14.8	49.4	5.6	17.2	17.1	5.9	0.0	2.0	19.9
		1970-3	8.5	40.2	7.1	4.7	60.6	5.3	12.1	12.1	4.6	0.0	1.1	16.3
		1980-3	24.9	42.5	3.4	1.7	72.4	2.2	10.0	10.0	3.6	0.0	0.5	11.2
		1990-3	29.4	39.9	1.4	0.6	71.3	1.9	11.7	11.7	2.8	0.0	0.2	12.3
		2003-6	35.5	38.4	1.1	0.2	75.2	0.7	8.6	8.6	1.9	0.0	0.5	12.9
5	Uttar Pradesh	1962-5	16.0	12.3	11.9	24.7	64.9	14.0	0.6	0.3	24.1	0.0	0.3	-3.9
		1970-3	14.6	23.2	11.2	19.8	68.7	13.5	0.4	0.2	21.6	0.0	0.2	-4.4
		1980-3	17.2	31.1	6.3	12.1	66.7	9.7	0.2	0.1	22.0	0.0	0.4	0.9
		1990-3	19.7	29.5	5.0	8.2	62.3	5.4	0.1	0.0	21.0	0.0	0.3	11.0
		2003-6	19.3	31.1	3.8	6.1	60.2	3.4	0.0	0.0	20.5	0.2	1.2	14.4
5	**North-West Region**	**1962-5**	**12.8**	**15.3**	**11.0**	**23.1**	**62.2**	**11.0**	**4.8**	**4.6**	**18.1**	**0.0**	**0.7**	**3.1**
		1970-3	**12.8**	**28.0**	**10.9**	**15.3**	**67.1**	**9.8**	**4.3**	**4.2**	**15.0**	**0.0**	**0.6**	**3.2**
		1980-3	**19.4**	**34.4**	**6.4**	**8.5**	**68.7**	**6.9**	**4.2**	**4.2**	**14.4**	**0.0**	**0.5**	**5.4**
		1990-3	**21.6**	**33.5**	**4.6**	**5.5**	**65.1**	**5.2**	**4.9**	**4.9**	**13.4**	**0.0**	**0.2**	**11.1**
		2003-6	**23.3**	**34.2**	**3.7**	**3.7**	**64.8**	**3.9**	**4.1**	**4.1**	**12.7**	**0.1**	**0.9**	**13.5**

Appendix 2.2 (contd.)

No	State /Region	Triennum	Rice	Wheat	coarse cereals	Pulses	Foodgrains	Oil seeds	Fibres	cotton	sugarcane	Plantation	spices	Remaining crops
6	Assam	1962-5	53.6	0.1	0.2	1.5	55.4	3.3	5.1	0.3	3.2	22.0	1.0	10.0
		1970-3	48.2	1.3	0.1	1.3	51.0	3.3	4.6	0.1	3.0	22.0	1.1	15.1
		1980-3	44.1	1.6	0.2	1.3	47.2	4.1	3.2	0.0	3.5	22.2	1.1	18.6
		1990-3	45.8	1.0	0.2	1.0	48.0	4.9	2.4	0.0	2.1	22.3	1.0	19.2
		2003-6	42.7	0.6	0.1	1.1	44.4	3.3	1.2	0.0	1.1	21.7	7.1	21.2
7	Bihar	1962-5	44.7	3.3	7.4	18.0	73.4	2.2	2.2	0.0	5.4	0.0	1.9	14.9
		1970-3	46.6	17.3	6.2	12.8	82.9	2.2	1.5	0.1	5.1	0.0	1.7	6.6
		1980-3	44.0	17.6	7.0	11.8	80.3	2.4	1.6	0.0	4.1	0.0	1.4	10.2
		1990-3	40.6	21.6	6.8	9.9	79.0	2.5	1.7	0.0	5.6	0.0	0.6	10.7
		2003-6	37.3	16.9	7.6	6.5	68.3	1.9	1.6	0.0	2.8	0.0	0.3	25.1
8	Orissa	1962-5	60.3	0.1	0.8	9.7	70.8	3.8	1.1	0.0	2.6	0.0	1.9	19.7
		1970-3	61.5	0.5	2.6	10.0	74.7	8.0	1.4	0.0	2.8	0.0	3.5	9.6
		1980-3	42.6	1.1	3.8	15.3	62.8	13.4	1.1	0.1	3.6	0.0	5.5	13.6
		1990-3	45.1	0.2	1.7	10.1	57.2	11.1	0.9	0.1	1.8	0.0	6.1	22.8
		2003-6	49.9	0.0	0.7	3.5	54.1	2.6	0.8	0.6	0.7	0.0	6.5	35.2
9	West Bengal	1962-5	67.5	0.3	0.6	7.5	75.8	1.2	9.0	0.0	2.1	4.6	1.1	6.3
		1970-3	65.6	6.6	0.7	5.1	78.0	1.3	6.2	0.0	1.9	4.6	0.6	7.4
		1980-3	60.2	3.6	0.6	3.3	67.7	3.7	7.8	0.0	1.3	5.3	1.3	12.9
		1990-3	59.4	2.2	0.5	1.4	63.5	4.9	5.6	0.0	0.5	3.3	2.3	19.9
		2003-6	58.9	2.4	0.4	1.1	62.7	5.5	6.1	0.0	0.5	3.4	2.5	19.4
	Eastern Region	**1962-5**	**55.8**	**1.3**	**3.1**	**11.1**	**71.3**	**2.4**	**4.2**	**0.1**	**3.6**	**3.9**	**1.6**	**13.1**
		1970-3	**56.0**	**8.1**	**2.8**	**8.2**	**75.1**	**3.3**	**3.4**	**0.1**	**3.3**	**4.5**	**1.7**	**8.7**
		1980-3	**48.4**	**6.7**	**3.2**	**8.5**	**66.7**	**5.9**	**3.6**	**0.0**	**3.0**	**5.2**	**2.4**	**13.2**
		1990-3	**49.4**	**6.2**	**2.3**	**5.6**	**63.5**	**5.9**	**3.0**	**0.0**	**2.3**	**4.3**	**2.7**	**18.3**
		2003-6	**49.5**	**5.2**	**2.2**	**2.9**	**59.7**	**3.7**	**3.2**	**0.1**	**1.2**	**4.4**	**3.5**	**24.4**

Appendix 2.2 (contd.)

No	State /Region	Triennum	Rice	Wheat	coarse cereals	Pulses	Foodgrains	Oil seeds	Fibres	cotton	sugarcane	Plantation	spices	Remaining crops
10	Gujarat	1962-5	5.4	3.1	12.4	3.8	24.6	33.4	22.0	22.0	1.7	0.0	1.3	17.0
		1970-3	4.0	5.7	14.1	2.3	26.1	26.2	21.7	21.7	1.8	0.0	0.8	23.4
		1980-3	4.2	7.1	10.8	4.4	26.5	28.7	15.3	15.3	3.7	0.0	0.5	25.3
		1990-3	4.7	5.6	7.9	6.0	24.3	27.3	11.2	11.2	6.3	0.0	1.0	29.9
		2003-6	4.2	5.2	4.4	3.1	16.9	28.9	20.9	20.9	4.5	0.0	2.9	25.9
11	Madhya Pradesh	1962-5	27.0	13.4	16.0	23.4	79.7	11.0	4.6	4.5	1.3	0.0	1.1	2.3
		1970-3	25.7	14.8	13.3	25.8	79.6	10.2	3.0	2.9	1.1	0.0	0.8	5.3
		1980-3	24.4	16.5	13.4	24.2	78.6	10.7	2.5	2.4	0.8	0.0	1.0	6.5
		1990-3	22.5	16.8	8.5	19.1	66.8	23.4	1.7	1.7	0.6	0.0	0.7	6.8
		2003-6	19.2	15.4	5.6	17.8	58.1	27.7	2.5	2.5	0.7	0.0	2.8	8.2
12	Maharashtra	1962-5	11.1	2.3	22.5	11.2	47.1	15.1	13.4	13.2	9.0	0.0	5.4	10.1
		1970-3	12.9	3.1	16.2	10.7	42.9	12.7	11.0	10.9	12.9	0.0	5.3	15.2
		1980-3	13.0	3.9	23.8	9.3	50.1	13.1	10.4	10.3	16.0	0.0	3.2	7.3
		1990-3	10.2	2.6	22.7	10.3	45.8	14.4	8.9	8.9	15.6	0.0	2.1	13.2
		2003-6	8.4	2.6	12.6	10.3	34.0	16.9	12.3	12.3	9.1	0.0	1.6	26.0
13	Rajasthan	1962-5	1.8	12.7	28.2	26.2	69.0	9.8	3.8	3.7	1.1	0.0	2.8	13.5
		1970-3	1.5	16.4	26.2	24.3	68.4	11.0	4.7	4.6	1.5	0.0	2.5	11.9
		1980-3	1.3	23.2	18.2	22.2	64.9	11.7	5.7	5.7	1.4	0.0	2.6	13.6
		1990-3	0.9	20.5	15.2	12.1	48.7	30.1	6.7	6.7	0.7	0.0	3.4	10.4
		2003-6	0.6	17.3	16.4	8.8	43.2	40.1	3.8	3.8	0.1	0.0	3.7	9.1
	Central Region	**1962-5**	**13.0**	**7.4**	**19.3**	**15.5**	**55.1**	**17.1**	**11.2**	**11.1**	**3.9**	**0.0**	**2.8**	**9.8**
		1970-3	**12.5**	**10.2**	**16.7**	**16.2**	**55.7**	**14.9**	**9.8**	**9.7**	**4.0**	**0.0**	**2.2**	**13.4**
		1980-3	**11.9**	**11.5**	**16.8**	**14.3**	**54.5**	**16.1**	**8.7**	**8.6**	**6.2**	**0.0**	**1.8**	**12.7**
		1990-3	**10.8**	**11.3**	**13.8**	**12.5**	**48.3**	**23.1**	**6.7**	**6.7**	**6.0**	**0.0**	**1.8**	**14.1**
		2003-6	**8.7**	**9.9**	**9.4**	**10.3**	**38.3**	**27.9**	**10.0**	**10.0**	**3.7**	**0.0**	**2.7**	**17.4**

Appendix 2.2(contd.)

No	State /Region	Triennum	Rice	Wheat	coarse cereals	Pulses	Foodgrains	Oil seeds	Fibres	cotton	sugarcane	Plantation	spices	Remaining crops
14	Andhra Pradesh		37.3	0.0	13.9	4.0	55.3	15.1	2.1	1.6	7.5	0.0	8.1	12.0
		1970-3	35.5	0.1	11.2	4.3	51.1	19.4	1.5	1.2	7.5	0.0	9.1	11.4
		1980-3	40.7	0.0	10.3	3.9	55.0	13.7	4.9	4.5	6.7	0.0	8.3	11.4
		1990-3	35.1	0.0	4.9	4.2	44.2	20.2	5.8	5.5	5.0	0.0	10.8	14.0
		2003-6	30.5	0.0	6.7	5.8	43.0	11.9	7.8	7.7	4.8	0.1	19.5	12.9
15	Karnataka	1962-5	19.4	0.9	20.9	6.6	47.9	15.8	6.8	6.7	7.6	3.2	3.8	14.9
		1970-3	18.2	0.9	19.4	5.7	44.2	13.0	5.5	5.4	7.9	4.8	2.7	21.9
		1980-3	17.5	1.1	17.7	6.7	43.0	12.1	5.2	5.2	10.7	5.9	3.6	19.5
		1990-3	15.5	0.6	15.0	5.1	36.2	19.3	5.4	5.4	12.4	5.9	3.1	17.6
		2003-6	19.6	0.6	16.9	6.5	43.7	14.8	3.2	3.2	7.9	7.7	4.4	18.3
16	Kerala	1962-5	17.1	0.0	0.1	0.4	17.7	0.7	0.2	0.2	0.7	5.4	4.2	71.2
		1970-3	15.1	0.0	0.1	0.2	15.4	0.5	0.1	0.1	0.4	7.3	3.5	72.8
		1980-3	15.9	0.0	0.0	0.4	16.3	0.4	0.1	0.1	0.7	11.2	5.4	66.0
		1990-3	10.7	0.0	0.0	0.3	11.0	0.2	0.2	0.2	0.5	16.7	6.1	65.2
		2003-6	7.2	0.0	0.0	0.1	7.3	0.1	0.1	0.1	0.3	36.3	12.1	43.8
17	Tamil Nadu	1962-5	35.6	0.0	9.0	1.4	46.0	20.6	4.6	4.6	5.4	2.0	7.4	14.0
		1970-3	38.9	0.0	6.8	1.7	47.4	18.1	3.3	3.3	7.6	2.4	7.1	14.2
		1980-3	33.7	0.0	6.3	2.1	42.2	15.4	2.5	2.5	13.5	3.4	4.6	18.5
		1990-3	30.9	0.0	4.0	2.5	37.4	15.6	2.5	2.5	11.3	2.9	2.7	27.4
		2003-6	31.7	0.0	3.3	1.8	36.8	13.0	1.3	1.3	14.9	4.4	4.8	24.8
	Southern Rgion	**1962-5**	**29.5**	**0.2**	**11.6**	**3.2**	**44.5**	**14.4**	**3.5**	**3.3**	**5.7**	**2.2**	**6.3**	**23.4**
		1970-3	**28.6**	**0.2**	**9.6**	**3.1**	**41.6**	**13.9**	**2.7**	**2.6**	**6.3**	**3.2**	**5.9**	**26.4**
		1980-3	**29.4**	**0.3**	**9.5**	**3.6**	**42.8**	**11.6**	**3.6**	**3.5**	**8.4**	**4.0**	**5.8**	**23.7**
		1990-3	**26.0**	**0.1**	**6.4**	**3.4**	**36.0**	**16.0**	**4.0**	**3.9**	**7.9**	**4.5**	**6.1**	**25.5**
		2003-6	**25.3**	**0.2**	**7.8**	**4.5**	**37.8**	**11.5**	**4.4**	**4.3**	**7.2**	**7.0**	**11.7**	**20.3**
	All India	**1962-5**	**26.7**	**6.0**	**11.9**	**13.0**	**57.6**	**11.8**	**6.2**	**5.2**	**7.7**	**1.4**	**3.0**	**12.4**
		1970-3	**25.4**	**11.5**	**10.5**	**10.6**	**58.1**	**11.0**	**5.1**	**4.4**	**7.4**	**1.8**	**2.7**	**13.9**
		1980-3	**25.0**	**14.2**	**9.5**	**8.7**	**57.4**	**10.4**	**5.1**	**4.5**	**8.5**	**1.9**	**2.7**	**14.0**
		1990-3	**24.8**	**14.1**	**7.0**	**6.8**	**52.7**	**12.3**	**4.8**	**4.3**	**8.0**	**1.9**	**2.7**	**17.6**
		2003-6	**23.5**	**14.1**	**6.1**	**5.8**	**49.6**	**13.2**	**5.9**	**5.4**	**6.6**	**2.3**	**3.7**	**18.8**

Source: Calculated from Annexures 1(a) to 1(e)

Appendix 3.1

Zero order correlation matrix between variables, All India, 2003-06.

(All variables in $\log_n$ form)

	Land	**Labour**	**Fertiliser**	**Tractor**	**Irrigation**	**Tubewells**	**Roads**	**Markets**	**Rainfall**
Land	1.000	0.656	0.524	0.427	0.070	0.251	0.315	0.404	-0.340
Labour		1.000	0.483	0.256	0.163	0.265	0.299	0.390	-0.043
Fertiliser			1.000	0.469	0.484	0.417	0.310	0.492	-0.178
Tractor				1.000	0.560	0.612	0.040	0.027	-0.595
Irrigation					1.000	0.602	-0.087	0.011	-0.281
Tubewells						1.000	0.066	0.109	-0.292
Roads							1.000	0.186	-0.130
Markets								1.000	0.191
Rainfall									1.000

Appendix 3.2

Inter-District Variations in Agriculture Production: OLS Regressions

(All India)

Variables	Estimates of Regression Coefficients			
	1970-73	**1980-83**	**1990-93**	**2003-06**
Land	0.401* (.062)	0.500* (.060)	0.455* (.065)	0.637* (.063)
Labour	0.106*** (.058)	0.057 (.054)	-0.012 (.056)	-0.253* (.048)
Fertilizer	0.250* (.026)	0.247* (.026)	0.291* (.032)	0.366* (.035)
Tractors	0.098* (.018)	-0.017 (.016)	0.014 (.019)	-0.006 (.024)
Tubewells	-0.067* (.018)	-0.056* (.017)	0.014 (.022)	-0.012 (.020)
Irrigation	-0.012 (.018)	0.107* (.027)	0.002 (.026)	0.067** (.032)
Roads	0.061** (.026)	0.085* (.030)	0.099* (.035)	0.031 (.028)
Markets	-0.029* (.011)	0.017 (.024)	-0.010 (.030)	0.056 (.031)
Rainfall (June)	-0.045 (.048)	0.059** (.025)	-0.047 (.029)	
Rainfall (Oct)	0.194* (.066)	0.072* (.002)	0.052** (.022)	0.293* (.056)
Constant term	3.988 (.615)	4.144 (.549)	5.270 (.618)	4.1285 (0.813)
R^2	0.75	0.76	0.71	0.71
Condition Index	178.4	159.5	154.3	125.7
Number of Observations	281	281	281	281

Note: 1. Figures in parenthesis are t-values of the coefficients.

2. Rainfall for 2003-06 is the annual average of three years.

3. Asterisk *, ** and *** indicate coefficients significant at 1 per cent, 5 per cent and 10 per cent level of significance respectively for two tailed t-test.