Chapter 9
Summary and Conclusions

In the state of Uttar Pradesh, agriculture is still the mainstay of livelihood to majority of the population. About two-third of the population still rely on agriculture for their livelihood. The farming community in general and small and marginal farmers in particular have low level of living and almost one-third of them are trapped in poverty. Human resources are underdeveloped and well being of the majority of the population is directly or indirectly related with agriculture development. But, the agriculture is grossly underdeveloped in the state as compared with its neighbouring states of Punjab and Haryana. Furthermore, there is serious tendency of deceleration in agriculture during the post reform period in the state. The state not only failed to match the feet of Punjab and Haryana during the green revolution period but it also could not benefit from the recent developments that led to spectacular performance of Gujarat and Bihar agriculture. Almost whole of the theoretical and empirical literature unanimously bring out the importance of agriculture not only in assuring food security and well being of the rural population, but also suggests a significant role of agriculture in development of the non-agriculture sector through forward and backward linkages. First and the foremost requirement for development of any sector or region is the information on ground realities, emerging dynamics, constraints and available opportunities. Though, empirical studies are available on some of these accounts, but most of these are either undertaken at the state level or for a specific region or segment of the farmers or cover few crops or are for a limited period. There is no comprehensive analysis on Uttar Pradesh agriculture dealing with different dimensions of its agriculture at the district level over a longer period. The present study was a humble attempt to fill the gap in this context.

The main objectives of the present study were:

1. To analyze the temporal pattern of agricultural performance in Uttar Pradesh during different policy regimes (Pre-green revolution, initial phase of green revolution, mature phase of green revolution, initial post reform period and new millennium phase) over the last half a century (1960-61 to 2010-11).
2. To examine the spatial (district and region) pattern of agricultural performance (level of development, output growth and disparities) in Uttar Pradesh over 1960-61 to 2010-11 period.

3. To identify the sources and constraints of agricultural development at the district level in Uttar Pradesh.

The present study is based on secondary data mainly collected and compiled by the Ministry of Agriculture, New Delhi, Government of India; Central Statistical Organization (CSO) of the Ministry of Statistics and Programme Implementation, Government of India and Directorate of Economics and Statistics (DES), Government of Uttar Pradesh. The temporal trend in agriculture production for the state as a whole is mainly based on the value of output of agriculture and allied sector publication brought out by the CSO. Information on land use pattern has been taken from the statistics compiled by the Directorate of Economics and Statistics (DES), Government of India.

The district level information on area and production of major agriculture crops grown in the state has been taken from the publication of DES, the online information available on its website, from Season and Crop Reports for various years published by the Directorate of Land Records, Uttar Pradesh and Statistical Abstracts of Uttar Pradesh. Information on workers employed in agriculture sector and level of literacy has been taken from various publications of Census of India (Uttar Pradesh), Primary Census Abstract, Directorate of Census Operations, Government of India. District wise data on fertilizers and rainfall has been obtained from the publication of Fertilizer Association of India and Indian Metrological Department, Pune, respectively.

The district wise information on area, production and yield has been compiled from 1960-61 to 2010-11. To estimate the total production in a district, individual crop production has been converted into value terms using 2010-11 constant prices. These prices were derived indirectly from the National Accounts Statistics for the relevant years.

The overall period from 1960-61 to 2010-11 was divided into five sub periods namely- pre-green revolution phase during 1960-61 to 1965-66, initial green revolution phase from 1967-68 to 1980-81, mature green revolution phase during 1981-82 to 1990-91, initial post reform period from 1991-92 to 2000-01 and new millennium period from 2001-02 to 2010-11 to study the temporal dynamics of growth at the state and zone level in Uttar Pradesh.
The number of districts increased from 46 to 72 during the study period (till 2010) in Uttar Pradesh. The current information on newly formed districts was available but the past information (before creation) was not available. Therefore, we converted 72 districts into 46 district units for spatial comparison. Besides the state and district level study of temporal and spatial pattern, we also clubbed these districts into eight agro-economic regions to get better insight into the spatial and temporal pattern of agricultural performance as well as dynamics of labour productivity in the state. The districts of current state of Uttarakhand, bifurcated from Uttar Pradesh during 2000 have been clubbed under Hill districts.

Besides measuring the growth and development, the inter-district disparities were examined using standard inequality measures of Gini coefficient, coefficient of variation, ratio of top to bottom quintile productivity, top to bottom quintile shares. Dynamics of disparity has been studied by analysing the sigma convergence, beta unconditional convergence, beta conditional convergence and club convergence approaches.

To find the correlates of agricultural performance, district wise growth and development has been compared with use of modern inputs- fertilizers, tractors, pumpsets, cropping intensity, irrigation, infrastructure facilities like roads and resource endowments, that include-agricultural workers, level of literacy, land structure and rainfall. Findings from the tabular and graphical analysis were tested using Random Effect Panel Data and Fixed Effect Panel Data Models.

Hence, a brief summary from findings of our empirical analysis is as follows:

**Five decades of agricultural performance in Uttar Pradesh**

Uttar Pradesh recorded mediocre performance in agriculture growth during the last half a century. It continues to achieve approximately average growth recorded by the agriculture sector in the country as a whole. The state could not benefit from green revolution technology as much as the gains harvested by its neighbouring states of Punjab and Haryana. Similarly, the state also could not match the big catch-up recorded by many other states like West Bengal, Gujarat and Bihar. Nevertheless, the agriculture growth rate in Uttar Pradesh accelerated significantly during the green revolution period, decelerated in the first decade of reform period (1990s) but recovered marginally during the first decade of the 21st century. The recent recovery of agriculture is mainly because of a significant improvement in growth of livestock production. The combined output of the crop sector experienced considerable
acceleration in growth from less than 1 percent per annum during pre-green revolution period to more than 3 percent during 1980s and decelerated to almost half (1.5 percent) during the new millennium. However like crop sector, the fishery production continues to decelerate from a high of 12 percent per annum growth during 1980s to 5 percent per annum growth during 2000s. Forestry production accelerated from negative during 1980s to 20 percent per annum during 1990s and declining to 4 percent during 2000s. In crop sector, the temporal pattern of acceleration up to 1980s and serious deceleration thereafter has mainly marked the cereal crops. The opposite behaviour is shown by oilseeds. Their combined growth decelerated up to 1980s but recovered thereafter. There is significant diversification of area under foodgrains with corresponding rise in area under non foodgrains in general and under sugarcane, fruits and vegetables and condiments and spices in particular. Within foodgrains, major shift in area took place from coarse cereals and pulses towards the green revolution superior cereals- rice and wheat. Diversification in value of output is more sharp in the case of total non foodgrains. This is mainly because of shift in area from low value coarse cereals and pulses towards high value condiments and spices and fruits and vegetable crops.

Decomposition of growth brings out that increase in yield was the main contributor to total agriculture production but it lost its importance during the last decade whereby, its contribution to total production declined from more than 50 percent to 17.6 percent during 2001-2011. The changes in cropping pattern from low value to high value crops accounted for considerable contribution to growth during 2001-2011. Almost one-fifth of the total production during the last decade was due to interaction between crop yield and changes in cropping pattern effects. Contribution of area effect first declined from one-fourth to a low level of approximately one-tenth during 1980s, but doubled to almost 20 percent during 2000s. In wake of technological deceleration, price and increasing role of markets seems to have played a significant role in changing relative contribution of area, yield and cropping pattern to agricultural performance in the state.

Agricultural growth in Uttar Pradesh: Spatial and temporal pattern

A regional and district level analysis of agricultural performance during 1960-61 to 2010-11 brings out different characteristics of temporal and spatial pattern of agricultural growth in Uttar Pradesh. For the period as a whole, agricultural performance varies considerably across agro-economic regions in the state. While three of the nine zones, namely Mid Western Plain Zone, South Western Semi Arid Zone and North Eastern Plain Zone achieved high growth
rates exceeding 3 percent per annum, whereas Hills, Vindhyan and Western Plain Zones recorded low growth during the overall period. The temporal pattern of growth also varies considerably across agro-economic regions. The agricultural growth in five of the nine agro-economic regions namely- Western Plain Zone, Mid Western Plain Zone, Central Plain Zone, North Eastern Plain Zone and Vindhyan Zone follow the overall state pattern of inverted ‘U’ curve behaviour overtime, indicating acceleration during the pre reform period and deceleration in growth during the post reform period. In rest of the four zones, the agriculture growth accelerated till 1980s but has not declined thereafter significantly as it accelerated albeit marginally, during the post reform period as well.

Like the output growth, the temporal pattern of growth in area under different crops is not uniform overtime for the state as a whole as well as for different agro-economic regions. In six of the nine agro-economic regions namely-Western Plain Zone, Mid Western Plain Zone, North-Eastern Plain Zone, Eastern Plain Zone, Vindhyan Zone and Hills, there was acceleration in area growth up to 1980s but it continued to decelerate significantly during the post reform period. Bundelkhand and Central Plain Zones were the only zones, where area continues to accelerate even during the post reform period as well. However, there was no significant change in growth of area in South Western Semi Arid Zone. The growth of crop yield also varies considerably across zones and overtime. Four agro-economic zones namely-Mid Western Plain Zone, South Western Semi Arid Zone, North Eastern Plain Zone and Eastern Plain Zone performed extremely well by recording growth exceeding 2.5 percent per annum. Like the earlier finding, the Hills, Bundelkhand and Western Plain Zones performed poorly on yield growth as well. Therefore, the differential performance of agriculture growth by different agro-economic regions seems to be mainly because of their differential performance in crop yield. There is mix picture regarding acceleration/deceleration of crop yield during the post reform period. The yield growth accelerated up to mature green revolution phase in all the zones but the post reform period does not follow any specific pattern in this context. While, the yield growth decelerated in post reform period in Mid Western Plain Zone, it accelerated in South Western Semi Arid Zone, North Eastern Plain Zone, Vindhyan Zone and Hills zone. In remaining four zones, the crop yield continues to grow at the same pace, it neither accelerated nor decelerated significantly.

The number of districts, recording different levels of growth, differs considerably overtime. The number of high growth districts increased from 15 during the pre-green revolution period to 37 during 1980s and declined to 12 during 2000s. The low performing districts depict just
opposite behaviour, as the number of districts recording less than 2 percent per annum growth declined from 27 during the pre-green revolution period to just one during 1980s but their number increased to 24 during 2000s. Though all districts experienced significant improvement in agriculture growth, but there are large inter-district variations in growth. The growth varies from 4 percent per annum for Moradabad and Piliphit districts to about 1 percent per annum in Bulandshahr and Hamirpur districts. Banda is odd man out district as it has not recorded any significant improvement in growth for the last five decades. Growth accelerated in almost all the districts with exception of Muzaffarnagar, Saharanpur, Bijnor, Mainpuri, Allahabad, Lucknow, Unnao, Ballia, Varanasi and Mirzapur districts. Almost half of the districts recorded significant deceleration in the post reform period, whereas agriculture growth accelerated in 14 of the 47 districts (including hills) units in the state. 12 districts just continued to grow with the same pattern during the post reform period at which they were growing during 1980s.

**Agricultural development in Uttar Pradesh: Temporal and spatial dynamics**

There are large spatial disparities in the level of agricultural development in Uttar Pradesh. The Western Plain Zone even though recorded mediocre agriculture growth during last five decades, yet continued to be much ahead of rest of the zones in terms of agricultural development. The per hectare productivity in 1960-63 in this zone was so high that even after 50 years, the three other zones namely- Bundelkhand, Vindhyan and Hill Zones could not match it even in 2010-11. However, due to very high growth recorded by Mid Western Plain and South Western Semi Arid Zones overtime and in comparison low growth recorded by the Western Plain Zone, these three zones emerged as the most developed zones in the state of Uttar Pradesh in 2008-11. However, Bundelkhand Zone, Vindhyan Zone and the Hill Zone (which form the present day Uttarakhand) continue to be agriculturally lagging zones of the state. The remaining three zones namely- Central Plain Zone, North Eastern Plain Zone and Eastern Plain Zone with mediocre growth, continues to maintain the middle level of development. Overtime, gap between the most developed Western Plain Zone and other zones followed inverted ‘U’ curve path over the last five decades i.e. the gap first continued to widen till 1980s but started declining thereafter.

Almost all the districts in Uttar Pradesh were trapped in low levels of development till 1980s. There was a gradual shift from low productivity to high and medium productivity levels during 1990s, as the number of low productivity districts declined from 46 during 1960-63 to
32 during 1990-93 and further to 15 during 2008-11. At present, while Western Plain Zone, Mid Western plain Zone and South Western Semi Arid Zone have none of their districts in the low productivity range, Bundelkhand and Vindhyan Zones have all their districts in low productivity category. There are still nine districts in the state namely- Allahabad, Banda, Hamirpur, Jalaun, Jhansi, Bahraich, Pratapgarh, Mirzapur and Hills district unit that are at such low levels of development that they were unable to match the level of development attained by the most developed Meerut district fifty years back- in early 1960s. These districts seem to be the ‘Achilles Heel’ of the Uttar Pradesh agriculture. Apart from this, there are 17 more districts that have not been able to achieve the level of development attained by most developed Muzaffarnagar district forty years back from now. For the period as a whole, inter-district disparities in the level of agriculture development increased marginally. Nevertheless, the pattern was not uniform, disparities widened till 1990s but declined thereafter depicting inverted ‘U’ curve behaviour overtime.

There is a definite regional contiguity so far as the district level development in Uttar Pradesh is concerned. Development started in the extreme North in 1970s then started spreading to its contiguous districts. By 2000, another spot of prosperity emerged in the East. By 2010, a specific pattern emerged with high developed districts forming a continuous belt in North-West, medium developed districts forming a continuous strip in the East, and underdeveloped districts forming a continuous long strip in South-East and East-West part of the state. Agro-climatic conditions along with demonstration effect seem to be at play for these regional disparities and spatial pattern of development and underdevelopment in Uttar Pradesh.

**Convergence/divergence of regional disparities in agricultural development**

For the period as a whole, there was sigma convergence in regional disparities in agricultural development in Uttar Pradesh. However, the pattern of inequality was of inverted ‘U’ type implying sigma divergence from 1960 to 1980 and sigma convergence from 1981 to 2010. The magnitude of convergence was more strong in the later period than the former, resulting in overall sigma convergence of declining regional disparities.

Besides sigma convergence, there is also significant evidence of beta unconditional convergence. It occurred mainly during the last three decades, whereas no such convergence occurred during the 1960s and 1970s. In other words, there is evidence of catch-up by the low developed districts with the medium and high developed districts from 1980s onward. The
results are robust to control for other exogenous structural factors affecting the agricultural development.

There is no conclusive evidence on prevalence of club convergence across districts for the last three decades. While beta convergence occurred in the club of high developed Western region districts during 1981-82 to 2010-11 period, but there is no such evidence from 1960-61 to 1980-81 for the club. However, neither the club of medium developed or the low developed districts and nor the clubs of Central region and Eastern region districts provide conclusive evidence regarding beta unconditional and beta conditional convergence. Therefore, the overall beta convergence of catch-up by low developed districts seems to be mainly because of very strong catch-up within the club of high developed, Western region districts and partly due to inter-region convergence of development.

**Dynamics of labour productivity**

Contrary to acceleration-deceleration in temporal pattern of agricultural performance, labour productivity growth continuously decelerated over the last five decades. During the last five decades, labour productivity recorded negative growth in Western Plain Zone and Vindhyan Zone whereas, the North Eastern Plain Zone and Mid Western Plain Zone recorded very high growth of labour productivity exceeding 1 percent per annum. There is no unique pattern of temporal variations in growth of labour productivity in each of the agro-economic regions.

There is continuous increase in labour productivity at the state level in Uttar Pradesh. Whereas no such consistent pattern of continuous increase is recorded at the regional level except in North Eastern Plain Zone. Though, like the level of land productivity, Western Plain Zone recorded the highest level of labour productivity as well, but there was decline in the productivity in the zone till 1990s and increased only marginally thereafter. Bundelkhand Zone remained almost at the same level of productivity between Rs 20000- 23000 per worker productivity. Moreover, four out of nine zones recorded a decline in labour productivity during the later period. All the districts in Western Plain Zone remained at the highest productivity levels since 1960s. Thereafter, except Budaun and Bareilly from Mid Western Plain Zone, rest all districts joined the high productivity levels during 1990s and districts from South Western Semi Arid Zone during 2000s. With exception of Deoria, Ghazipur, Barabanki, Gonda, Azamgarh, Faizabad and Sultanpur districts all other districts from the North Eastern Plain Zone, Eastern Plain Zone, Vindhyan and Hills Zones remained trapped in
low levels of labour productivity for the last five decades. Stagnation of labour productivity in these zones along with Bundelkhand Zone districts is worrisome situation.

Contrary to inverted ‘U’ relationship of regional disparities in agriculture growth, the labour productivity depicts ‘L’ type relationship overtime. Disparities in labour productivity declined during 1960-1980 period, but stagnated thereafter for the last three decades (1981-2010). However, this pattern is mainly due to the fact that the main gain of agriculture growth went to the middle 60 percent of the districts. These middle group districts gained immensely in their share of agriculture production at the cost of the districts in the bottom and top quintiles. The most worrisome is substantial decline in share of bottom low productivity districts whose share in agriculture production declined from 18.8 percent to 12.8 percent.

Revival of growth in low and stagnate labour productivity districts is urgently required as the level of labour productivity and the incidence of poverty are inversely related in the state. Persistence of very high incidence of poverty in low productive districts and zones suggests that the policies to overcome agricultural backwardness in these districts may go a long way in overcoming the serious problem of very high incidence of poverty and low level of living of overall population in general, and that of small and marginal farmers and agricultural workers in particular.

Sources of agricultural performance in Uttar Pradesh

The inter-district differentials in agricultural performance in the state of Uttar Pradesh arises both due to differentials in resource endowments in zones as well as due to differentials in use of modern inputs in agriculture. Among the modern inputs, the use of chemical fertilizers, tractors and pumpsets contribute to agricultural development but the impact on inter-district differentials is significant in case of the former two. Among the resource endowments, increasing area under cultivation contributes to higher growth, whereas the labour force employed in agriculture is not significantly related to production differentials in the state. Not only the expanding area leads to higher growth, but the structure of land distribution plays an equally important role in this context.

Contrary to widely accepted inverse farm size productivity relationship in Indian agriculture, higher proportion of small farmers turned out to be a constraint on agricultural development suggesting that there is positive farm size productivity relationship in Uttar Pradesh agriculture.
Infrastructure facilities do not contribute significantly to agriculture growth and development. But inter-district differentials in the state of Uttar Pradesh are not significant due to differentials in road density and the extent of irrigation facilities in the district when other factors are controlled in the Panel Data Models. Besides the man made resources, the natural endowments of zones in the form of agro-climatic conditions play a very significant role in inter-district disparities in the performance of agriculture in the state. The favourable agro-climatic conditions in Western and Central regions and unfavourable agro-climatic conditions in Bundelkhand, Eastern and Vindhyan zones are significantly related with high and low level of development achieved by the districts falling in these climatic zones.

**Some policy implications**

The low level of development and a serious deceleration in Uttar Pradesh agriculture since initiation of economic reforms along with existence of inter-district disparities is a major concern for planners and policy makers in the state. To achieve the objective of inclusive, sustained and balanced regional development of national planning and attaining 5.1 percent growth in agriculture sector during twelfth plan period and transforming the state into a ‘Granary of the Nation’, the agriculture sector needs to be rejuvenated in the state. The need for rejuvenation is not only an important issue in itself for revival of the momentum of growth, but is equally important to address many other crucial socio-economic concerns like alleviation of poverty, generation of more remunerative rural farm and non-farm employment opportunities, diversification of rural economy by generating surplus processable raw material for industrial use. The findings from this study as well as drawing from the experience of other developed states like Punjab and Haryana along with recent spectacular growth recorded by Gujarat and Bihar agriculture, to us, it seems that the state agriculture is operating under serious constraints. Five of these important constraints are: the natural constraints, technological constraints, market constraints, information constraints and the financial constraints. Therefore, policy initiatives are required in these areas to reverse the deceleration tendencies as well as to put the state agriculture on path of high sustainable and equitable growth. Some of the initiatives in this context are as follows:

1. Significant low level of development in Bundelkhand Zone, Vindhyan Zone and some districts in Eastern and Central Plain Zones indicate adverse agro-climatic conditions and low level of irrigation facilities. Therefore, besides low level of irrigation, some districts in the eastern region are prone to flooding during monsoon season. Therefore, risk and uncertainty
related with low and untimely rainfall as well as excess rainfall leading to floods, needs to be tackled on priority basis. Development of ground water irrigation facilities therefore, needs to be taken at the priority basis along with bunding of rivers to check the devastation caused by floods. Hence, along with provision of credit, some incentive (subsidy) for plantation of tubewells and provision of electricity for running the tubewells may be provided on priority basis, especially in the low irrigation intensity districts.

2. The state of Uttar Pradesh could not benefit from the earlier green revolution technology and the recent gains from breakthrough in biotechnological developments to the extent as other agriculturally leading states have benefitted. A big gap in yield of major crops in Uttar Pradesh and other leading states (Appendix 9.1), suggest the need to develop the suitable technology of different crops for different agro-economic regions in the state.

3. Besides improvement of technology of existing major crops, policy initiative needs to be taken to benefit from the emerging market opportunities for high value commercial crops like condiments and spices, fruits and vegetables. There is already a shift towards some of these crops which further needs to be accelerated for other crops as well.

4. The biggest problem encountered in the farming sector is the imperfections in the agriculture market and high market demand and price risk, for both inputs and outputs. With indication of government’s phased withdrawal from agriculture markets and poor capacity of the small and marginal farmers to participate and benefit from the commodity markets, we feel the need of some protection mechanism for farmers against the vagaries of agriculture markets. There is a need to promote the cooperative agriculture markets, development of agro-processing industries for surplus agriculture products in general and for processing of fruits and vegetables in particular. Contract farming with the agro-processing firms and big retail market chains are rapidly emerging in the country. Since small and marginal farmers are too weak to deal with such strong and big firms, there is an urgent need to evolve the strong institutional mechanism that facilitate and regulate such contracts to protect the interest of farming community in case of moral hazards by contracting parties.

5. Recent situation assessment survey of the farmers, suggest a big information gap in the state of Uttar Pradesh so far as the scientific knowledge about modern agriculture practices and policies, programmes and extension services provided to the farmers are concerned (Appendix 9.2). The existing large gap in potential and actual yield to a greater extent is because of such information gap among the farmers in the state. Dissemination of information
on these accounts and strengthening of the extension network of agricultural departments, Universities, research stations, Krishi Vigyan Kendra’s and involvement of NGO’s is the need of the hour.

6. Evidence suggests low level of both public and private capital formation in state agriculture compared with the other agriculturally leading states in the Northern and Southern parts of the country (Pandey, 2015). Evidence also suggests that the public sector play a complimentary role in this context. Therefore, besides more efforts for public investment in rural areas, there is an urgent need to promote private investment in agriculture. Investment in groundwater irrigation, tractor and other implements, improvement in land and other allied agriculture activities require investment that has long gestation period. Small and marginal farmers in the state who have very low level of living may not be having enough savings to undertake these investments. The rural credit institutions can play a significant role in this context. Compared with other leading states, the per hectare credit supply to Uttar Pradesh farmers is grossly low and inadequate (Appendix 9.3). There is an urgent need for augmenting the institutional credit supply to agriculture in the state.

7. Besides improvement in production and productivity, equally important are the initiatives to reduce the cost of production in the agriculture sector. Such measures are urgently required not only to augment returns to the farmers and to improve their socio-economic well being, but initiative is equally important to make farming a more remunerative activity. Thus, the state may emulate many successful initiatives undertaken in Punjab agriculture in this context. Some of these initiatives are: promotion of farmer’s machinery cooperatives with most modern implements which include tractors, laser leveller, rotavator, tractor driven insecticide spray facilities, sowing machines and thresher services. Similarly, provision of cattle and buffalo breed improvement, through imported artificial insemination services provided to the farmers, are likely to go a long way to facilitate the development of dairy farming in the state. Special incentive scheme for small and marginal farmers for economy net/poly farming can prove to be a boom to small-marginal farmers, located adjoining to big cities for vegetable farming. The state must take initiative to implement these and other similar initiatives in Uttar Pradesh as well.

8. Last but not the least, we feel the need of more intensive efforts for development of agricultural backward districts in the state. In our opinion, there is a need to undertake micro-level studies for the lagging districts in the state to find out the local constraint and to design the most appropriate policy initiatives for development of such districts.