Doubling the Farmers' Income in Uttar Pradesh by 2022 -

- Opportunities & Constraints

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The approach of the Government of India to the farmers' welfare has shifted from Raising Agriculture Output (RAO) to Income Enhancement (IE). The advantage of the IE approach is that it gives equal importance to both production and post-production components of agricultural development and farmers' welfare. Against this backdrop, this study is an attempt to evolve a strategy for doubling the farmers' income in Uttar Pradesh. The strategy is based on the farmers' prevailing needs, constraints, income and income composition information collected from 1200 agricultural households across 48 villages in the state.

The multi-stage sampling procedure was applied to select 1200 sample households. First, all nine agro-climatic zones of UP were divided into three groups on the basis of agricultural productivity – high (western plain, southwestern semiarid, mid-western, and Tarai & Bhabhar zone), medium (mid-plain or central, north-eastern plain and eastern plain) and low (Vindhyan and Bundelkhand zones). From the first group, two zones (western plain and southwestern semi-arid zone) with the highest level of agricultural productivity were chosen. From the second group, all three zones were chosen for the purpose of the study as there was a negligible difference in agricultural productivity across these zones. Finally, Bundelkhand zone was chosen from the third category of agro-climatic zones as it had the least agricultural productivity.

From each zone, one sample district was chosen following the criteria of vulnerability to climate change, as it has become an important determinant of agriculture production in the state. Thus, the following districts were selected: Lalitput (Bundelkhand agro-climatic zone), Pratapgarh (central zone), Varanasi (eastern plain zone), Gorakhpur (northeastern plain zone), Firozabad (southwestern semi-arid zone), and Ghaziabad (western plain zone). From each agro-climatic zone, a district with the median level of climate change vulnerability was chosen. However, the districts thus selected from each agro-climatic zone show different levels of vulnerability to climate change. From each sample district, two blocks were selected randomly and from each selected block, two sets of villages were chosen; each set had two villages. One set of the villages was selected on the basis of irrigation ratio and the other one set of villages was chosen on the basis of availability of agricultural marketing facilities.

Uttar Pradesh is the most populous state in India and every fourth farmer in the country comes from here. Hence, one cannot expect the farmers' welfare in India without considering the farmers of UP. Apart from this, UP is the largest producer of agricultural products in India. About 17 per cent of total foodgrain production of the country comes from UP. Despite these achievements for the state, the situation of its farmers is not very good. The average monthly income of an agricultural household in UP is about Rs. 4900, as per the latest information available for the year 2012-13 from 70th Round of National Sample Survey. In comparison, the average monthly income of the agriculture household in Punjab and Haryana was Rs. 18000 and 14400, respectively. Agriculture in UP is less lucrative as it is characterized by low crop yield, mainly fine cereals (rice and wheat) and high inter-regional variation.

SUMMARY OF FINDINGS

1. Kharif and Rabi are the two major crop seasons in the state. It was observed that farmers preferred to keep their land fallow during the Jayad season. In the sample districts of Firozabad (southwestern semi-arid region), Pratapgarh (central zone), and Gorakhpur (north-eastern plain zone) not a single farmer was found cultivating any crop in the Jayad season. In the sample districts of eastern plain, western plain and Bundelkhand, a few farmers engaged in sowing crops in Jayad season.

2. Between Kharif and Rabi season, Rabi season appeared to be the prime agriculture season.

3. Wheat was the major crop in Rabi season in all parts of UP. Paddy was an important crop for Kharif season at the aggregate state level though not for every zone as is reflected from our data. Urad was the principal crop of Kharif season in Bundelkhand region of the state. Similarly, bajra was the major crop in the district of southwestern semi-arid zones.

4. Access to irrigation and rainfall were the major determinants of the cropping pattern.

5. The second principal crop in both the seasons varies from region to region within the state. In Firozabad district (southwestern semi-arid region), potato was the second principal crop in Rabi season and paddy in Kharif season. In Ghaziabad district (western plain zone), sugarcane was the second principal crop in Kharif

season and potato in Rabi season. Pratapgarh district (central part of Uttar Pradesh) followed a single crop system in both the seasons (Rabi and Kharif). Bundelkhand region of the state, represented by Lalitpur, had maize and gram as the second principal crop in Kharif season and Rabi season, respectively. Potato was the second principal crop in Rabi season in the eastern Uttar Pradesh as was reflected from both sample districts (Varanasi and Gorakhpur). However, in the Kharif season, Varanasi (eastern plain zone) and Gorakhpur (northeastern plain zone) had a different second principal crop each – bajra in Varanasi and maize in Gorakhpur.

6. At the aggregate state level, sugarcane was the most profitable crop in the state except for Bundelkhand and Central regions. The crops value or profitability varied significantly across agro-climatic zones of the state.

7. In terms of relative profitability, the importance of crops changed over regions of the state. Sugarcane, mustard, rapeseed, and potato were identified as the most profitable crops in the western part of the state, as was reflected from both sample western districts in the study (Firozabad and Ghaziabad). Cereals, particularly paddy, was the most profitable crop in the central part of the state, as was shown by Pratapgarh district of the central region of Uttar Pradesh. Similarly, wheat was the most profitable crop in Bundelkhand region. In the eastern region, sugarcane and potato were the most lucrative crops in the region.

8. As high as 71 per cent of the total sampled households were indebted; most of them belonged to western districts (Ghaziabad and Firozabad). The share of indebted households in these districts was 93 per cent and 82 per cent, respectively. A lesser number of sample households were found indebted in eastern and Bundelkhand districts compared to western and central districts.

9. Non-institutional sources such as relatives and moneylenders were still important sources of credit for agricultural households. About 40 per cent of the outstanding amounts came from these sources in each sample districts except for Lalitpur.

10. It was noted that about 60 per cent of indebted farmers had taken the loan for agricultural purposes such as agricultural machinery, fertilizers, seed etc.

11. The average household annual income for the agriculture year 2016-17 was estimated at Rs. 153488 in Uttar Pradesh. Per-capita household annual income in the state is Rs. 25659.

12. There was inter-region variation in average household annual income in Uttar Pradesh. The highest average annual income was reported by agricultural households of western plain regions (Ghaziabad), followed by the northeastern plain zone (Gorakhpur) of the state. The lowest household average annual income was reported from Bundelkhand region followed by the districts of central zone and eastern plain zone of the state.

13. Agricultural households belonging to the general caste category reported a much higher average annual income in comparison to other categories. Similarly, agricultural households with large land holdings reported much higher income than the households with other land categories.

14. A very weak correlation exists between per-capita farm income and the size of land holdings. However, there is a negative correlation between per-capita annual non-farm income and the size of landholdings.

15. Farm income was the chief source of earnings for the agricultural households in UP. It contributed around 55 per cent of total income for sampled agricultural households. The rest of 45 per cent of income came from the non-farm sources such as wage/salaried employment, business etc. The share of farm income in the total income was much higher in Bundelkhand region in comparison to other regions of the state.

16. Among the sources of non-farm income, wage earnings accounted for almost 50 per cent, salary and/or business accounted for 40 per cent, and remittances, subsidies and property sale accounted for the remaining 10 per cent of the total non-farm income of the agricultural households. The wages were earned from casual employment, indicating a lack of formal employment opportunities in rural manufacturing and the service sectors in the state. Further, across UP there was no significant spatial variation in the share of earning from wages in total non-farm income.

17. The net household annual farm income for the agriculture year 2016-17 is estimated at Rs. 56691 at the aggregate state level. The highest net farm income per household was observed in the western plain districts and Bundelkhand regions of UP. The lowest net annual farm income was reported by the agricultural households in north-eastern plain (Gorakhpur) followed by the southwestern semi-arid and the eastern plain zones of the state.

18. A larger chunk of farmers in the state are either marginal or small farmers. During the survey and the focus group discussions, it was revealed that a majority of them grew food crops such as wheat, paddy etc. to meet their household food requirements, even though cash crops or commercial crops such as sugarcane, potato, fruits and vegetables, could be more lucrative.

19. The second significant causal factor of low farm income was inadequate compensation for farm produce.

20. The study team noticed 5 to 10 per cent of output loss in farm commodities such as paddy, wheat, and potato etc. This causes a substantial loss in farm income.

21. Livestock activities (i.e. dairy, poultry etc.) were the secondary activities for the agricultural households. It was observed that not all sample household were engaged in livestock farming. The proportion of households engaged in these activities was about 72 per cent in Varanasi district, 53 per cent in Gorakhpur district, 78 per cent in Firozabad district, 80 per cent in Ghaziabad district, 96 per cent in Pratapgarh district, and 55 per cent in Lalitpur district.

22. Among the sample households engaged in the livestock activities, about 51 per cent of the households earned negative net income from these activities, indicating greater expenditure on the livestock than the income. The proportion of livestock expenditure vis-a-vis income was higher in Gorakhpur and Ghaziabad districts.

23. The average annual net income from the livestock activities per agricultural household was about Rs. 16550. It varied from Rs. 11308 in Gorakhpur to Rs. 29790 in Ghaziabad.

24. The buying agency played an important role in net income from the livestock activities. Likelihood of a positive net return from the livestock activities was much higher in the case of direct selling to consumers. Selling livestock products to milkman also had a high probability of returning a positive net profit from the livestock activities.

25. The state offered limited non-farm employment opportunities in the rural areas even though people were eager to shift away from the agriculture sector.

26. In the survey, not a single farmer was found to be aware of the FASAL insurance scheme. The farmers who had taken a loan through Kisan Credit Card knew that FASAL insurance scheme premium amount was deducted from the amount of their loan, but they were not informed on the insurance scheme, its benefits, sum insured under the scheme, whether it was life insurance or general insurance, or when and how can they claim it.

27. The benefit of Soil Health Mission had not reached many farmers. Only 4.75 per cent of the sample households confirmed that soil of their field was tested. Only 1.83 per cent of agriculture households had received soil health card so far. And only 43.67per cent farmers in the study area had received Kisan Credit Card.

28. About 90 per cent of the households in five out of six districts perceived a change in average temperature. In Ghaziabad district 98 per cent of the sample households acknowledged this change.

29. More than 50 per cent of the households across all six districts emphasised a decrease in the average rainfall. In Firozabad, 95.5 percent of the sample households, in Ghaziabad district, 89 per cent sample households, and in Pratapgarh 84 per cent of sample households emphasised decrease in the average annual rainfall.

30. The survey also noted a common observation among the sample households of the longer dry spells in the region. In Ghaziabad (71.5 percent) and Firozabad (62 percent) households admitted long dry spells. Whereas only 50 households across all six districts perceived an increase in floods.

31. In the districts of Gorakhpur, Ghaziabad, and Firozabad, a large number of households reported an increase in the cases of diseases such as malaria, dengue, chikungunya, tuberculosis, typhoid, cholera, and jaundice. The households in the same three districts have also reported higher incidence of diseases among their livestock.

32. With an exception of the district of Ghaziabad, the majority of the households in the surveyed districts had acknowledged a lack of awareness about the effects of agricultural practices on climate variability.

33. While most of the surveyed households expect improved agricultural inputs, innovative methodologies, and better irrigation methods, some had even shown inclination towards better machinery, utilization of clean energy, multiplication of plantation and other land development initiatives. The survey gathered agriculture households' views on various constraints like access to information on capital, credit, inputs, etc. that restrain their farm productivity and income.

34. The Incremental Capital Output Ratio (ICOR) for the period 2004-05 to 2014-15 was estimated at 0.22 for the state.

35. To double the income of the farmer households in UP by 2022, the value of agriculture output must reach Rs. 592185.34 crore at 2016-17 prices. To achieve this, an investment of Rs. 655 billion or Rs 131 billion per year at 2016-17 prices would be required to raise the agriculture output in the year 2022-23 with ICOR of 0.22.

36. Capital expenditure for year 2014-15 was about Rs. 55 billion. Therefore, more than double of the current investment would be required for a significant raise in the farm-based income.

37. Irrigation, food storage and warehousing, forestry and wildlife, and crop husbandry were the key sectors of public investment. The state has shown a positive growth trend in the net irrigated area.

38. Micro irrigation and warehousing need to be the focus areas of the government investment in Uttar Pradesh as these were the major challenge for agricultural

development in the state. At the same time, investment portfolio should diversify towards animal husbandry, agricultural marketing and food processing sectors as these appeared to have the potential to boost the farmers' income in the state.

KEY AREAS OF POLICY CONCERN & SOLUTIONS

Crop diversification away from food crops to commercial crops and fruits and vegetables need to be promoted for increasing the farmers' income from cultivation. Food crops were found to be less lucrative than the commercial crops. The farmers were found allocating more land to cereals such as rice and wheat to meet their domestic requirement. Uneconomic size of land holding of the most of farmers in UP appeared as a major factor which discourage farmers from diversify to commercial crops. It also causes to low level of marketable surplus, which, further, decreases farmers' bargaining power in the market. Here, **group/collective farming and adoption of Model Lease Act has potential to solve the above problem.** Viability of small land holdings can be improved by promoting group/collective farming and adopting Model Lease Act suggested by NITI Aayog. **Promotion of Farmer Producers Organization (FPO) could also be effective.** But, all FPOs in UP were found concentrating on input supply and marketing. They should be encouraged to shift focus on production too to harness the advantage of economies of scale. **Financing FPOs appeared as a key challenge in the state.**

Further, increased crop productivity will also help in crop diversification and thus increasing farmers' income. In order to increase crop productivity in the state, the focus should be on adoption of quality seeds and improvement of production efficiency. Also, Western, Bundelkhand, and Central regions of UP need irrigation supports as it emerged as a major challenge of agriculture growth in these regions. As farmers throughout the state, barring eastern zone, were facing the severe decline in water-table. Improved access to irrigation would increase agriculture production. **Water conservation and use of micro irrigation need to be promoted in the state. Idea of farmers' school and financial support would be helpful here.**

Adoption of hybrid and improved seeds would significantly increase crop productivity. Use of hybrid and improved seeds was low throughout the state mainly because of lack of awareness, lack of availability and accessibility, and high price. **Input support in form of subsidy will assist in increasing farmers accessibility to quality seeds. In order to**

increase availability, the focus should be on production of quality seeds and its marketing. Input supply mechanism needs to be improved. Technical inefficiency was observed in the cultivation practices of the most crops in Uttar Pradesh. This inefficiency had increased in the last two decades. Due to high technical inefficiency, output gap (the difference between potential and actual output) was high. Improved technical efficiency would increase agriculture output and reduce the cost of production. **Proper extension services and demonstration of application of best practices would be effective and to tap the potential of these channels, farmers' school at panchayat level would be useful.**

In Uttar Pradesh, farmers remain forced to sell their produce for prices that are much lower than Minimum Support Price (MSP). It is mainly due to inadequate government procurement system, poor market infrastructure and road connectivity, and involvement of the intermediaries. **Improved public procurement and agricultural marketing system would improve farmers income.** A sound procurement machinery needs to be erected in the state, which includes opening enough procurement centres and increasing procurement targets. **Since benefits of government procurement and MSP reach to paddy and wheat farmers largely, market intervention and price support schemes like price deficiency payment scheme would benefit farmers of other than the above crops.** Adequate infrastructure (roads, transportation services, godowns, cold storage etc.) should also be created and put in place to encourage farmers to get their produce to the mandis.

The state lacked non-farm employment opportunities in the rural areas. **Promoting agriculture value addition industry could be a better option here as it does not require huge investments and high skills.** Besides, a well-developed food processing sector helps in the reduction of wastage, improves value addition, promotes crop diversification, ensures a better return to the farmers as well as increase export earnings. Nonetheless, the food processing sector in UP faces several challenges – inadequate supply chain, lack of related infrastructures (*i.e.* cold storage, power supply, market etc.), lack of finance, and absence entrepreneurial skill. **Recently, the Government of Uttar Pradesh came up with a scheme called one district one product and introduced new food processing policy. These initiatives could be effective in promoting food processing sector in the state, if these are implemented properly at ground level without any corruption.**

1 INTRODUCTION

Since the honourable Prime Minister shared his vision of doubling the farmers' income with the nation at his Bareilly address on 28th February 2017, the approach of the Government of India to farmers' welfare has shifted to their Income Enhancement (IE) over the previous approach of Raising Agriculture Output (RAO). In the RAO approach, the prime attention was paid to improvement in crop productivity through use of high yielding variety seeds, scientific irrigation methods, application of chemical fertiliser and mechanization. It had helped India become a food self-sufficient country at the aggregate level.[1] However, the farmers' situation was not improved as about 22.5 per cent of farm households in the country have income below the poverty line **(Chand, 2017).**[2] The proportion of the farm households suffering from poverty was quite high in some states; for example, it was 45.3 per cent in Jharkhand, 32.1 per cent in Odisha, and 28.4 per cent in Bihar.

RAO approach to farmers' welfare was itself responsible for the pathetic situation of Indian farmers as this approach primarily focused on production. The post-production process (*i.e.* marketing, storage etc.) got little attention. Whereas for the welfare of farmers both production and post-production aspects of agriculture are equally important. For a better farm income, the IE approach gives equal emphasis to production and post-production processes (essentially marketing system) for wholistic agriculture development and a better net farm income.

Against this backdrop, this study has made an attempt to evolve the state- specific strategy for doubling the farmers' income taking into account their specific needs and the constraints. Despite low crop productivity, Uttar Pradesh is the largest producer of foodgrain and sugarcane in the country which makes it very important in India's overall food and nutrition security programme.

In order to accomplish the above objective, 1200 agricultural households from 24 villages in the state were surveyed using pre-defined and structured questionnaire. Regional information from the surveyed villages was collected through focus group discussions.

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[1] In 1950s and early 1960s, India was facing the problem of food deficit and it was a net food importer country.

[2] This estimate is based on household information on consumption expenditure for year 2011-12 collected from National Sample Survey Organization, New Delhi.

Apart from primary information, this study has used secondary information collected from National Sample Surveys (NSS), India Human Development Surveys (IHDS), and Directorate of statistics and Economics of Government of Uttar Pradesh located in Lucknow.

1.1 WHY UTTAR PRADESH

UP is the largest producer of agricultural products in India. About 17 per cent of the total foodgrain production of the country comes from this state (Figure 1.1). UP has vast rich fertile landmass and water resources. It plays a significant role in the country's food and nutritional security programmes. Despite all these advantages, the situation of farmers in UP is not very good. This is clearly reflected in the existing inter-state variation in income of agricultural households in India (Figures 1.2, 1.3, & 1.4). The average monthly income of an agricultural household in UP was about Rs. 4900, as per the latest information available for year 2012-13 from 70th Round of National Sample Survey. On the other hand, the same data shows that an agricultural household in Punjab and Haryana earned Rs. 18000 and 14400 per month, respectively. The situation gets even worse when income only from farming and animal husbandry was compared across states. Average monthly income from farming and animal husbandry in UP was much lower than that in Punjab and Haryana. In these states, an agricultural household earned 3 to 4 times higher income than in UP.

UP was the most populous state in India and each forth farmer in the country came from this state. Hence, one cannot expect farmers' welfare in India without considering the farmers in UP.

1.2 IMPORTANCE OF AGRICULTURE SECTOR IN UP

Agriculture is the main occupation in the state – about 59.3 per cent of total workers in the state are engaged in agriculture. But, the more important phenomenon is that the percentage share of cultivators to total workers has reduced from 41.1 per cent in 2001 to 29.0 per cent in 2011. On the other hand, the share of agriculture labour to total workers has increased from 24.8 per cent in 2001 to 30.3 per cent in 2011. Land fragmentation, as reflected from the temporal changes in landholding, was the major reason of the above rising trend of agriculture labour in the state. The average size of land holding has reduced from 0.83 hectare in 2000-01 to 0.76 hectare in 2010-11. Around 91 per cent of total operational

holdings were under the category of marginal and small land holdings in 2000-01 and this figure increased to 92.46 per cent in 2010-11.

Agriculture also occupies significant space in the gross state domestic product (GSDP). Nevertheless, the contribution of agriculture sector to GSDP had a declining trend. From 35.5 per cent of GSDP in 1999-00, it reduced to 23.5 per cent of GSDP in 2015-16.

Though agriculture was the leading sector in the state, its output growth has been low and stagnant for the past three decades. During the 1980s, agriculture recorded a 2.43 per cent growth rate, which marginally reduced to 2.40 per cent in the first decade of the 21st century (**Tripathi, 2017**). Agriculture output growth in UP had always been lower than the all-India average since the 1980s (Tripathi, 2017) even though it has strong agriculture base being the largest producer of foodgrains, pulses, sugarcane and potato (Tripathi, 2017). The state ranks first in both wheat and sugarcane production and third in both rice and pulse production (Table 1.1). It also ranks first in potato production (Table 1.1). Despite this, the output per hectare of almost all crops in the state is average (**GoI, 2011**); the output per hectare for not a single crop was the highest in the country. The productivity of any crop depends on the size of land holdings, farm mechanization, irrigation, consumption of fertiliser and use of high yield variety seeds. Barring its western region, farming practices in the rest of the state are lacking in the above-mentioned productivity factors, which may be the main reason for the average yield per hectare for almost all crops in the state. Moreover, the total factor productivity of agriculture as a whole was found to be very low in UP as compared to Haryana and Punjab. A very recent study (**Chaudhary, 2012**) estimated total factor productivity performance in agriculture for fifteen major states and found only 1.14 per cent productivity growth rate for the period 1983-84 to 2005-06 in U.P., which is far below the country average (3.43 per cent), whereas states like Haryana (8.35 per cent), Punjab (10.67 per cent), Tamil Nadu (5.52 per cent), etc had a much higher productivity growth rate than the country average. This study analyses productivity growth in terms of technological progress and technology uptake in the state. The results indicated a low level of technological progress as the cause of poor total factor productivity growth in UP.

The low level of technological progress could be the result of inadequate government support, poor infrastructure, fragmentation of land holdings, etc. It was also noted that the state's plan expenditure on agriculture and the allied sector as a percentage of the total plan expenditure had declined over the years (Figure 1.5). During the first five-year plan period, this share was 16 per cent which had reduced to about 8 per cent during the eleventh five-year plan period. Similarly, the share of plan expenditure on irrigation had declined from 25 per cent in the first five-year plan period to 7 per cent in the eleventh five-year plan period (Figure 1.5). The average size of operational land holding in the state had also shown a declining trend in the year 2000-01, the average size of land holding in UP was 0.89 ha, which has now reduced to 0.76 ha (Figure 1.6). On the other hand, the average size of land holding at the aggregate country level is about 1.15 ha, way above the state average.

Several infrastructural facilities relevant for agricultural development such as market, road network, electricity, storage capacity, and irrigation are inadequate in the state. As per 2011 statistics of 28 states released by the Ministry of Road Transport and Highways, U.P. stood at 25th position in road density per lac population and at 9th position in road density per 100 sq km area. The state's per capita electricity consumption during 2009-10 was 386.93 kWh against an all India average of 778.63 kWh (**CEA, 2011**). Only 23.8 per cent households in the state had electricity, while the corresponding figure at the country level was around 55.2 per cent. There were only three agricultural regulated markets per 1000 sq km area in U.P., which though was better than the all-India average (2 markets per 1000 sq km area) but poor in comparison to agricultural dominated states like Punjab and Haryana with 10 and 6 regulated markers per 1000 sq km area, respectively. Similarly, the percentage of irrigated area in UP was slightly better than the country average but poor in comparison to Punjab and Haryana.

As shown in Table 1.2 and Table 1.3, the low level of crop-productivity observed in the state translated into poor crop profitability and rural poverty. Profitability and poverty are closely linked with agriculture productivity (**Datt and Ravallion, 1998; Tripathi, 2013**). In Table 1.2, the profitability of three major crops in UP namely rice, wheat and sugarcane is compared with the profitability of these crops in two other states where these crops were the mainstay of agriculture. Crop profitability was measured by subtracting the total cost (Cost C2) from the gross value of output, including main and by-product. Crop profitability was presented in the form of two years average for four periods viz., 1996-98, 2000-2002,

2004-06, and 2008-10 at intervals of two years. Above three crops are very important in UP as they together account for around 70 per cent of the total cropped area in the state. In each case, except for paddy in West Bengal, crop profitability was the lowest in UP. Similarly, the incidence of rural poverty, presented in Table 1.3, was significantly higher for UP in comparison to Haryana, Punjab and all-India average. Table 1.3 presents the percentage of rural population below the poverty line in UP and compares it with Haryana, Punjab and all-India average. Both Haryana and Punjab were chosen for the above comparison as these two states, like UP, are predominantly reliant on agriculture. Agriculture productivity in these two states was much higher in comparison to UP. The same phenomenon was observed within the state: rural poverty was much higher in the districts with low productivity. (**Pandey and Reddy, 2012**).

The production portfolio shows that crops account for the largest portion of the value of agriculture output, but the contribution of other sub-sectors such as livestock, forestry and fisheries also increased significantly between 1980-81 and 2008-09 (Figure 1.6). The above changes, particularly in livestock and fisheries sub-sector, are mainly attributed to change in the demand scenario. Demand for milk and milk products, meat, egg, and fish in the state has increased significantly in the last two decades (**GoI, 2013**). The major reasons for the above shift in demands are obviously increase in income, change in lifestyle, and urbanization.

Unlike this, no significant changes were observed within crop sub-sector of agriculture in the state. The share of cropped area under paddy and wheat was still very high in the state. Both together account for around 65 per cent of the total cropped area in UP. Moreover, temporal pattern presented in Table 1.4 suggests that the cropping pattern in UP has shifted towards cereals, particularly wheat and paddy. It indicated the specialized nature of agriculture in the state. This had already been recognized in earlier studies: **Fahimuddin, (2010) and Jha and Tripathi (2010).** Fahimuddin (2010) has made an attempt to evaluate the pattern of crop diversification achieved in UP during the post-liberalization period (1990-91 to 2006-07). He noted that agriculture economy of UP was largely food crop based during the post-liberalisation period as it was before and thus indicated the slow pace of diversification in the state. Similarly, in their study, Jha and Tripathi (2010) calculated diversification indices for three different points of time – 1983-84, 1993-94 and 2003-04, and observed no significant changes. Improved irrigation, availability and access to high-

yielding and disease-resistant varieties, huge subsidies on water, power and other inputs, and assured output prices and procurement by the government were the main reasons for the shift in cropping pattern in favour of fine cereals. The cropped area under commercial crops and oilseeds had increased only slightly; this showed poor commercialisation of agriculture in the state —this was because agriculture was less market-oriented in UP than in Haryana and Punjab.

The performance of agriculture in UP varies from region to region. The Western region is agriculturally the most progressive region; the largest chunk of the state's agriculture output comes from this region (around 50 per cent). The eastern region contributes around 28 per cent, next to western region, in the total value of the state's agriculture output. The Bundelkhand accounts for only 4 per cent of the state's gross value of agriculture output. Agriculture in Bundelkhand region was vastly rain-dependent, diverse, complex, under-invested, risky and vulnerable mainly because of its geographical condition. The average foodgrain yield in the western region was 2577 kg per hectare, which is much higher in comparison to other regions, particularly Eastern (1997 kg per ha) and Bundelkhand region (1067 kg per ha). Availability of Irrigation and use of fertilisers were the major determinants of the variation in agriculture productivity across regions (**Narain et al., 2001; Pandey and Reddy, 2012**).

1.3 Objectives of the Present Study

The study objectives encompass both micro (farmer level) as well as macro aspects of the study theme

1.3.1 FARMER LEVEL OBJECTIVES

I. To estimate the current income level of the farmers in various agro-climatic zones of Uttar Pradesh and its composition (land holding size-wise, social class wise, etc.).

II. To understand the constraints faced by the farming community (including the distress situations, their frequency) that limit their opportunities for income enhancement.

III. To study the constraints, opportunities and support required for diversification of activities at the farmer level, especially towards allied, off farm and non-farm activities.

IV. Estimation of farm economics and financial requirement (including bank loan) to double farm income (by 2022) and strategies to meet their financial requirement, if any.

V. The extent of assistance received from the Centre/State/PRIs by the farming community and the hindrances in getting the benefits, if any.

VI. Support/facilities/policy etc. required to double the farmers' income by 2022 (farmer's view).

1.3.2 MACRO LEVEL OBJECTIVES

I. Evolve the state-specific strategy for doubling the income of farmers taking into account farmers' needs and the constraints.

II. Suggest sector specific broad interventions (especially on irrigation, soil health, warehousing, cold-chains, value addition, marketing, allied activities, non-farm/off-farm sectors, wage employment, etc.) to be implemented with appropriate phasing.

III. Study the trend in investment in major sectors (especially infrastructure), and suggest investment requirements, year wise phasing and expected outcomes.

IV. Outline the involvement of major development partners in the state, suggest partnerships, stakeholders, channel partners in the endeavour and their extent, and convergence required.

V. Give the roadmap/action plan for the implementing agency/stakeholder for each intervention.

1.4 ORGANIZATION OF THE REPORT

The rest part of this report is as follows: Chapter II discusses different theoretical options for the farmers' income growth. Chapter III elaborates sampling design of the study and discusses demography characteristics, and features of farming such as cropping pattern, principal crops, etc. Chapter IV presents the estimates of household income of agriculture households and its composition. Farmer level objectives are discussed in this chapter. Chapter V discusses the possible strategy for doubling the income of agricultural households. Chapter VI concludes the study and elaborates different policy actions.

Figure 1-1: Foodgrain Production (In thousand ton) from Major States in India
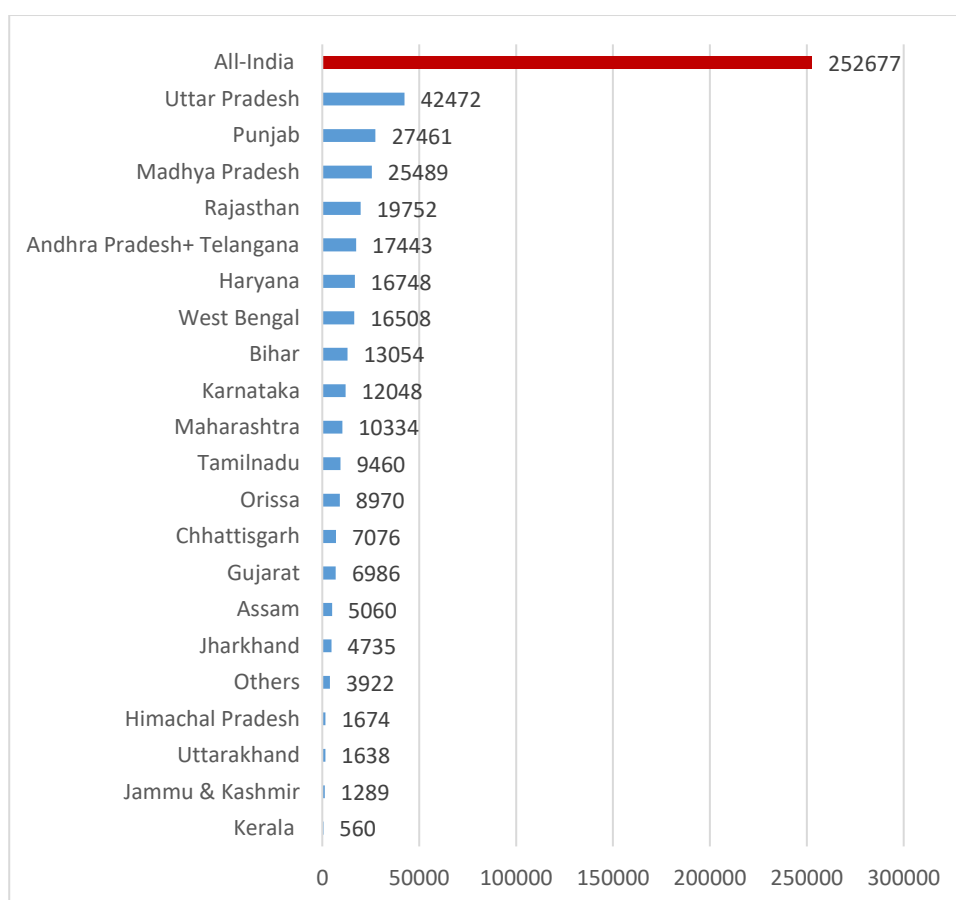
Source: Author's own calculation based on data collected from Agriculture Statistics at a Glance (2016).

Figure 1-2: Average Monthly Income (In Rs.) of Agricultural Household during 2012-13 for Major States
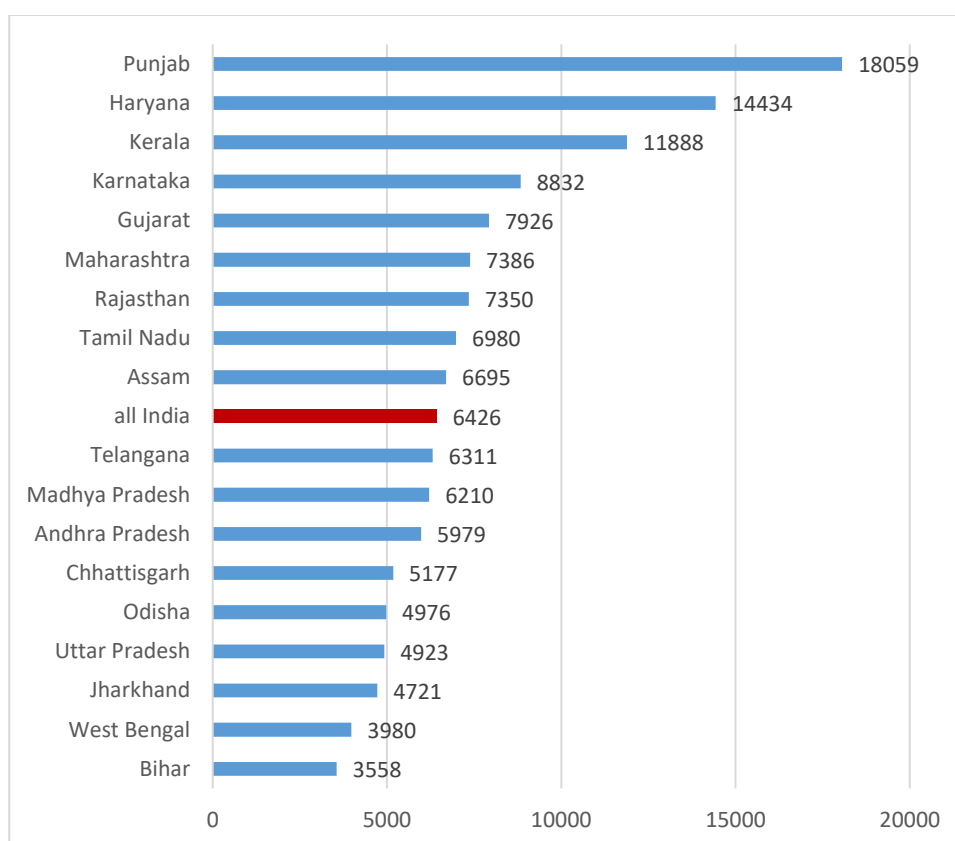
State	Income
Punjab	18059
Haryana	14434
Kerala	11888
Karnataka	8832
Gujarat	7926
Maharashtra	7386
Rajasthan	7350
Tamil Nadu	6980
Assam	6695
all India	6426
Telangana	6311
Madhya Pradesh	6210
Andhra Pradesh	5979
Chhattisgarh	5177
Odisha	4976
Uttar Pradesh	4923
Jharkhand	4721
West Bengal	3980
Bihar	3558

Source: 70th Round National Sample Survey on Situation Assessment of Agricultural Households.

Figure 1-3: Average Monthly Net Income (In Rs) from Cultivation of Agricultural Household during 2012-13 for Major States
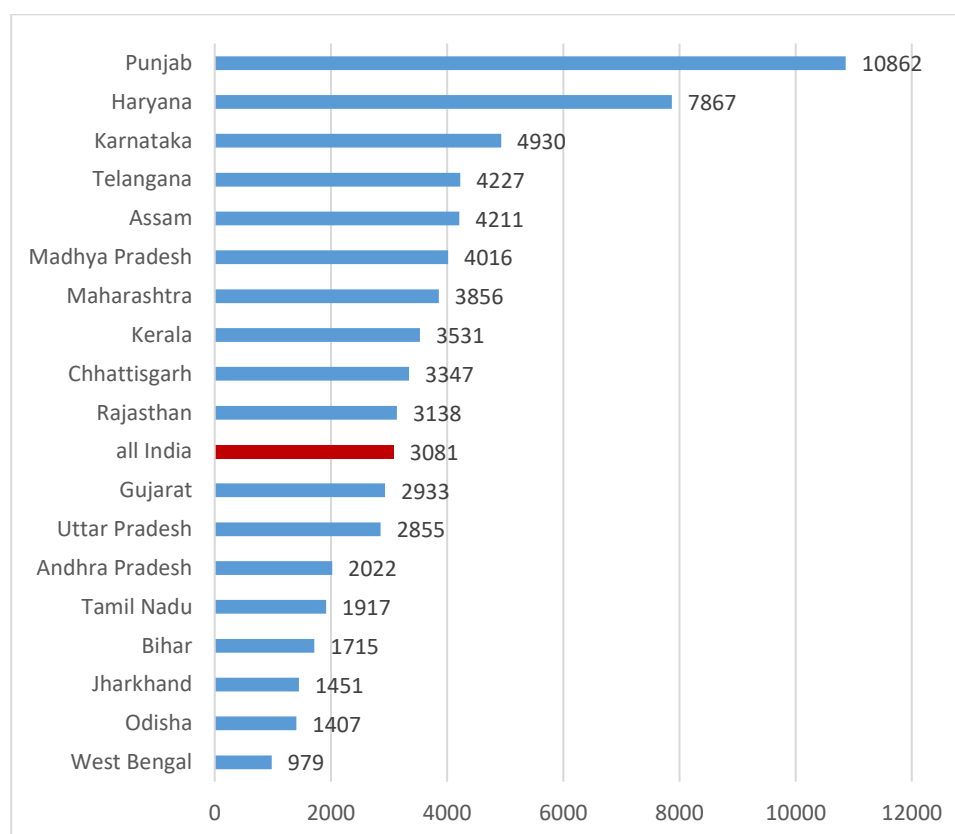
State	Value
Punjab	10862
Haryana	7867
Karnataka	4930
Telangana	4227
Assam	4211
Madhya Pradesh	4016
Maharashtra	3856
Kerala	3531
Chhattisgarh	3347
Rajasthan	3138
all India	3081
Gujarat	2933
Uttar Pradesh	2855
Andhra Pradesh	2022
Tamil Nadu	1917
Bihar	1715
Jharkhand	1451
Odisha	1407
West Bengal	979

Source: 70th Round National Sample Survey on Situation Assessment of Agricultural Households.

Figure 1-4: Average Monthly Net Income from Animal Husbandry of Agricultural Household during 2012-13 for Major States
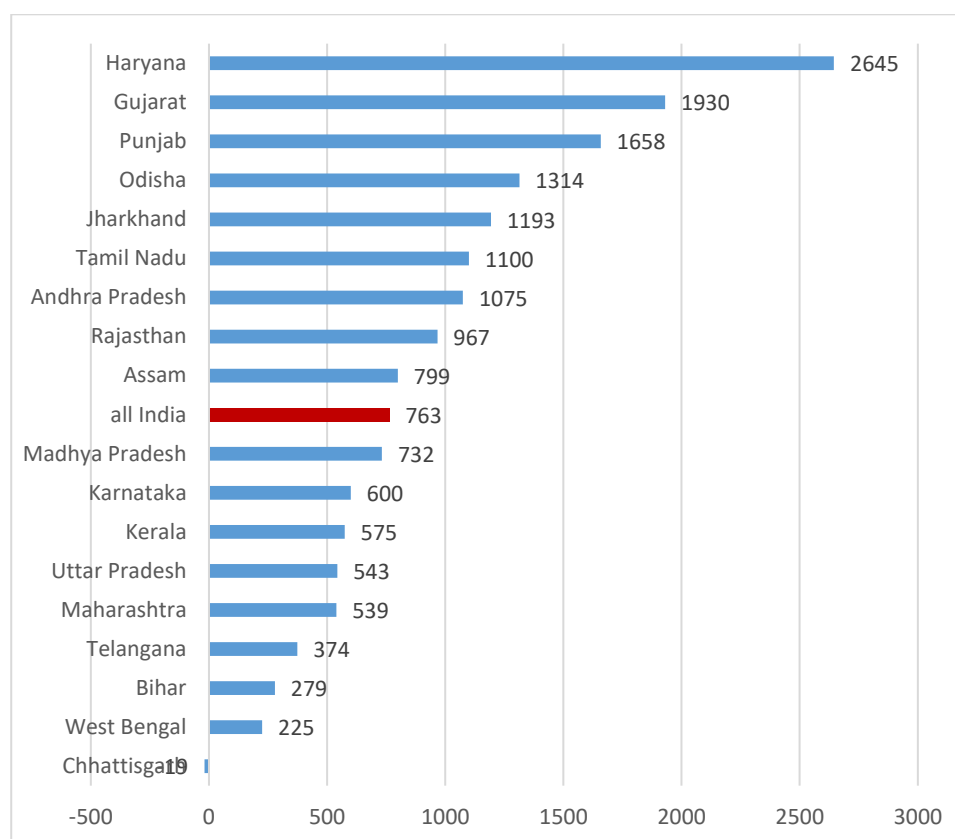
State	Value
Haryana	2645
Gujarat	1930
Punjab	1658
Odisha	1314
Jharkhand	1193
Tamil Nadu	1100
Andhra Pradesh	1075
Rajasthan	967
Assam	799
all India	763
Madhya Pradesh	732
Karnataka	600
Kerala	575
Uttar Pradesh	543
Maharashtra	539
Telangana	374
Bihar	279
West Bengal	225
Chhattisgarh	19

Source: 70th Round National Sample Survey on Situation Assessment of Agricultural Households.

Table 1-1: Crop-wise Largest Producing States in India

Foodgrains	Rice	Wheat	Coarse cereals
U.P. (19.80)	West Bengal (15.60)	U.P. (34.72)	Maharashtra (16.67)
Punjab (12.36)	Andhra Pradesh (13.16)	Punjab (19.14)	Karnataka (16.51)
Madhya Pradesh (7.34)	U.P. (12.70)	Haryana (13.20)	Rajasthan (15.26)
Pulses	**Oilseeds**	**Cotton**	**Jute & Mesta**
Madhya Pradesh (27.33)	Madhya Pradesh (27.78)	Gujarat (32.40)	West Bengal (78.28)
Maharashtra (13.77)	Rajasthan (18.22)	Maharashtra (22.92)	Bihar (11.26)
U.P. (13.34)	Gujarat (13.52)	Andhra Pradesh (14.68)	Assam (6.36)
Sugarcane	**Potato**	**Onion**	
U.P. (39.18)	U.P. (35.99)	Maharashtra (29.84)	
Maharashtra (21.62)	West Bengal (24.63)	Karnataka (17.22)	
Tamil Nadu (10.83)	Bihar (14.65)	Gujarat (9.61)	

Note: The value given in parentheses is state's share (in percent) to all-India production.
Source: Author's own calculation based on data collected from Agriculture Statistics at a Glance (2016).

Figure 1-5: Trend in Plan Expenditure on Agriculture and Allied Sector and Irrigation
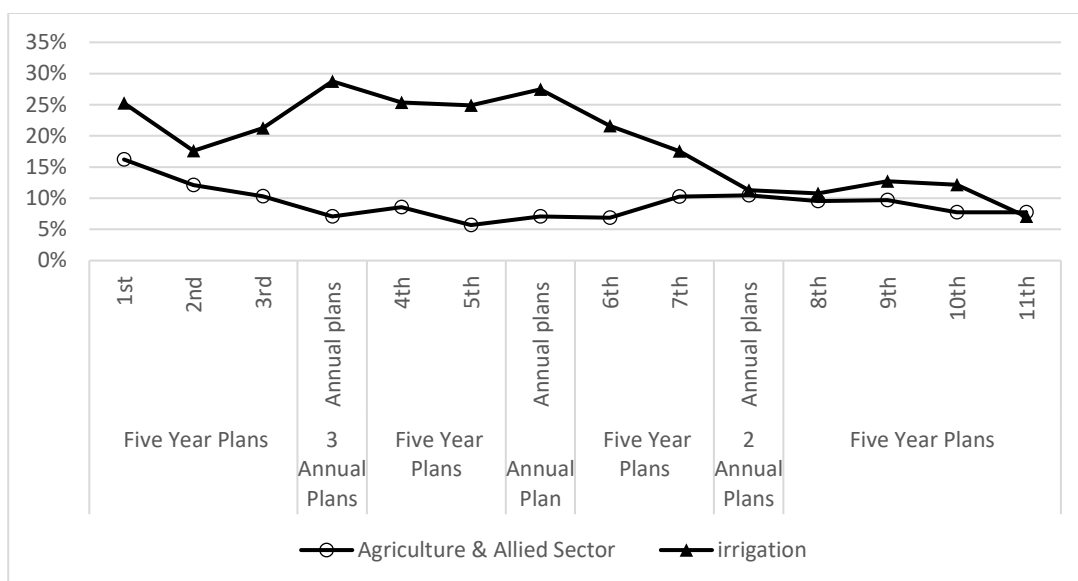
Source: Planning Department, Government of Uttar Pradesh, Lucknow.

Figure 1-6: Average Operation Land Holdings in U.P. and India
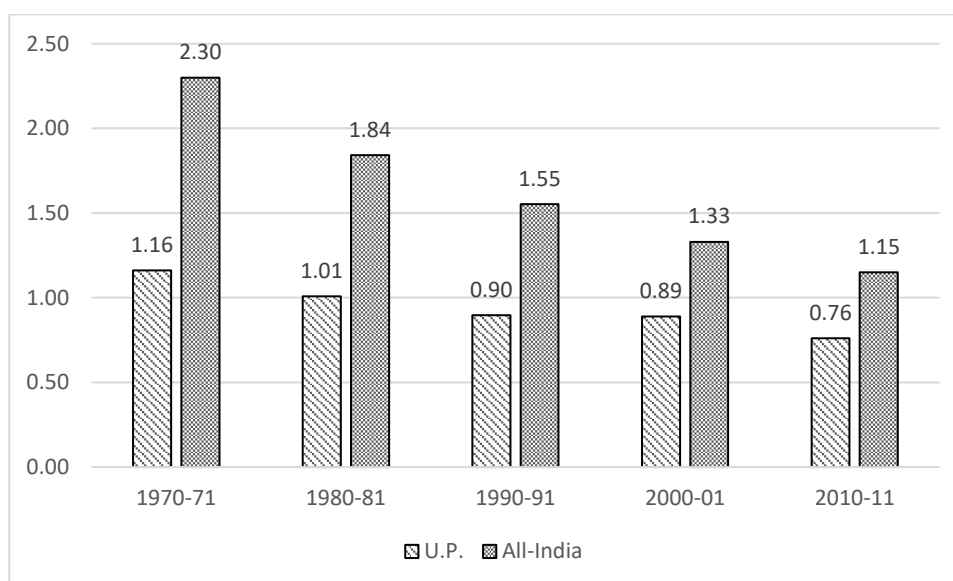
Source: Agriculture Census, Ministry of Agriculture, Government of India, Delhi.

Table 1-2: Profitability of the select crops in UP and two other major producing states

Crops	Period	U.P.	State A	State B
Rice	1996-98	2525.81	16660.95	438.76
	2000-02	76.21	-2927.19	380.45
	2004-06	-428.80	-1838.25	3926.34
	2008-10	7009.53	1303.56	10516.92
Wheat	1996-98	5425.05	4895.19	6114.94
	2000-02	3567.99	8751.40	6904.68
	2004-06	1618.24	6870.61	5516.22
	2008-10	8610.14	12978.30	16048.43
Sugarcane	1996-98	13310.33	9071.51	NA
	2000-02	12142.19	-53.955	25100.79
	2004-06	24925.94	18231.03	22334.63
	2008-10	47898.81	51922.43	51532.63

Note: (i) State A and B are West Bengal and Andhra Pradesh, respectively, for rice, Punjab and Haryana for wheat and Maharashtra and Tamil Nadu for sugarcane. (ii) All above figures are in Rs per hectare.
Source: Author's own calculation based on information collected from the annual reports of Commission of Agriculture Cost and Price (CACP), Ministry of Agriculture, Government of India, New Delhi.

Table 1-3: Percentage of Rural Population below Poverty Line in Select States

Year	U.P.	Haryana	Punjab	All India
1993-94	48.40	35.9	22.40	45.30
2004-05	40.90	24.1	20.90	37.20
2011-12	30.40	11.64	7.66	25.74

Note: (i) All above figures are in percent. (ii) All above poverty estimates were calculated by Planning Commission using Tendulkar Methodology.
Source: Planning Commission, Government of India, New Delhi.

Figure 1-7: Changing contribution of different sub-sectors in agriculture GDP
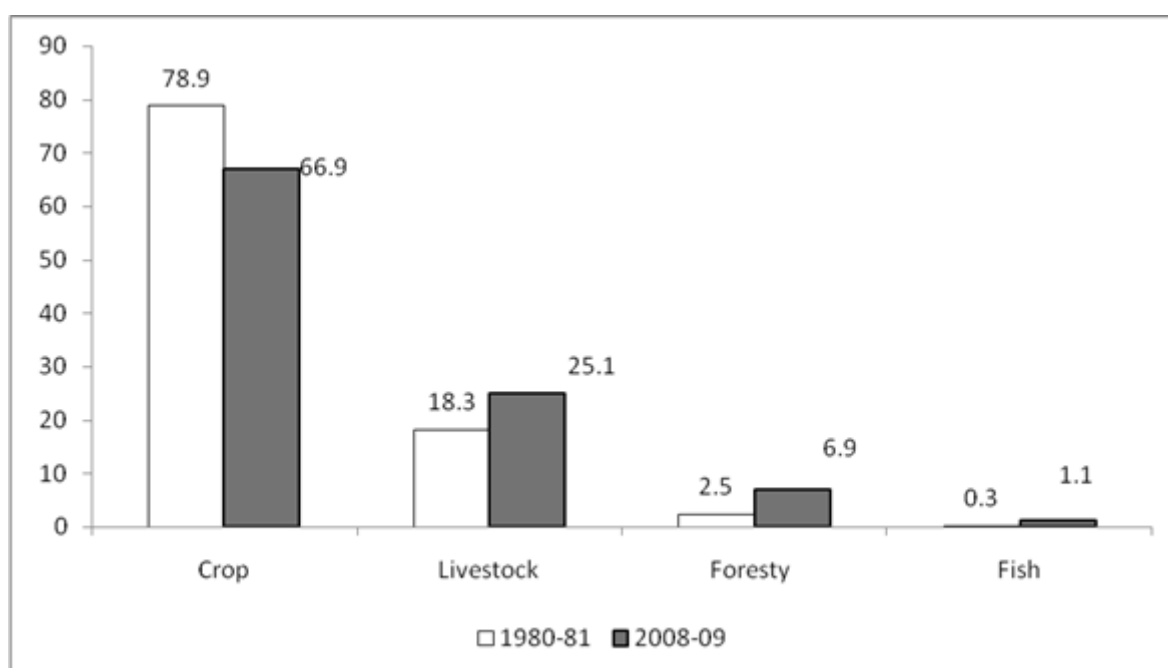
Note: All figures are in percent.
Source: Author's own calculation based on data collected from Central Statistical Organisation, New Delhi.

Table 1-4: Changing cropping pattern (in per cent) in UP since 1982

GROUP	TE1982-83	TE1991-92	TE2001-02	TE2007-08
PADDY	36.02	23.14	25.40	24.72
WHEAT	32.96	37.06	39.22	39.99
COARSE CEREALS	13.31	12.12	10.30	9.40
CEREALS	82.29	72.32	74.92	74.11
PULSES	11.11	12.77	11.40	10.09
OILSEEDS	1.58	5.16	3.59	4.23
COMMERCIAL CROPS	5.02	9.74	10.09	11.57

Source: Author's own calculation based on data collected from various issues of *Uttar Pradesh ke Krishi Ankare* and UP Development Report.

Figure 1-8: Regional dispersion of income across years
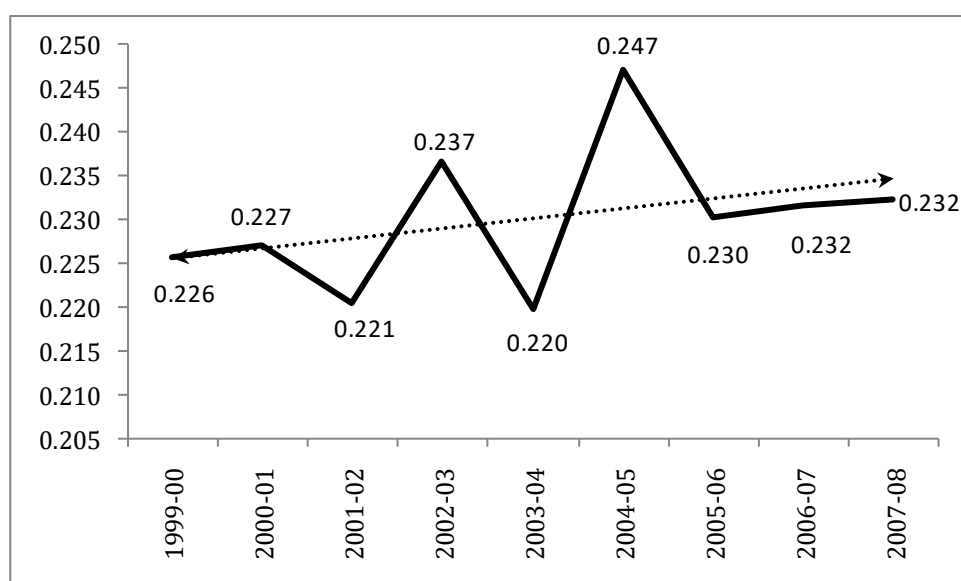
Source: Author's own calculation using information collected from the Directorate of Economic and Statistics, Government of Uttar Pradesh, Lucknow.

2   THEORY OF FARMERS' INCOME

This chapter synthesises the existing literature and provides a theoretical foundation for the study on farmers' livelihood. A livelihood is more than just income (**Lipton and Maxwell, 1992**) as it includes income (both cash and kind), as well as the social institutions, gender relations, property rights required to support and to sustain a given standard of living, and access to, and benefits derived from social and public services provided by the state such as education, health services, roads, water supplies, and so on (**Ellis, 1998; Davies and Hossain, 1997; Bryceson, 1996; Hart, 1995; Blackwood and Lynch, 1994; Lipton and van der Gaag, 1993; Berry, 1989; Dwyer and Bruce, 1998**). Livelihood based on an identical portfolio of activities always seems risky. **Ellis (2000)** observed that diverse rural livelihoods were less vulnerable. Hence, livelihood diversification is suggested as a strategy of livelihood security. It is defined as the process by which the rural families construct a diverse portfolio of activities and social support capabilities in order to survive and improve their standards of living (Ellis, 1998).

Keeping these views in mind, one can follow the combination of two measures for increasing the farmers' income. The first measure would belong to the agriculture sector itself, but the second measure would belong to the non-agriculture sector. Chand (2017) has also discussed the action plan for doubling the farmers' income by 2022 on the same line. Chandrasekhar and Mehlotra (2016) believe that focusing only on income from cultivation for facilitating income growth will not have the desired outcome.

Here, it is also important to note that a common strategy for all farmers in the State would not work. Identification of low-income farmers and their location would be important in designing the policy inputs for farmers' welfare (Birthal et al. 2017).

2.1 SOURCES OF INCOME GROWTH WITHIN AGRICULTURE SECTOR

To understand the sources of income growth operating within the agriculture sector, let's assume that there is a farmer 'X', who produces rice. According to economic theory, income of farmer 'X' from farming of rice depends on both his total revenue and total cost, as explained by Equation 1.

$$I = TR - TC \qquad \qquad ...(1)$$

where, I = Income, TR = Total revenue, and TC = Total cost.

Equation 1 illustrates that income of farmers 'X' from cultivation of paddy can be increased either by increasing total revenue or by decreasing total cost of paddy cultivation or by both. First, we discuss how total revenue can be increased, then we will focus on total cost.

Total revenue is basically determined by price of rice received by the farmer and the total quantity of the marketed surplus. Equation 2 depicts the relation among these three components. Realization of a higher price would lead to a higher total revenue. However, realization of remunerative price depends on the agriculture marketing system. An efficient marketing system provides assurance of remunerative price to the farmers (**Acharya, 2004**).

$$TR = P_R \times Q_{MS} \qquad \qquad ...(2)$$

where, P_R = Price received by farmer 'X', and Q_{MS} = The quantity of marketed surplus of rice.

Another important factor in the total revenue earning is the quantity of the marketed surplus, as is reflected from Equation 2. There are two concepts of surplus often used in agriculture economics – *One,* Marketable surplus, and *Two,* Marketed surplus.

Marketable surplus refers to the quantity of produce that farmer has available for disposal after caring all his needs (own family consumption, seed, feed, and payment of wage in kind) and wastage, whereas marketed surplus is that part of marketable surplus which is actually made available to the market. But, it is not necessary that marketed surplus will always be lesser than or equal to marketable surplus. In some situations, marketed surplus could be more than marketable surplus (**Kumar et al. 2013; Alagh, 2014**). Such situations arise when the farmer retains a smaller quantity of the produce than his actual requirement

for family and farm needs. This holds true especially for small and marginal farmers, whose need for cash is more urgent and immediate. This situation of selling more than marketable surplus is termed as distressed or forced sale (**Sadhu and Singh, 2012**). Keeping these facts in mind, marketed surplus can be defined as:

$$Q_{MS} = P_D - (C_F + S + F + P_W + W + R - D_S) \qquad \text{... (3)}$$

where, P_D = Quantity of production, C_F = Quantity of the produce held for own family consumption, S = Quantity of the produce held for use as seed in next season, F = Quantity of the produce held for feeding animal, P_W = Quantity of the produce used to pay wage in kind, W = Quantity of the produce wastage in transportation and storage, R = Quantity of the produce repurchased, and D_S = Quantity of the produce sold in distress.

Equation 3 clearly indicates the marketed surplus is positively related to production. It means that higher the production, higher would be the marketed surplus. It is also reflected from the equation that the marketed surplus is adversary related to wastage, indicating that lower wastage would beget higher marketed surplus. The quantity of the marketed surplus is largely determined by the quantities of production and wastage because other factors mentioned in the Equation 3 are the necessities of the farmer. Production quantity of a crop depends upon its area under cultivation and its yield (Equation 4). Since land is a limiting factor, there is a little scope for expansion of cultivated area (**Birthal et al., 2017**). Therefore, the focus needs to be on crop yield, which, itself, relies on technical progress and improvement in technical efficiency (Birthal et al., 2017; **Coelli and Rao, 2005**). Public investment in agriculture research and extension plays critical role here both in technological progress and technical efficiency (**Rosegrant and Evenson, 1992**).

$$P_D = A \times Y \qquad \text{... (4)}$$

where, P_D = The quantity of production, A = Cultivated area under the crop and Y = Yield of the crop.

On the other hand, the second key component of the marketed surplus is the quantity of wastage. It is determined by the availability of better infrastructure to connect farmers to the markets, effective and efficient value chains that provide sufficient incentives at the producer level, and opportunities to adopt collective marketing and better technologies (**Hodges et al., 2011; Affognon et al., 2015**).

Another important component in the farmers' income is the cost of cultivation. Farmers' income can be increased by controlling the cost of cultivation. Data provided by the Commission of Agricultural Cost and Prices (CACP) indicate continuous rise in the cost of cultivation of all principal crops in the country. It was noted that increase in the cost of cultivation was higher in the post-reform period in comparison to pre-reform period when input subsidy was provided (**Raghavan, 2008**). Here, one can suggest input subsidy as a step of restricting cost of cultivation. But everyone would not agree with this measure given its certain adverse implications, such as excess use of inputs, which leads to degradation of natural resources like soil fertility and groundwater etc., fiscal burden on states, etc. Efficient input use coupled with access to input and output market, and adoption of resource conservation techniques such as zero-tillage, direct-seeded rice etc. are effective in rationalizing the cost of cultivation (**Satyasai and Mehrotra, 2017; Coelli et al. 2002**).

2.2 SOURCES OF INCOME GROWTH OUTSIDE AGRICULTURE SECTOR

In India, there is an over-dependence on the agriculture sector for the livelihood as it accounts for about 14 per cent of Gross Domestic Product and engages more than 60 per cent of the total workforce. This shows significant underemployment. Shifting workforce away from agriculture can play a crucial role in enhancing the farmers' income (**Vaidyanathan, 1983; Hazell and Haggblade, 1990; Ranis et al., 1990; Lanjouw and Sharif, 2000; Lanjouw and Lanjouw, 2001**). But the question is 'where to engage the surplus labour?'. This is a difficult question for India where rural manufacturing sector is miserable. Value addition to agriculture can be a good option given its several advantages, such as no requirement of specific skill, small to tiny investment, and the direct market for the farmers who produce raw materials, etc.

Labour allocation decisions in farm and non-farm sector in rural settings depends upon the absorption capacity of the rural non-farm sector, which itself depends on the rural infrastructure and easy access to credit markets. **Escobal (2001)** has noted in rural Peru that access to public goods and services (*i.e.* roads, electricity etc.) and adequate endowment of the private assets (especially education and credit) are the important determinants of access to the rural non-farm sector income. **Reardon et al. (2001)** also arrived at a similar conclusion that education and access to infrastructure (roads, electricity, communication etc.) are crucial determinants of rural non-farm employment and rural non-farm income. Here, it is important to note that education does not have a homogenous impact – it varies

from primary to tertiary level of education. Primary education has a positive impact on income of subsistence farmers, whereas post-primary education affects the income of commercial farmers (**Yunez-Naude and Taylor, 2001**). Advanced schooling provides an opportunity to increase wage employment.

Summing-up, for doubling the farmers' income focus on agriculture sector alone may not be adequate since factors outside of agriculture sector play a critical role in accelerating the farmers' income This chapter underscores that the major factors affecting the farmers' income are productivity (yield); technology adoption and technical inefficiency; prince realization; agriculture logistics; and cost of cultivation. The factors outside agriculture that impact the farmers' income are rural non-farm sector, value addition to agriculture, rural infrastructure and education and skill development.

3   SAMPLES & SAMPLING PROCEDURES

Uttar Pradesh (UP) is the most populous state in India with 16.16 per cent of India's total population (**Census 2011**). In terms of area, it is the fourth largest state in the country. Its geographical area is about 241000 square km. As per Census 2011, it has a population of 19.98 crore, an increase from 16.62 crore in Census 2001, even though there has been a decline in its population growth rate. Its population growth was 20.23 per cent in the period 2001 – 2011, while it was 25.80 per cent during the period 1991 - 2001. The share of the state population in the country's total population increased to 16.50 per cent in 2011 from 16.16 per cent in 2001. Of the state's total population, about 78 per cent people live in rural areas. Though the state's rural population is much larger than its urban population, the population in urban areas is rapidly growing. In this decade, the population growth in the rural area was about 20 per cent, whereas in urban areas it was 29 per cent. This refers to increasing urbanization in the state.

There were 912 females per 1000 males in 2011 at the aggregate state level; It was about 898 in 2001. Improvement in sex ratio was observed consistently in both rural and urban areas. However, a minor difference in the sex ratio of urban and rural regions was noted. In urban areas, 894 females per 1000 males were counted in 2011, whereas this estimate was about 918 for rural areas.

Literacy rate in Uttar Pradesh shows an upward trend. It increased to 67.68 per cent as per 2011 population census from 56.27 per cent in 2001. But there exists a significant gender gap in literacy. The state's male literacy stands at 77.28 per cent while female literacy is 57.18 per cent. In 2001, the male and female literacy rate was 68.82 per cent and 42.22 per cent, respectively. Similarly, the literacy rate is higher in the urban areas in comparison to the rural areas.

3.1   SAMPLING PROCEDURES

For this study, primary information was collected from a sample of 1200 agricultural households. The multi-stage sampling procedure was followed in the selection of sample households.

UP is divided into nine agro-climatic zones (Figure 3.1). Of these, six zones were selected for the purpose of the study following the criterion of agricultural productivity. Nine agro-climatic zones of the state can be divided into three categories of agricultural productivity – High, Medium and Low (Table 3.1). Western plain, southwestern semiarid, mid-western, and Tarai and Bhabhar zones fall under the category of high agricultural productivity. Three zones (mid plain or central, northeastern plain and eastern plain) fall under the category of a medium range of agricultural productivity. Vindhyan and Bundelkhand zones come under the category of low agricultural productivity. From the first category of zones, two zones with the highest level of agricultural productivity were chosen. These are the western plain and southwestern semi-arid zone. The highest level of agricultural productivity was observed in these two zones. From the second category of agro-climatic zones, all three zones were chosen for the purpose of the study as there was negligible difference in the agricultural productivity across these zones. Finally, Bundelkhand zone was chosen from the third category of agro-climatic zones because it has the least agricultural productivity.

After the selection of agro-climatic zones, one sample district was chosen from each of the sample zones (Figure 3.2). The district's vulnerability to climate change was considered in the selection of sample districts because several crops have started experiencing the adverse impact of climate change. It highlights the need for the climate-resilient agricultural development in the state. First, a vulnerability index was calculated for each district of the state using indicator approach (Figure 3.3) and then the districts in their respective agro-climatic zones were arranged in the ascending order of the value of vulnerability index. The district that fell at the median level of vulnerability in each zone was finally selected for the purpose of this study (see Table 3.2). The district with a median level of vulnerability was chosen as it helps to avoid the selection of districts with extreme cases of climate change vulnerability. However, sample districts selected from different agro-climatic zones have different levels of vulnerability to climate change. Six selected districts were Lalitpur (Bundelkhand agro-climatic zone), Pratapgarh (Central zone), Varanasi (Eastern plain zone), Gorakhpur (northeastern plain zone), Firozabad (southwestern semi-arid zone), and Ghaziabad (western plain zone).

From each sample district, two blocks were selected randomly and from each selected block, two sets of villages were chosen; each set has two villages. One set of villages was selected on the basis of irrigation ratio and another set of villages was chosen on the basis of

availability of agricultural marketing facilities (See Table 3.2). The sample size of agricultural households assigned to each selected village was decided on the basis of the proportion of its population to the total population of all four villages.

3.2 SAMPLE DISTRICTS

In this study, six districts of UP were chosen for collecting primary information from agricultural households. The following sub-sections provide a brief introduction of each of the sample districts.

3.2.1 VARANASI

Varanasi is situated on the banks of the Ganges. Its total geographical area is about 1526.36 sq. km and its total population is about 31.48 lakh persons. The district with 2063 persons per square km is most densely populated, the state's average population density is 828 persons per square km. Varanasi is famous for handlooms, handicraft, wood toys, and religious tourism. About 73.5 per cent of its total geographical area is cultivated. The net sown area in Varanasi is around 1.14 lakh hectares, of which 62 thousand hectares is sown more than once. About 87 per cent of the cropped area is irrigated. Wheat, paddy, maize, and potato are the major crops of the district.

We had chosen Chiraigaon and Pindra blocks randomly from Varanasi district. Chiraigaon block has 141 villages and a total of 48648 households. Its total population is about 322,652. Of this, 47.24 per cent are females. The literacy rate in the block is about 61 per cent. Pindra block has 191 villages, 40648 households and a total population of about 275679. Of this, 49.39 per cent are females. The literacy rate of Pindra Block is 62 per cent.

3.2.2 GORAKHPUR

Gorakhpur is located on the banks of Rapti and Rohini rivers in the north-eastern part of UP. Its geographical area is about 3483.8 square km. The population of the district is about 37,69,456. Its population density is about 1140 persons per square km, indicating high density. The literacy rate is about 43.3 per cent, which is much lower than the state average. Female literacy in the district is even worse - only 24.4 per cent of females aged seven years and above are literate.

The area is highly prone to floods; data of the past 100 years shows a considerable increase in the intensity and frequency of floods in Gorakhpur district. About 76 per cent of the geographical area is under cultivation. Net area of 2,54,765 hectare is under cultivation, of which more than half is sown more than once. About 80.34 per cent of the cultivated area is irrigated. Of the 19 blocks in the district, 7 blocks (Chargawa, Bhathat, Jungle Kauria, Pipraich, Sardar Nagar and Gola) are covered by canals. Groundwater availability is satisfactory in all the blocks of the district. Landholding type is predominantly small and marginal. Small landholdings and poor irrigation activities have resulted in subsistence farming and economic backwardness.

Campierganj and Belghat blocks were selected randomly for the purpose of the study. Campierganj block is located in the northern region of the district. There are 140 villages in the block and a population of 274914, of which 48 per cent are females. Literacy rate in the block is about 51 per cent. Belghat block is located in the southern region of the Gorakhpur district, far from the district headquarters.

3.2.3 LALITPUR

Lalitpur District is a part of Jhansi Division. The geographical area of the district is 5039 sq. km. The district is divided into six development blocks. It has a population of 1,221,592 as per census of 2011. The population density of the district is very low –about 242 per square km – in comparison to the state average. The climate of the district is sub-tropical, which is characterised by a very hot dry summer and a cold winter.

Lalitpur is one of the most backward districts of India. Agriculture is the major activity in the district and is rainfed. Due to the lack of irrigation facilities, crops are grown mainly in the Rabi season. Therefore, the cropping pattern is dominated by Rabi crops such as wheat, peas etc., that together occupy about 76 per cent of the district's total cropped area.

Bar and Mandawara blocks of the district were selected randomly for the study. Bar block has 93 villages with a total of 29752 households in this Block. Bar has a population of 165179. Of this, 47.31 per cent are females. Literacy rate in the block is about 48 per cent. About 44 per cent population of the block are employed and 52.16 per cent of them are dependent on agriculture. Mandawara block has 136 villages, a total of 26418 households, and the population of 148757. Of this, 47.65 per cent are females. Literacy rate in this block

is 50 per cent. About 44 per cent population in the block was employed, of that 43.54 per cent were entirely dependent on farming.

3.2.4 GHAZIABAD

Ghaziabad is one of the industrial districts of the state. It is near the National Capital Region, which is an advantage for the district. The geographical area of the district is about 1179 sq. km and has a population of 4,681,645. The population density of the district is very high – it is about 3971 persons per square km. Another feature of the district is its urbanization. It is one of the most urbanised districts of UP; about 67.55 per cent of the population lives in urban regions of district.

About 73 per cent of its geographical area is under cultivation. The net sown area is around 1.5 lakh hectares, of which 93 per cent of the cropped area is irrigated. Wheat is the major food grain crop in the district followed by paddy and coarse grains. Sugarcane and potato are other prominent crops grown in the district.

Muradnagar and Hapur blocks were selected randomly from Ghaziabad district for the household survey. Muradnagar block has 65 villages and 25273 households. Its population is about 148580. Hapur block has 116 villages and 51874 households. Its population is about 317004.

3.2.5 FIROZABAD

Like Ghaziabad, Firozabad district also belongs to the western part of the state. The district is divided into nine development blocks. As per the Census of 2011, its total population is about 25 lakh and the population density is about 1038 per sq km. Firozabad's average literacy rate is about 72 per cent. Despite a good literacy rate, the sex ratio of the district is about 875 only.

Paddy, wheat and potato are its major crops. Potato accounts for the largest share of total cropped area in the district. It has helped the district draw private investment in rural infrastructure which reflects from the fact that a large number of cold storages are spread across the nine blocks of the district.

Of the nine blocks, Eka and Tundla blocks were chosen for this study. Two villages were selected from each sample blocks. Eka block has 96 villages, 33471 households, and 202461

population, of which 46.71 per cent are females. Only 59 per cent people in the block are literate. In Tundla block, there are 93 villages. Its total population is about 284173, of which 46.25 per cent are females. About 60 per cent people of the block are literate.

3.2.6 PRATAPGARH

Pratapgarh district is one of the oldest districts of the state. Its total geographical area is about 3,717 square km. The district is divided into 16 development blocks. According to Census 2011, the total population of Pratapgarh district was 3,209,141; of which, 94.54 per cent lived in rural area. We had chosen two blocks - Patti and Rampur Sangramgarh for the study. Patti block has 129 villages; it has the population of 125063, of which 50.51 per cent were females. Rampur Sangramgarh block has 124 villages and population of 159498.

3.3 SAMPLE VILLAGES & THEIR RELATIVE POSITION IN DEVELOPMENT

In this study, a total of 48 villages were surveyed. Name of the sample villages and their corresponding blocks and districts is provided in Table 3.2. To assess the status of socio-economic development in the sample villages, village level information on 24 different indicators of development were collected. These indicators are listed in Table 3.3. Availability of each indicator was inquired during the survey. In case the indicator was available, the value of "1" was assigned against that indicator to the villages. In case the indicator was not available, the value of "0" was assigned against that indicator to the villages. Using this information, a composite index of village development was calculated to see which village was the most developed and which one was the least developed.

To calculate the composite index, the principal component analysis was performed using information collected on 24 indicators. This analysis was done employing 14.1 version of STATA (statistical software). Since all variables were categorical, the usual principal component analysis using this software could be applied. Here, the first correlation matrix was estimated applying tetrachoric correlation. It was used to estimate the correlation coefficients of the binary variables. Then, the principal component analysis was performed using estimated tetrachoric correlation matrix.

Estimated results, presented in Figure 3.4, show that the villages in Gorakhpur and Lalitpur districts were poor in terms of socio-economic development, as half of the sample villages in each of these two districts were found to be at the substandard level of development. On

the other hand, most of the sample villages in Ghaziabad were observed as outstanding in terms of socio-economic development. Villages in Varanasi, Firozabad and Pratapgarh were also better in terms of the socio-economic development than the sample villages of Gorakhpur and Lalitpur districts.

3.4 SAMPLE CHARACTERISTICS

This section discusses the demographic characteristics of the sample of 1200 agriculture households in the following sub-sections.

3.4.1 DEMOGRAPHIC FEATURES

A total of 1200 households were surveyed in this study. The sample included 7712 people; of these, 4323 persons were male and 3419 were female. In terms of the total sample population, Varanasi district was on the top, followed by Firozabad and Gorakhpur (Table 3.4). The smallest sample population was from Pratapgarh. Although, as per Census 2011, the total population of Ghaziabad district was the highest and that of Lalitpur was the lowest amongst the sample districts (Table 3.4). The sex ratio of the sample population was much lower than the ratio given in the Census data for each chosen district, whereas literacy rate and the share of workforce population presented just the opposite picture – estimates based on the sample were more accurate than those based on the Census. Persons of age between 15 and 59 years were considered as workforce population. However, distribution of the non-working population (children and elderly people) showed a similar pattern in both sample and population (Census) estimates (Table 3.5).

The ratio of the female-headed household was much lower in our sample data than what was shown in the Census data for each sample districts (Table 3.6). The difference in the number of female-headed households between sample and Census data was the highest in Pratapgarh and Varanasi and the lowest in Lalitpur district among the sample districts.

3.4.2 OCCUPATIONAL PATTERN

The sample data further showed that cultivation was the main source of occupation as about 58 per cent of the sample population claimed that cultivation was their primary occupation (Table 3.7). However, there was significant variation across different parts of the state. For example, 95 per cent of people in Bundelkhand region, as represented by Lalitpur district, were engaged in cultivation and 26 per cent of the sample population in Firozabad district followed cultivation as the principal source of their livelihood. Livelihood occupation pattern was found to be relatively more diversified in the eastern part of the state represented by Varanasi and Gorakhpur districts than the western and Bundelkhand regions. Within the western region, occupation pattern was found more diversified in Firozabad district than that in Ghaziabad district.

3.4.3 ASSETS OWNERSHIP

Table 3.8 provides information on the ownership of durable goods in the houses. The table indicates that more than 96 per cent of households had basic mobile phones, and 21.42 per cent households had smart mobile phones. Ghaziabad district has the largest number of smart mobile phones with 34 per cent followed by Varanasi, Gorakhpur and Firozabad districts. About 55 per cent of the sample population had television and 13 per cent had radios in their homes. About 43 per cent of households had a motorcycle. It was also observed in the field survey that a good number of households did not have essential goods: only 9 per cent of households had refrigerators, 6 per cent had coolers, 27 per cent had an almirah, and 17 per cent had a sewing machine. About 35 per cent of households did not even have any fans in their homes. At the same time, 86 per cent household had iron cooking pans, 93 per cent of households had furniture, 68 percent had gold and silver jewellery, and 84 per cent had bicycles in their homes.

The presence of the tools and equipment used in farming indicate the household's economic situation. In this perspective, Table 3.9 indicates that the economic condition of the farmers in Uttar Pradesh is not satisfactory. The table shows that the low cost and non-critical tools like *panga,* shovel and fodder cutting machine were the only farm tools available with more than 50 per cent of sample households. Important and critical tools and machinery like tractor, plough, trolley, thresher, irrigation pump and spraying machines were far few in numbers. Like other development indicators, asset ownership was a significant spatial

variation - Ghaziabad district was much better than other districts. In Ghaziabad, 16 per cent farmer had their own tractors, plough, trolley and threshers. While Varanasi, its nearest competitor, was far behind in this regard. The situation of asset ownership of farmers in Pratapgarh district was very disappointing.

3.4.4 SOCIAL STATUS

The largest chunk of sample households belonged to Hindu religion – the share of the Hindu population in the sample was estimated to be more than 95 per cent in all chosen districts except for Ghaziabad, where 91 per cent of the total sample households were of Hindu religion (Table 3.10). In the sample households, the share of the Christian population was meagre and observed in two districts (Firozabad and Lalitpur) only. There was no Christian population in the sample of the remaining districts. Among the Hindu population, the majority of the sample households belonged to the Other Backward Caste (Table 3.11). About 56 per cent of total sample households were from OBC. However, this ratio was significantly different in the sample population of Ghaziabad district. In this district, the Hindu population of the sample equally represented general caste, schedule caste and OBC category. In the sample population, the proportion of scheduled tribes was very low and was confined to four districts: Firozabad, Ghaziabad, Pratapgarh and Lalitpur.

3.5 FARMING CHARACTERISTICS OF THE SAMPLE

3.5.1 MAJOR SEASONS OF AGRICULTURE

Kharif and *Rabi* seasons are the major crop seasons in the state, as was noted from the sample data collected from each sample district. It was also observed from the primary data collected in this study that farmers prefer to keep their land fallow during the *Jayad* season. No farmer was found cultivating any crop during the *Jayad* season in our sample data collected from districts of Firozabad, Pratapgarh and Gorakhpur. In the remaining sample districts (Varanasi, Ghaziabad and Lalitpur), some farmers were observed sowing crops in the *Jayad* season.

Between *Kharif* and *Rabi* season, *Rabi* season was the prime agriculture season. The secondary information on the total cropped area in both the seasons collected from Crop Production Statistics the selected states for the periods 1999-00, 2002-03, 2005-06, 2008-09, 2011-12, and 2014-15 confirms the above pattern (Figure 3.5). As per data, the total

cropped area in Rabi season had increased at a higher rate than that in Kharif season. Cropping pattern in *Rabi* season was more diversified than that in *Kharif* season.

3.5.2 MAJOR CROPS

Tables 3.12, 3.13, 3.14, 3.15, 3.16, and 3.17 give detail of the crops grown in all agriculture seasons in each of the sample districts. These tables contain districtwise information on the number of crops grown in each district. These tables also provide information on the number of farmers engaged in the activity.

Wheat emerged as the major crop in *Rabi* season in all parts of UP. Paddy was the most important crop for *Kharif* season at the aggregate state level. But it was not true in each part of the state, as is reflected from our data. Urad was the principal crop of *Kharif* season in Bundelkhand region of the state. Similarly, bajra was the major crop in Firozabad district. The crop selection is indicative of poor irrigation facility and scant rainfall in these districts.

The second principal crop in both the seasons varies from region to region within the state. Potato and Paddy were the second principal crops in *Rabi* season and *Kharif* season, respectively, in Firozabad. Sugarcane in *Kharif* season and Potato in *Rabi* season were the second principal crop in Ghaziabad. The central part of Uttar Pradesh, represented by Pratapgarh district, showed the unique features. The region practised single cropping system in both the seasons in this district. Bundelkhand region of the state, represented by Lalitpur, had maize and gram as the second principal crop in *Kharif* season and *Rabi* season, respectively. Potato was the second principal crop in *Rabi* season in the eastern Uttar Pradesh as was seen in Varanasi and Gorakhpur districts. There was one dissimilarity in identifying the second principal *Kharif* crop within the eastern region of the state: while Varanasi district cultivates bajra, Gorakhpur grows maize.

3.6 INDEBTEDNESS

The survey showed that about 71 per cent of the total sampled households were indebted, and their largest number belonged to western districts of Ghaziabad and Firozabad (see Figure 3.7). The share of indebted households in these districts was 93 per cent and 82 per cent, respectively. The figure further indicates that a lesser number of sample households were found indebted in the eastern and Bundelkhand districts compared to western and central districts.

3.6.1 SOURCES OF RURAL CREDIT

One good thing noticed across regions in Uttar Pradesh was that institutional sources such as commercial banks and cooperative societies were the largest sources of rural credit (Table 3-18). More than 50 per cent of the outstanding amounts were provided by the financial institutions. In Lalitpur district of Bundelkhand region, these sources account for more than 80 per cent of total loan amount. Nevertheless, non-institutional sources such as relatives and moneylenders were still important sources of credit for agricultural households. About 40 per cent of outstanding amounts came from these sources in each sample districts except for Lalitpur.

3.6.2 PURPOSES OF RURAL CREDIT

It was also noted that about 60 per cent of the indebted farmers had taken the loan for agricultural purposes such as agricultural machinery, fertilisers, seed etc (Table 3.19). In Pratapgarh district of the central region of Uttar Pradesh, about 48 per cent of all loans were taken for non-agricultural purposes.

Figure 3-1: Agro-climatic zones in Uttar Pradesh

Bhabhar and Tarai zone
Western Plain zone
Mid-Western Plain zone
South Western Semi-Arid zone
North Eastern Plain zone
Eastern Plain zone
Vindhyan zone
Bundelkhand zone
Central zone
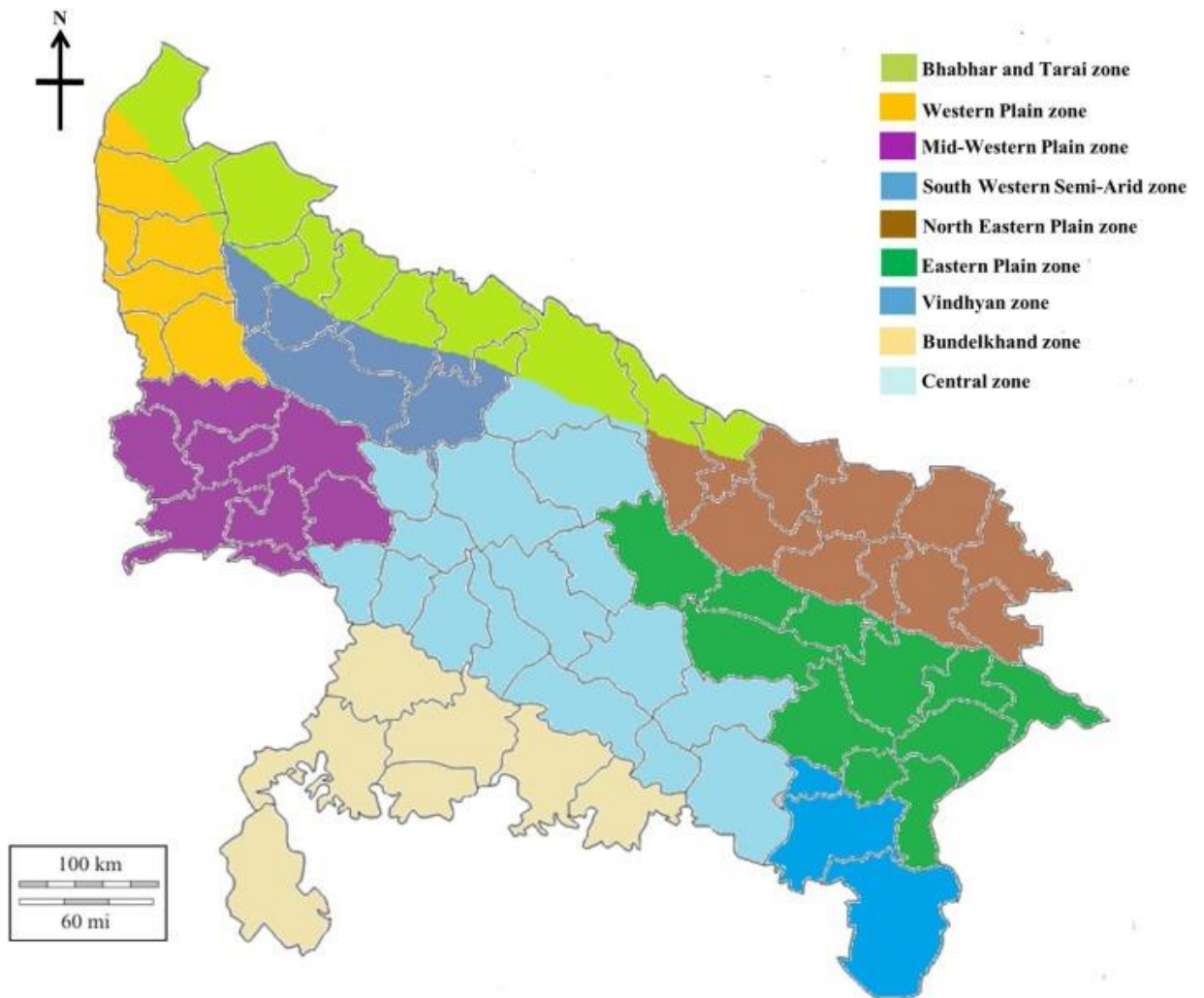
Table 3-1: Categorization of agri-climatic zones on the basis of agricultural productivity

Zones	Productivity of Food-grains (Q/Ha)	Category
Tarai & Bhabhar	25.07	High
Western Plain	31.53	High
Mid- Western	25.17	High
South Western Semi-dry	27.51	High
Mid-Plain/ Central	24.68	Medium
Bundelkhand	14.58	Low
North Eastern	23.24	Medium
Easter n Plain	23.43	Medium
Vindhyan	17.62	Low
Uttar Pradesh	23.66	

Source: NITI Aayog, New Delhi.

Figure 3-2: Sample Districts of the Study in Uttar Pradesh
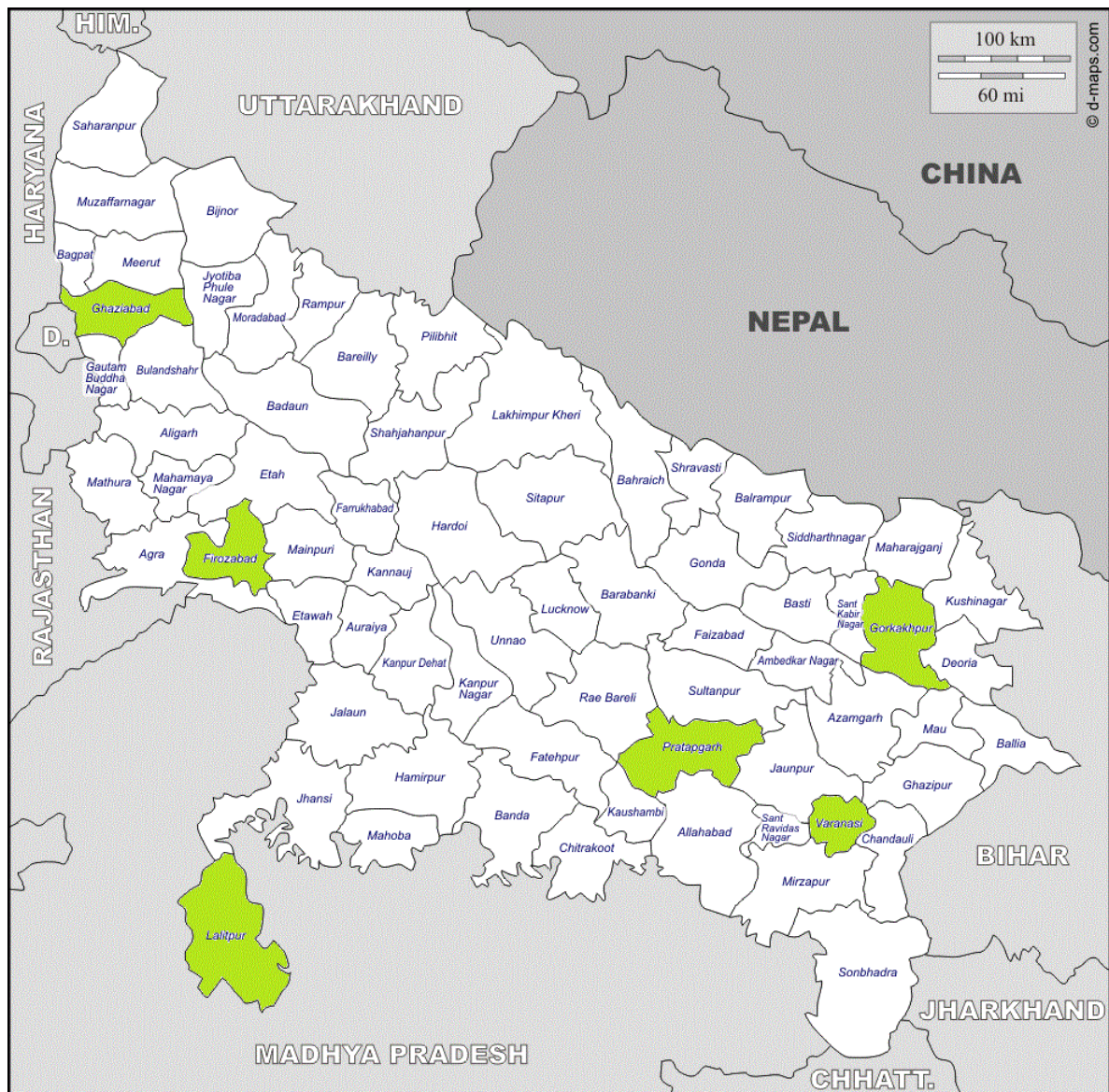
Figure 3-3: Spatial pattern of climate change vulnerability index of Uttar Pradesh
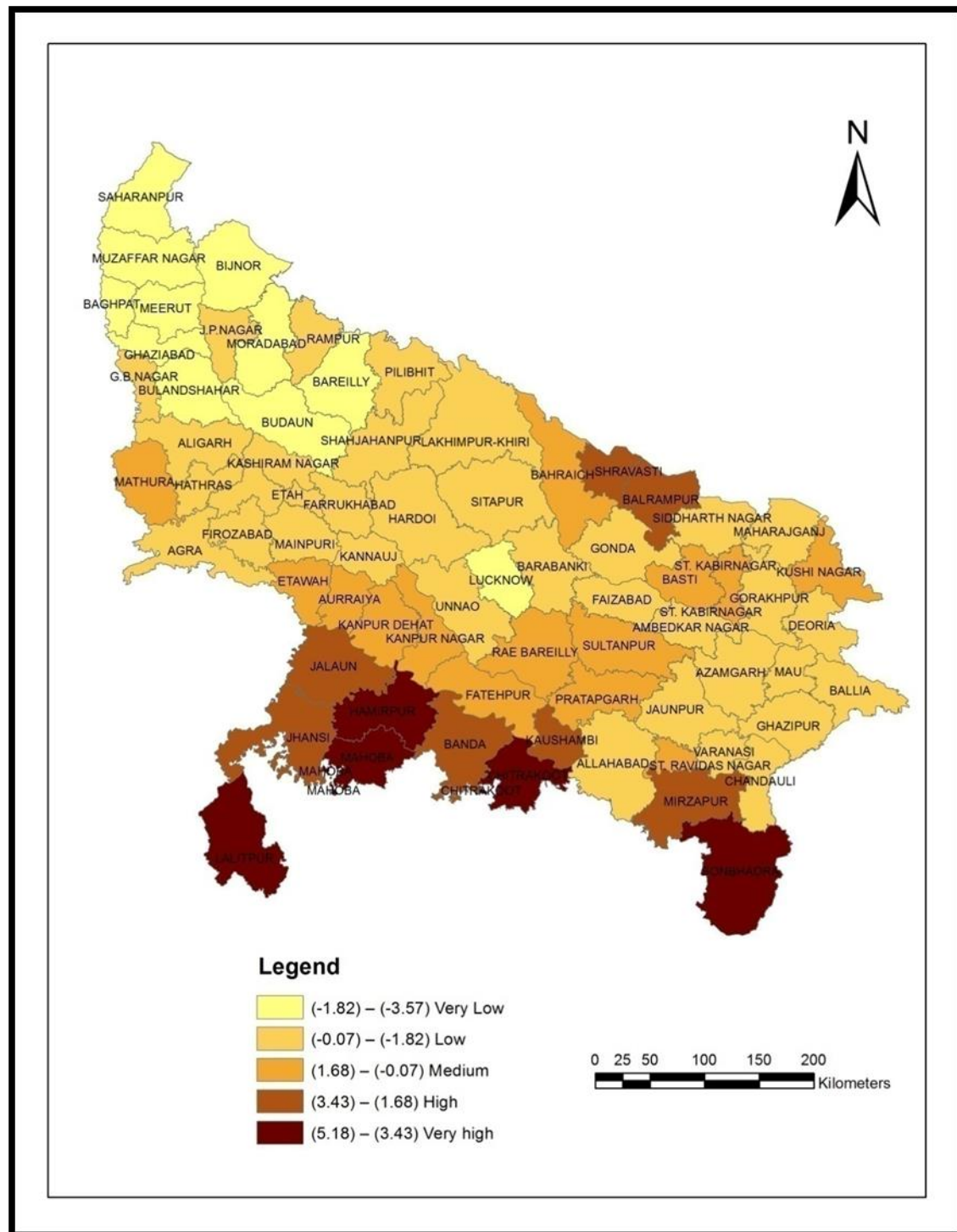
Note: (i) Vulnerability index (VI) is composite index of Exposure (EI), Sensitivity (SI) and Adaptive capacity (ACI) indices. (ii)VI = EI + SI - ACI
Source: Tripathi (2017)

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Table 3-2: Name of sample villages and their primary features

Block	Name of Village	Number of HH (Census 2011)	Agricultural Credit Societies (Distance from Village)	Mandis / Regular market (Distance from Village)	Weekly Haat (Distance from Village)	Agricultural marketing society (Distance from Village)	Total Irrigated Land Area (In per cent)
			1. VARANASI				
Pindra	Rampur	709	0-5 km	10+ km	10+ km	10+ km	89.56
	Maruee	949	10+ km	0-5 km	Yes	Yes	96.10
	Godiya	180	0-5 km	Yes	Yes	Yes	84.58
	Jamalpur	102	5-10 km	0-5 km	10+ km	10+ km	81.59
Chiraigaon	Chamauli	840	Yes	0-5 km	0-5 km	0-5 km	92.16
	Raimala	193	NA	Yes	Yes	5-10 km	98.86
	Goithaha	493	NA	Yes	Yes	Yes	78.65
	Bartharra Gangwar	1	10+ km	5-10 km	5-10 km	10+ km	86.14
			2. GORAKHPUR				
Campierganj	Belama	239	NA	Yes	Yes	Yes	6.58
	Thakur Nagar	929	5-10 km	0-5 km	0-5 km	5-10 km	99.29
	Machhali Gaon	828	0-5 km	Yes	Yes	Yes	81.58
	Jangal Jhajhwa	503	0-5 km	10+ km	10+ km	10+ km	99.15
Belghat	Pharenia Bujurg	66	NA	Yes	Yes	Yes	92.04
	Keradih	28	5-10 km	10+ km	10+ km	Yes	98.41
	Raepur	153	NA	Yes	Yes	Yes	100.0
	Belaw Khurd	698	NA	Yes	Yes	Yes	49.69
			3. FIROZABAD				
Eka	Kodra	705	0-5 km	10+ km	5-10 km	10+ km	100.0
	Madhipur	230	5-10 km	5-10 km	5-10 km	Yes	60.73
	Hathooli Jaisinghpur	205	0-5 km	10+ km	5-10 km	10+ km	96.96
	Garhi	206	NA	0-5 km	Yes	Yes	100.0
Tundla	Pratapur	118	Yes	Yes	Yes	Yes	100.0
	Ramgarh Urf Umm	2615	Yes	10+ km	5-10 km	10+ km	100.0
	Jondhri	378	Yes	10+ km	Yes	10+ km	100.0
	Rasulabad	1537	Yes	10+ km	5-10 km	10+ km	88.36

Block	Name of Village	Number of HH (Census 2011)	Agricultural Credit Societies (Distance from Village)	Mandis / Regular market (Distance from Village)	Weekly Haat (Distance from Village)	Agricultural marketing society (Distance from Village)	Total Irrigated Land Area (In per cent)
			4. GHAZIABAD				
Muradnagar	Saunda	1030	5-10 km	Yes	Yes	Yes	100.0
	Khindaura	939	5-10 km	10+ km	Yes	Yes	100.0
	Nabipur	270	0-5 km	5-10 km	5-10 km	Yes	100.0
	Husainpur	287	10+ km	10+ km	5-10 km	10+ km	100.0
Hapur	Sarawa	1004	5-10 km	10+ km	5-10 km	10+ km	100.0
	Tiyala	814	NA	Yes	5-10 km	5-10 km	100.0
	Shekhpur	329	5-10 km	10+ km	0-5 km	10+ km	100.0
	Ayadnagar	540	5-10 km	Yes	Yes	Yes	100.0
			5. PRATAPGARH				
Patti	Saifabad	565	Yes	Yes	Yes	10+ km	25.87
	Kanja Sarai Gulami	461	5-10 km	5-10 km	Yes	5-10 km	100.0
	Asuti	150	0-5 km	Yes	Yes	Yes	71.34
	Thneypur Gopapur	194	0-5 km	10+ km	0-5 km	10+ km	95.88
Rampur Sangramgarh	Kedaura	289	10+ km	Yes	Yes	Yes	100.0
	Kamapatti	673	5-10 km	0-5 km	0-5 km	5-10 km	100.0
	Budhiyapur	235	10+ km	10+ km	10+ km	10+ km	100.0
	Prataprudrapur	53	5-10 km	0-5 km	0-5 km	5-10 km	68.27
			6. LALITPUR				
Bar	Pata Pachaura	84	NA	10+ km	10+ km	10+ km	100.0
	Hanupura	311	5-10 km	10+ km	10+ km	10+ km	99.02
	Jaraoli	263	5-10 km	5-10 km	10+ km	Yes	66.20
	Chidaura	310	NA	Yes	Yes	Yes	100.0
Mandawara	Daulat Pur	48	0-5 km	Yes	Yes	Yes	45.73
	Barchon	283	0-5 km	10+ km	10+ km	10+ km	99.08
	Khutguwan	143	10+ km	10+ km	5-10 km	10+ km	99.86
	Uldana Khurd	187	5-10 km	10+ km	10+ km	10+ km	5.06

Source: District Census Handbook 2011.

Table 3-3: Development indicators

S. No.	Indicators	Abbreviations used in the study
1	Availability of Public Transportation	PUBT
2	Part of Village Inaccessible	INAC
3	Availability of Electricity	ELEC
4	Availability of Normal Quality of Electricity	ELECQ
5	Availability of Internet	INRNT
6	Availability of Police Station	POLST
7	Availability of Fair Price Shop	PDSFS
8	Availability of Market	MARK
9	Availability of Canal	CANAL
10	Availability of Government Tube-well	GTUBWEL
11	Availability of Cold Storage	COLDS
12	Availability of Self-Help Group	SHG
13	Availability of Non-government Organization	NGO
14	Availability of Cooperative	COOP
15	Availability of Water Users Associations	WUAS
16	Availability of Farmer Producers Organization	FPO
17	Availability of Community Sanitation	CSCR
18	Availability of Aganwadi Centre	ICDS
19	Availability of Primary School	PRIMARY
20	Availability of Middle Girls School	MIDLEG
21	Availability of Middle Boys School	MIDLEB
22	Availability of ANM Centre	ANMCN
23	Availability of Primary Health Centre	PHC
24	Availability of Community Health Centre	CHC
25	Availability of Government Maternity Centre	GMC

Figure 3-4: Distribution of village development index across sample villages
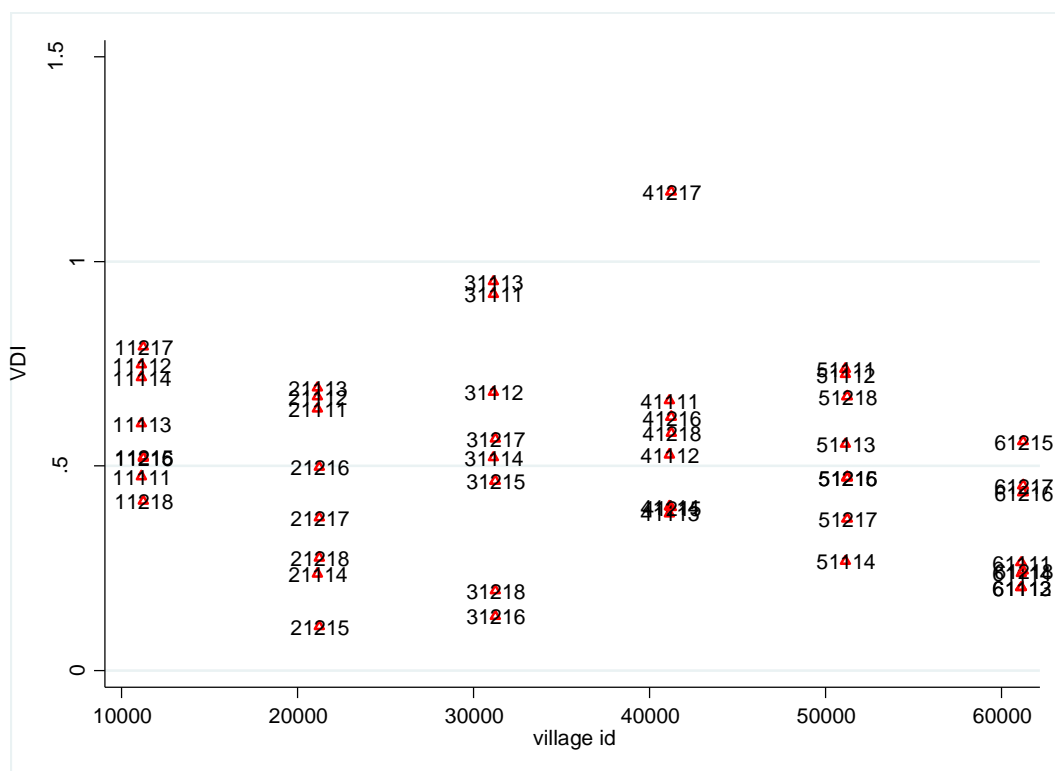
Note: In each sample district, total eight villages were selected for study. Each sample village is marked using Unique Identification Code in this graph, so that identification of village would be easy. Villages with codes from 11111 to 11218 belong to Varanasi district. Similarly, villages with codes from 21111 to 21218 to Gorakhpur, codes from 31111 to 31218 to Firozabad, codes from 41111 to 41218 to Ghaziabad, codes from 51111 to 51218 to Pratapgarh and villages with codes from 61111 to 61218 to Lalitpur district.

Source: Author's own calculation using information collected form agricultural households in Uttar Pradesh.

Table 3-4: District-wise sample population and characteristics

District	Total population		Sex Ratio		Literacy		Workforce (15 - 59)	
	Sample	Census	Sample	Census	Sample	Census	Sample	Census
Varanasi	1440	3,676,841	77.12	91.3	79.38	75.6	0.64	0.33
Gorakhpur	1406	4,440,895	83.79	95.0	76.74	70.8	0.63	0.30
Firozabad	1420	2,498,156	73.80	87.5	72.96	71.9	0.62	0.30
Ghaziabad	1159	4,681,645	79.69	88.1	85.59	78.1	0.66	0.32
Pratapgarh	1123	3,209,141	83.20	99.8	76.22	70.1	0.69	0.33
Lalitpur	1164	1,221,592	81.88	90.6	72.68	63.5	0.59	0.41
Uttar Pradesh	7712	199,812,341	79.64	91.2	77.18	67.7	0.64	0.33

Source: Author's own calculation using information collected form agricultural households in Uttar Pradesh and Census 2011.

Table 3-5: District-wise child ratio

District	Child Ratio (0 - 4)		Children Ratio (5 - 14)		Young Ratio (15 - 59)		60 years and above	
	Sample	Census	Sample	Census	Sample	Census	Sample	Census
Varanasi	0.06	0.08	0.22	0.24	0.64	0.59	0.08	0.08
Gorakhpur	0.08	0.09	0.22	0.25	0.63	0.57	0.07	0.08
Firozabad	0.08	0.10	0.22	0.26	0.62	0.56	0.08	0.07
Ghaziabad	0.07	0.10	0.18	0.22	0.66	0.60	0.08	0.06
Pratapgarh	0.05	0.09	0.20	0.26	0.69	0.56	0.07	0.09
Lalitpur	0.12	0.12	0.24	0.26	0.59	0.55	0.05	0.07
Uttar Pradesh	0.076	0.10	0.21	0.25	0.64	0.56	0.073	0.08

Source: Author's own calculation using information collected form agricultural households in Uttar Pradesh and Census 2011.

Table 3-6: Female Headed Household in Sample

District	Female headed HH	
	Sample Ratio	Census Ratio
Varanasi	0.02	0.14
Gorakhpur	0.04	0.15
Firozabad	0.08	0.10
Ghaziabad	0.03	0.10
Pratapgarh	0.06	0.19
Lalitpur	0.05	0.07

Source: Author's own calculation using information collected form agricultural households in Uttar Pradesh and Census 2011.

Table 3-7: Occupation pattern based on primary occupation

Main Occupation	Varanasi	Gorakhapur	Firozabad	Ghaziabad	Pratapgarh	Lalitpur	Total
Cultivation	56.50	44.50	26.00	74.00	57.00	95.50	58.92
Agriculture Laborer	13.00	4.50	2.00	0.50	1.50	0.50	3.67
Livestock Herder	5.00	0.00	6.00	0.50	0.50	0.50	2.08
Salaried-employment	9.00	8.50	11.50	6.50	8.50	0.00	7.33
Non-Farm businesses	5.00	7.50	14.50	5.00	8.00	0.00	6.67
Artisan	0.00	0.00	4.50	0.00	0.00	0.00	0.75
Casual Labour	11.50	35.00	35.00	12.50	24.50	3.50	20.33
Other (Specify)	0.00	0.00	1.00	1.00	0.00	0.00	0.33
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: Author's own calculation using information collected form agricultural households in Uttar Pradesh.

Table 3-8: Share of households (in %) owing durable goods

Assets	Varanasi	Gorakhpur	Firozabad	Ghaziabad	Pratapgarh	Lalitpur	Total
Car(s)	3.50	2.00	0.50	1.00	1.00	0.00	1.33
Motorcycle	38.50	44.00	49.00	59.00	37.50	29.00	42.83
Refrigerator	6.00	6.50	11.00	24.00	5.50	1.00	9.00
Television	60.50	49.00	69.00	77.00	52.00	25.00	55.42
Fan	72.50	53.00	68.00	94.00	59.50	44.50	65.25
Cooler	4.50	2.50	11.00	18.00	3.00	0.50	6.58
Radio	13.00	4.00	9.00	14.00	12.50	28.00	13.42
Cell phone (Basic)	96.00	98.00	97.50	96.00	97.50	93.00	96.33
Cell phone (smart phone)	26.00	23.50	23.00	34.00	15.00	7.00	21.42
Bicycle(s)	87.50	94.50	86.00	84.00	89.00	67.00	84.67
Gold/jewelry	71.50	77.50	78.00	63.50	42.50	77.00	68.33
Furniture	94.50	100.00	73.00	96.50	92.00	99.50	92.58
Iron cooking pan(s)	75.00	99.50	70.50	98.00	76.00	96.50	85.92
Almirah	29.50	30.50	28.00	51.00	17.50	10.00	27.75
Sewing machine	9.50	15.50	26.00	38.50	10.00	3.00	17.08

Source: Author's own calculation using information collected form agricultural households in Uttar Pradesh.

Table 3-9: Share of households (in %) owing farm assets

Assets	Varanasi	Gorakhpur	Firozabad	Ghaziabad	Pratapgarh	Lalitpur	Total
Panga	42.00	55.50	70.50	46.00	73.00	66.00	58.83
Shovel	98.00	98.50	89.00	99.00	96.50	98.50	96.58
Carts (hauling)	0.00	0.00	1.50	11.00	3.00	0.50	2.67
Tractor	7.00	6.00	3.00	16.50	1.00	3.50	6.17
Plough	6.50	6.00	3.00	16.00	0.50	3.50	5.92
Trolley/Trailers	6.00	5.00	2.50	16.00	1.00	1.00	5.25
Thresher	7.50	4.50	1.50	16.00	0.50	7.00	6.17
Fodder cutting machine	66.00	69.50	69.00	82.50	62.00	39.00	64.67
Generator/Diesel Pumps	10.00	24.50	23.00	27.50	23.00	20.00	21.33
Spraying machines (chem./fertilizer)	2.50	2.50	1.00	18.00	0.50	3.00	4.58
Bulls/oxen	0.50	1.50	2.00	14.50	0.00	1.00	3.25

Source: Author's own calculation using information collected form agricultural households in Uttar Pradesh.

Table 3-10: Distribution of sample households (in %) in terms of religion

	Varanasi		Gorakhpur		Firozabad		Ghaziabad		Pratapgarh		Lalitpur	
	Sample	Census	Sample	Census	Sample	Census	Sample	Census	Sample	Census	Sample	Census
Hindus	95.5	84.52	98	90.28	99	85.69	91	72.93	96	85.11	99.5	95.27
Christians	×××	×××	×××	×××	0.5	0.13	×××	×××	×××	×××	0.5	0.11
Muslims	4.5	14.88	2	9.09	0.5	12.60	9	25.35	4	14.10		2.76
Total	100.0		100.0		100.0		100.0		100.0		100.0	

Source: Author's own calculation using information collected form agricultural households in Uttar Pradesh.

Table 3-11: Distribution of sample households (in %) by the category of caste

	Varanasi	Gorakhpur	Firozabad	Ghaziabad	Pratapgarh	Lalitpur	Total
General	24.0	17.5	18.5	31.5	21.5	11.5	20.8
SC	8.0	23.5	19.5	34.5	11.5	27.5	20.8
ST	×××	×××	0.5	6.0	2.5	1.0	1.7
OBC	68.0	59.0	61.5	28.0	64.5	60.0	56.8
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: Author's own calculation using information collected form agricultural households in Uttar Pradesh.

Figure 3-5: Temporal pattern of cropped area in Kharif and Rabi seasons
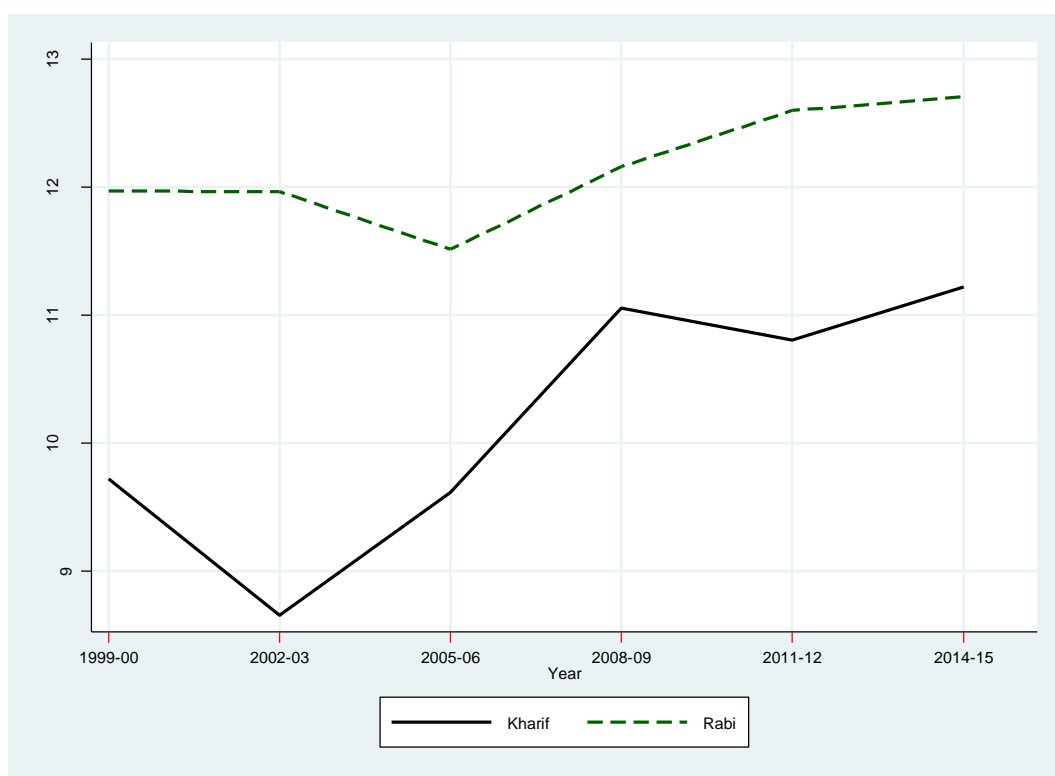
Table 3-12: Crops Grown in Firozabad District in Kharif and Rabi Seasons

Crop	Kharif		Rabi	
	Number	Share (In %)	Number	Share (In %)
Wheat	××	××	184	92
Paddy	54	27	××	××
Bajra	85	42.5	××	××
Maize	22	11	××	××
Millets	42	21	1	0.5
Mustard & Rapeseeds	××	××	17	8.5
Groundnut	××	××	1	0.5
Potato	2	1	80	40
Chili	2	1	1	0.5
Garlic	××	××	14	7
Total	207	103.5	298	149

Source: Author's own calculation based on primary data.

Table 3-13: Crops grown in Ghaziabad district in all seasons

Rop	Kharif		Rabi		Jayad	
	Number	Share (In %)	Number	Share (In %)	Number	Share (In %)
Wheat	××	××	178	89	××	××
Paddy	155	77.5	××	××	××	××
Bajra	5	2.5	××	××	××	××
Maize	8	4	××	××	××	××
Millets	1	0.5	××	××	××	××
Musterd		0	9	4.5	××	××
Potato	1	0.5	11	5.5	××	××
Chilli	1	0.5	××	0	××	××
Arhar	1	0.5	××	0	××	××
bottlegourd	××	0	1	0.5	1	0.5
Cabbage	××	0	1	0.5	××	××
Carrot	××	0	2	1	××	××
Cauliflower	××	0	5	2.5	××	××
Jowar	2	1	××	0	××	××
ladyfinger	2	1	1	0.5	1	0.5
Mango	1	0.5	××	0	××	0
Moong	1	0.5	××	0	1	0.5
Pea	××	0	6	3	××	0
Sugarcane	118	59	××	0	××	0
Urad	3	1.5	××	0	××	0
Fodder	××	0	××	0	1	0.5
Total	195	97.5	317	158.5	5	2.5

Source: Author's own calculation based on primary data.

Table 3-14: Crops grown in Pratapgarh district in all seasons

Crop	Kharif		Rabi	
	Number	Share (In %)	Number	Share (In %)
Wheat	××	××	196	98
Paddy	198	99	××	××
Musterd	××	××	7	3.5
Potato	××	××	7	3.5
Pea	××	××	1	0.5
Amla	1	0.5	××	××
Total	199	99.5	211	105.5

Source: Author's own calculation based on primary data.

Table 3-15: Crops grown in Varanasi district in all seasons

Crop	Kharif		Rabi		Jayad	
	Number	Share (In %)	Number	Share (In %)	Number	Share (In %)
Wheat	××	××	192	96	××	××
Paddy	176	88	××	××	××	××
Bajra	11	5.5	××	××	××	××
Maize	3	1.5	××	××	××	××
Millets	1	0.5	××	××	××	××
Musterd	××	××	6	3	××	××
Potato	××	××	22	11	××	××
Garlic	××	××	3	1.5	××	××
Arhar	5	2.5	××	××	××	××
ladyfinger	××	××	2	1	××	××
Pea	××	××	3	1.5	××	××
Sugarcane	3	1.5	××	××	××	××
Tomato	××	××	10	5	××	××
Brinjal	××	××	1	0.5	××	××
Spinach	1	0.5	1	0.5	××	××
Redish	2	1	2	1	××	××
Pumpkin	××	××	××	××	2	1
Coriander	××	××	2	1	1	0.5
Cucumber	××	××	2	1	××	××
Gram	××	××	6	3	××	××
Lobia	1	0.5	××	××	××	××
Pulse	××	××	××	××	××	××
Onion	××	××	2	1	××	××
Total	203	101.5	254	127	3	1.5

Source: Author's own calculation based on primary data.

Table 3-16: Crops grown in Gorakhpur district in all seasons

Crops	Kharif		Rabi	
	Number	Share (In %)	Number	Share (In %)
Paddy	175	87.5	××	××
Maize	7	3.5	××	××
Groundnut	4	2	××	××
Chilli	1	0.5	××	××
Arhar	2	1	××	××
Sugarcane	2	1	××	××
Banana	1	0.5	××	××
Brinjal	1	0.5	××	××
Wheat	××	××	198	99
Musterd	××	××	14	7
Potato	××	××	20	10
Cauliflower	××	××	1	0.5
Pea	××	××	2	1
Tomato	××	××	1	0.5
Gram	××	××	2	1
Total	××	××	238	119

Source: Author's own calculation based on primary data.

Table 3-17: Crops grown in Lalitpur district in all seasons

Crops	Kharif		Rabi		Jayad	
	Number	Share (In %)	Number	Share (In %)	Number	Share (In %)
Paddy	2	1	××	××	××	××
Maize	24	12	××	××	××	××
Groundnut	6	3	××	××	××	××
Moong	1	0.5	××	××	××	××
Urad	190	95	××	××	××	××
Soya	23	11.5	××	××	××	××
Till	1	0.5	××	××	××	××
Wheat	××	××	173	86.5	××	××
Maize	××	××	1	0.5	××	××
Musterd	××	××	5	2.5	××	××
Groundnut	××	××	1	0.5	××	××
Jowar	××	××	2	1	××	××
Pea	××	××	43	21.5	××	××
Gram	××	××	101	50.5	××	××
Barley	××	××	1	0.5	××	××
Lentil	××	××	19	9.5	××	××
Soya	××	××	1	0.5	××	××
Potato	××	××	××	××	1	0.5
Arhar	××	××	××	××	1	0.5
Moong	××	××	××	××	1	0.5
Coriander	××	××	××	××	2	1
Barley	××	××	××	××	1	0.5
Total	247	123.5	347	173.5	6	3

Source: Author's own calculation based on primary data.

Figure 3-6: Indebtedness in sample households across sample districts
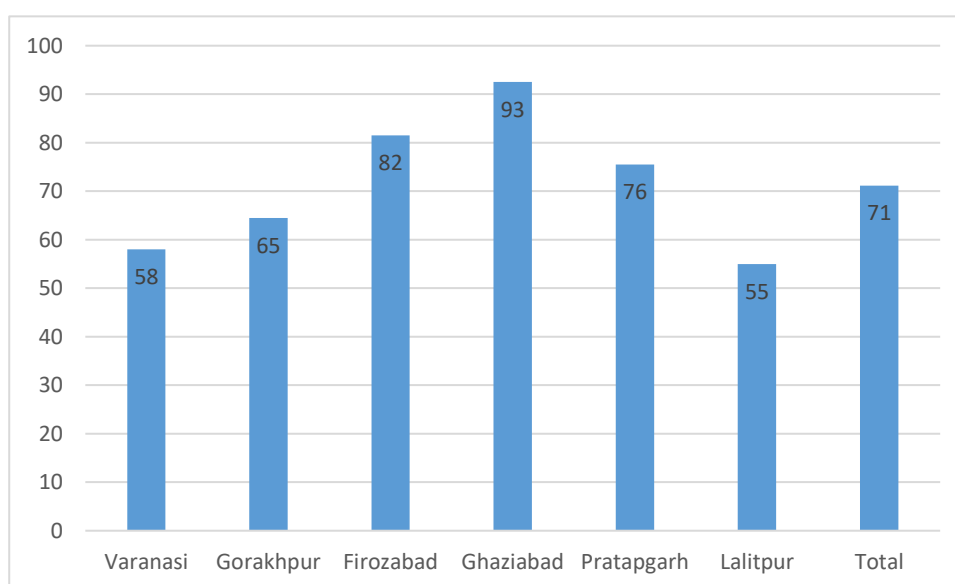
Source: Author's own calculation based on primary data.

Table 3-18: Major sources of rural credit in sample districts

Sources	Firozabad	Ghaziabad	Gorakhpur	Lalitpur	Pratapgarh	Varanasi
Relatives	38.44	6.82	28.31	5.69	34.32	32.97
Moneylenders	5.87	5.56	4.18	5.92	11.64	11.11
Cooperative	7.63	26.84	2.96	18.12	15.96	8.43
Commercial Banks	47.03	39.32	61.11	67.38	35.32	45.75
Microfinance	0.41	1.56	2.83	0.66	0.65	1.28
Others	0.62	19.90	0.61	2.23	2.10	0.46

Source: Author's own calculation based on primary data.

Table 3-19: Purpose of rural credit in sample districts

Purpose	Firozabad	Ghaziabad	Gorakhpur	Lalitpur	Pratapgarh	Varanasi
Agricultural	58.39	67.31	59.06	76.56	51.53	64.39
Non-Agricultural	41.61	32.69	40.94	23.44	48.47	35.61

Source: Author's own calculation based on primary data.

4 FARMERS' INCOME IN UTTAR PRADESH

In this chapter, we discuss the income of agricultural households in Uttar Pradesh by social groups, categories of farmers and regions. There are two major sources of the farmers' income –farm income and non-farm income. Farm income sources include incomes from cultivation, animal husbandry, fisheries, forestry and agricultural wages. Non-farm income sources comprise incomes from wages, salaries, pension, business and remittances. The composition of the household income and factors affecting income diversification are also discussed. Last but not least, this chapter highlights the support required for enhancing the farmers' income.

4.1 CURRENT INCOME LEVEL OF FARMERS AND ITS COMPOSITION

4.1.1 INCOME LEVEL

The survey collected information from agricultural households on net income earned from both farm and non-farm sources from July 2016 to June 2017. Based on this information, average annual household income and average per-capita income per agricultural household was worked out for the agricultural year July 2016 - June 2017 (see Table 4.1). Average annual household income for the agriculture year 2016-17 was estimated at Rs. 153488 in Uttar Pradesh; Per-capita annual income was calculated Rs. 25659.

Table 4.1 shows inter-region variation in the average annual household income in Uttar Pradesh. The highest average annual income was reported by agricultural households of the western plain regions (Ghaziabad) followed by the northeastern plain zone (Gorakhpur) of the state. The lowest average annual household income was reported by the Bundelkhand region followed by districts belonging to the central zone and the eastern plain zone of the state.

Average annual income per agricultural household by castes is given in Table 4.2. It be noted that the general category of farmers earned the highest income – Rs. 208144 annually; households of the Other Backward Castes (OBCs) earned the lowest income, which was very surprising as the farmers of this category are known for their farming skills.

Average annual income per agriculture household by land category is presented in Table 4.3. Income of farm household varied across the large, medium, small and marginal categories of the farmers as seen in Table 4.3. Income of the large farmers was much higher than the other categories. It was noted in each sample district except for Firozabad where average annual income per agriculture household was similar for both medium and large categories of farmers. To understand the relationship between the size of land holdings and income, scatter plot was drawn by considering farm income and non-farm income separately. These plots are presented in Figures 4.1 and 4.2, respectively. A very poor positive correlation exists between per-capita farm income and the size of land holdings, as is reflected from Figure 4.1. However, there is a negative correlation between per-capita annual non-farm income and the size of landholdings, though it is weak in magnitude (Figure 4.2).

4.1.2 INCOME COMPOSITION

As we know, both farm and non-farm sources of income play an important role in the income growth of the farm households. Comparing farm and non-farm earning during the agriculture year 2016-17 in our sample (Table 4.4), it was observed that farm income was the chief source of earnings of agricultural households in UP. It contributed around 55 per cent of total income for the sampled agricultural households. The rest of 45 per cent of the total income was contributed by non-farm sources such as wage/salaried employment, business etc. (Table 4.4). In the Bundelkhand region, the share of farm income was much higher than the other regions.

Among sources of non-farm income, earnings from wages was almost 50 per cent. These wages were earned from casual employment, indicating a lack of formal employment opportunities in the rural manufacturing and service sectors in the state. More interestingly, there was not a significant spatial variation in the share of earning from wages in total non-farm income in this state. The other 40 per cent of total non-farm income was contributed by income from salary and business. Remaining 10 per cent of non-farm income come from remittances, subsidies, and property selling.

Statistics presented in Table 4.4 underscore that there is no difference in the distribution of the farmers' income among social groups and categories of farmers except for Schedule Tribe (ST) farmers and farmers with the marginal land holdings. In the case of ST farmers,

36 per cent of their income came from the agriculture sector, while in the case of marginal farmers about 50 per cent of their income was realized from the agriculture sector.

4.2 NET INCOME FROM CULTIVATION

Net income from the cultivation per agriculture household was calculated by adding the net return of each crop grown by the agricultural households divided by the number of the sample agricultural households. The net return of each crop was estimated by taking the difference between gross return and total cost. Gross return was calculated by multiplying the quantity of the produce sold and the unit price received by the farmers. The amount of produce kept in the home for own consumption was also taken into account in the calculation of the gross return. Net income per household was further divided by the average gross cultivated area per household to get cultivation income per unit of land. This explained the effect of the size of landholding and farm income. Estimates are presented in Table 4.5.

Net annual income from cultivation for the agriculture year 2016-17 was estimated at Rs. 56691 per household at the aggregate state level. The highest net cultivation income per household was observed in the Bundelkhand and western plain regions of UP. The lowest net annual cultivation income was reported by agricultural households in the northeastern plain (Gorakhpur) followed by the southwestern semi-arid and eastern plain zones of the state. The table further indicates the comparatively lower returns from cultivation in the eastern part of the state. Therefore, the eastern region of the state should get priority in agricultural development in the state. The table also shows strong spatial variation within the western region of the state. The sample households in Firozabad district earned about 40477 Rs per annum from cultivation while we have seen that farmers in Ghaziabad earned much more income in comparison to the above estimate. In the central and Bundelkhand regions, the household income from cultivation was about Rs. 54621 and 82106 respectively, indicating higher cultivation income in these regions than that in the eastern region of the state.

4.2.1 INCOME FROM PRINCIPAL CROPS

Though cultivation was the primary occupation of the sample households, about 20 to 30 per cent of the farmers realised a negative return in farming food crops (Table 4.6). Whereas only 2 per cent of sugarcane farmers and about 10 per cent of potato farmers said that they

realized a negative return. However, this ratio was higher in the case of rice and wheat and much higher in the case of coarse cereals such as bajra, maize etc. Interestingly, only a few farmers of cereals reported a negative return from the farming of cereals in Bundelkhand region represented by Lalitpur district. It was astonishing observation as villages selected from Lalitpur districts were among the most backward villages in our sample (for detail, please see Figure 3.4).

Crop profitability was also estimated by taking the difference between gross return and expenditure. Gross return is calculated by multiplying the quantity of the produce sold and the unit price received by the farmers. In the calculation of the gross return, part of the produce retained by the households for the domestic consumption was included as in the absence of this practice, the farmer would buy it from the market. Results are presented in tables from 4.7 to 4.12. Crop profitability at aggregate state level indicates that sugarcane was the most profitable crop in the state except in Bundelkhand and the central regions. The value of profitability of the most of crops varies significantly across each region of the state.

In terms of the relative profitability, importance of crops changes over regions of the state. Sugarcane, mustard and rapeseed, and potato were identified as the most profitable crops in the western part of the state, as is reflected from both sample western districts in the study (Firozabad and Ghaziabad). Cereals, particularly paddy, was the most profitable crop in the central part of the state, as is shown by Pratapgarh district of the central region of Uttar Pradesh. Similarly, wheat was the most profitable crop in Bundelkhand region. In the eastern region of the state, mirrored from both sample eastern districts (Varanasi and Gorakhpur), sugarcane and potato were the most lucrative crops in the region.

CACP data confirms the above aggregate state-level findings. Figure 4.3 indicates that sugarcane was the most profitable crop in Uttar Pradesh. It was also confirmed from the figure that potato was also very lucrative crop in the state. Cereals were found to less profitable crops. Figure 4.3 also compares crop return between two periods – 2003-04 and 2013-14. In most of the cases, crop return declined over the years, indicating a gloomy picture of the agriculture sector in the state.

4.2.2 CONSTRAINTS IN GROWTH OF CULTIVATION INCOME

Net annual income from cultivation in Uttar Pradesh was low. This was true for the entire state except for western plain region. The agriculture income in the state appeared to be

much lower than the income earned from MGNREGA in the state. The latter assures a person Rs 175 per day as the wage for his or her services. From different layers of interaction with the farmers of UP, we arrived at the following three important causes of low income from cultivation.

First, the largest chunk of the farmers in the state had the marginal and small landholdings. During the survey and the focus group discussions, it was noticed that these farmers majorly grew food crops such as wheat, paddy etc. mainly for the household food requirements. While, these crops were less lucrative than the commercial crops such as sugarcane, potato, fruits and vegetables. Hence, diversifying cropping pattern away from food crops to commercial crops and fruits and vegetables would be a good option for increasing the farmers' income from cultivation.

The second significant causal factor of low income from farming was the realization of low price by the farmers. Table 4.13 presents an estimate of price spread (the difference between consumer and producer price) of major crops and confirms the above observation. It is clearly reflected from the table that price spread was about 30 to 40 per cent in some of the commodities like wheat, bajra, and paddy. Again, the performance of commercial crops such as sugarcane and potato in terms of price spread was much better than food crops. Poor agricultural marketing system was primarily responsible for low prices received by the farmers for their agricultural commodities. Almost 90 per cent of the sample farmers were found selling their produce to the middleman.

The third important causal factor for low income was the post-harvest losses. In most cases, 5 to 10 per cent of output loss was noticed. This leads to a substantial loss in income earned from cultivation. Poor agricultural logistics such as storage, transportation, cold chain etc. was mainly responsible for the post-production crop loss.

4.3 Net Income from Animal Husbandry

The livestock sector has a critical role in income and food security of agricultural households (Birthal et al., 2002). From this study, it was evident that livestock activities (*i.e.* dairy, poultry etc.) were the secondary activities for agricultural households. It was also observed that not all sample households were engaged in livestock activities. The proportion of households engaged in these activities was 72 per cent, 53 per cent, 78 per cent, 80 per

cent, 96 per cent, and 55 per cent in Varanasi, Gorakhpur, Firozabad, Ghaziabad, Pratapgarh and Lalitpur, respectively (Table 4.14). Among the sample households engaged in livestock activities, about 51 per cent of the households earned negative net income from these activities, indicating more expenditure on livestock than the return from the sector (Table 4.15). The share of such losses was even higher in Gorakhpur and Ghaziabad districts among the sample districts of the study. *Net income from livestock activities was calculated by subtracting the cost of material from gross earnings of milk, milk products, poultry and poultry products. It be clarified that total earnings includes value of milk and milk products used for the household consumption.*

4.3.1 DITERMINANTS OF LIVESTOCK INCOME

To understand the determinants of livestock income, households were first categorised into two groups – a group of households that does not earn positive net income from livestock activities and another group of households that does earn positive net income. The first group was categorized as '0' and another group as '1'. It was then regressed on the category of buying agency, family size, land holdings and the classification of the district using logistic regression. The results are presented in Table 4.16. The table shows that the buying agency plays an important role in determining the earning from livestock activities. Likelihood of a positive net return from livestock activities is much higher in the direct sale to consumers. Selling livestock products to milkman also gave positive net profit from livestock activities.

The estimates presented in Table 4.16 reflect that there was no statistically significant impact of the size of land holding and family on the probability of getting a positive net return from the livestock sector. However, estimates show that as the size of landholding and family increases, chances of getting positive net livestock income increases. Parameters related to the category of districts confirm strong spatial variation in net livestock income in the state.

4.4 DIVERSIFICATION OF ACTIVITIES

Income of the farmers in Uttar Pradesh can be substantially improved by shifting the workforce away from agriculture. In UP, the share of non-farm employment in total employment increased from 17 per cent in 1983 to 33 per cent in 2009-10. This increase in

the share was largely attributed to the manufacturing and construction industry. Nevertheless, push factors appear to be the key determinants of the above growth in the rural non-farm sector (Shukla, 2012). In our survey, we observed limited opportunities for non-farm employment in the rural areas, though people have a desire to shift away from the agriculture sector. Value addition to agriculture appears to be a good option for generating non-farm rural employment in Uttar Pradesh given its low cost of investment and access to the leading producers of agricultural commodities.

The service sector in the state is rapidly growing as its contribution in the Gross State Domestic Product reached 48 per cent from 45 per cent in 2011-12. This sector is growing at a faster rate than agriculture and manufacturing sectors in the state. But this sector has a limited capacity to absorb the rural population of the state because of their poor skills. In focus group discussions organized in each sample district, it was observed that rural youths have limited skills.

4.5 SUPPORT& HINDRANCES FOR THE FARMERS

The Government of India had launched a number of schemes such as Soil Health Mission, Pradhanmantri Fasal Bima Yojana, etc, to support the farmers in improving crop productivity and farm income. These schemes have been in practice for the last few years. However, by and large, the farmers in UP were unaware of these schemes. Fasal Bima Yojana was a big example here. Not a single farmer in our sample households was found aware of this scheme during the survey. Farmers who had taken a loan through Kisan Credit Card knew that the premium amount for Fasal Bima Yojna was deducted from the amount of their loan. But, they were unable to answer any question related to insurance scheme such as its benefits, or whether it was life insurance or general insurance, what was the insured sum amount, when they could claim insurance, etc.

Similarly, the benefit of Soil Health Mission has also not reached many farmers – only 4.75 per cent of sample households had claimed that soil of their field was tested. Only 1.83 per cent of agriculture household had received soil health card so far (Tables 4.18 & 4.19). It was also very disappointing that the only 43.67per cent farmers had Kisan Credit Card in the study area, indicating a high dependency on the informal sector for credit (Table 4.17). In the absence of KCC, it is not easy to get financial assistance from the mainstream banking system.

4.6 Issues of Climate Change & Support Required by Farmers

This study analysed the changes observed in the last two decades in five major climatic determinants such as average temperature, average rainfall, rainfall variability, and cases of climate variability induced diseases in both human and livestock population. These determinants were identified based on survey analysis of 1200 households across six major districts in the state of Uttar Pradesh, namely Varanasi, Pratapgarh, Lalitpur, Gorakhpur, Ghaziabad, and Firozabad.

Tables 4.20 and 4.21 show the district-wise perception of the households on five major factors of climate change. The first table shows the household data in absolute terms and the second in percentage of total households. These tables clearly show that close to 90 percent of the households in five out of six districts perceived a change in average temperature. In Ghaziabad district, 98 per cent of the households acknowledged this change.

More than 50 per cent of the households across all six districts had witnessed a decrease in average rainfall. This figure goes up to 95.5 percent in the district of Firozabad, 89 percent in the district of Ghaziabad, and 84 percent in the district of Pratapgarh. In addition, an average of 69.75 per cent of all 1200 households across the six districts confirmed rainfall variability in the last two decades. Amongst these households, 66.8 percent witnessed erratic rainfall.

The survey also highlighted that a majority of the sample households in Ghaziabad (71.5 per cent) and Firozabad (62 per cent) observed longer periods of drought, whereas less than 50 households across all six districts perceived an increase in floods.

In the districts of Gorakhpur, Ghaziabad, and Firozabad, a large number of households reported an increase in the cases of diseases such as malaria, dengue, chikungunya, tuberculosis, typhoid, cholera, and jaundice. The households in these districts also reported an increase in the cases of livestock diseases.

Table 4.22 shows the district-wise awareness level of households with regard to the effects of agricultural practices on climate change. With an exception of Ghaziabad district, the majority of the households in every other surveyed district accepted a lack of awareness towards the effects of agricultural practices on climate variability.

While most of the surveyed households expect improved agricultural inputs, innovative methodologies, and enhanced irrigation, some have even shown inclination towards better machinery, utilization of clean energy, multiplication of plantation and other land development initiatives. The survey also found that a lack of access to capital, credit, information, inputs, and land was the major constraint that prohibited these households in raising their income.

Table 4-1: The farmers' total income in the six districts

District	Parameters	Average Annual Income per Household (In Rs.)	Average Annual Income per Capita (In Rs.)
Varanasi	Mean	126126	17416
	CV	1.28	0.89
Gorakhpur	Mean	169365	24141
	CV	1.22	0.91
Firozabad	Mean	148549	23088
	CV	1.00	1.88
Ghaziabad	Mean	234802	44228
	CV	0.73	0.73
Pratapgarh	Mean	126891	23805
	CV	0.95	0.82
Lalitpur	Mean	115195	22209
	CV	0.68	0.78
Total	Mean	153488	25659
	CV	1.03	1.09

Source: Author's own calculation based on primary data.

Table 4-2: Total income across caste categories

Caste category	Parameters	Average Annual Income per Household (In Rs.)	Average Annual Income per Capita (In Rs.)
General	Mean	228161	37504
	CV	1.12	1.32
SC	Mean	153753	25746
	CV	0.93	0.81
ST	Mean	186529	27569
	CV	0.86	0.59
OBC	Mean	125159	21466
	CV	0.78	0.77
Total	Mean	153488	25659
	CV	1.03	1.09

Source: Author's own calculation based on primary data.

Table 4-3: Status of the farmers' total income according to the size of landholding

Category of Farmers	Parameters	Average Annual Income per Household (In Rs.)	Average Annual Income per Capita (In Rs.)
Marginal	Mean	139893	23667
	CV	1.03	0.93
Small	Mean	169527	30318
	CV	1.03	1.47
Medium	Mean	237952	34841
	CV	0.72	0.66
Large	Mean	476160	41458
	CV	0.72	0.79
Total	Mean	153488	25659
	CV	1.03	1.09

Source: Author's own calculation based on primary data.

Table 4-4: Sources of income of agricultural households

District	Sources of Farm Income (In %)			Sources of Non-farm Income (In %)						
	Agricultural Income	Agriculture wage Income	Total	Casual wage income	Salary	Business	Subsidy	Remittances	Other	Total
1. District wise										
Varanasi	0.55	0.11	0.65	0.14	0.09	0.06	0.04	0.00	0.01	0.35
Gorakhpur	0.28	0.12	0.40	0.31	0.09	0.11	0.07	0.00	0.01	0.60
Firozabad	0.33	0.04	0.37	0.30	0.08	0.14	0.06	0.01	0.04	0.63
Ghaziabad	0.50	0.01	0.51	0.19	0.11	0.13	0.04	0.00	0.02	0.49
Pratapgarh	0.52	0.05	0.57	0.18	0.11	0.07	0.05	0.01	0.01	0.43
Lalitpur	0.73	0.05	0.78	0.10	0.03	0.03	0.05	0.00	0.00	0.22
Total	0.49	0.06	0.55	0.20	0.09	0.09	0.05	0.00	0.01	0.45
2. Farmers Category										
Marginal	0.43	0.07	0.50	0.23	0.09	0.10	0.05	0.01	0.02	0.50
Small	0.59	0.05	0.64	0.14	0.08	0.08	0.05	0.00	0.01	0.36
Medium	0.69	0.03	0.71	0.11	0.05	0.07	0.04	0.00	0.02	0.29
Large	0.65	0.00	0.65	0.10	0.13	0.08	0.04	0.00	0.00	0.35
3. Social Group										
General	0.54	0.03	0.57	0.14	0.11	0.13	0.04	0.00	0.01	0.43
SC	0.46	0.07	0.53	0.24	0.09	0.08	0.06	0.00	0.02	0.48
ST	0.34	0.01	0.36	0.38	0.05	0.16	0.05	0.00	0.00	0.64
OBC	0.48	0.08	0.55	0.21	0.08	0.08	0.05	0.01	0.02	0.45

Source: Author's own calculation based on primary data.

Figure 4-1: Relationship between per-capita farm income and size of land holding
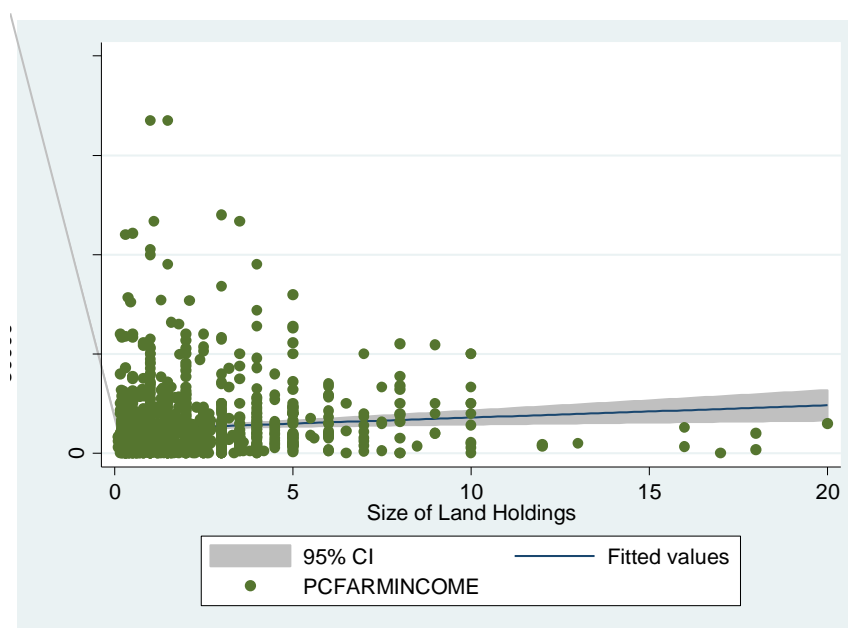
Source: Author's own calculation based on primary data.

Figure 4-2: Relation between per-capita non-farm income and size of land holding
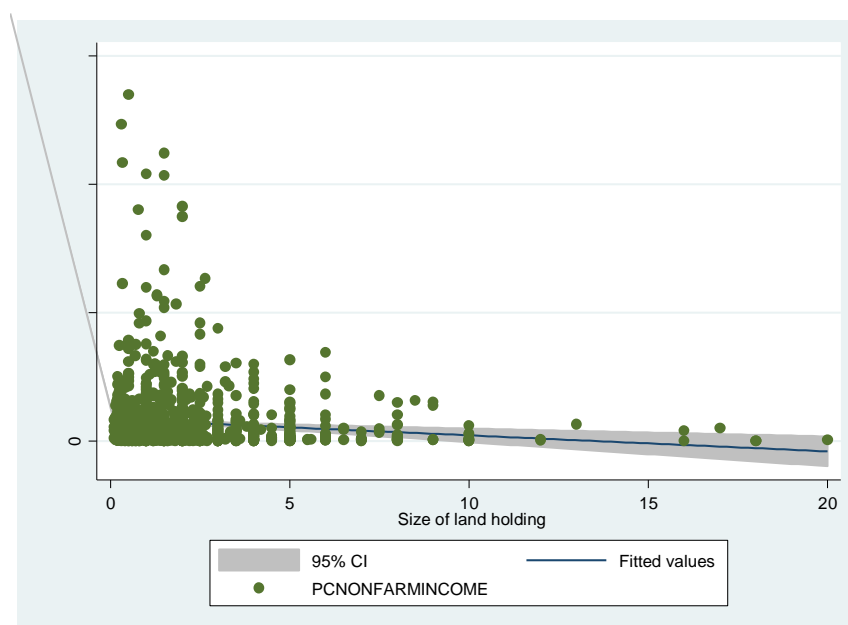
Source: Author's own calculation based on primary data.

Table 4-5: Average income from different sources across sample districts

District	Statistics	Income from agriculture labour	Income from Casual Labour	Remittances	Income from Salary	Income from Self-employment /Business	Income from Property Sale	Income from Pension	Subsidy	Income from Other Sources	Income from Animal Husbandry	Income from Crop Husbandry
Varanasi	Mean (Rs.)	7155	10640	0	31550	5005	0	342	4368	419	18815	47832
	CV	1.86	1.84	0.00	3.56	3.36	0	4.97	3.90	5.06	2.17	1.76
	Share (%)	5.67	8.44	0.00	**25.01**	3.97	0	0.27	3.46	0.33	**14.92**	**37.92**
Gorakhpur	Mean (Rs.)	10379	46068	600	27850	21755	0	3501	10509	2197	11308	35199
	CV	1.77	1.72	14.14	4.83	2.92	0	7.46	1.55	4.68	1.33	2.01
	Share (%)	6.13	27.20	0.35	**16.44**	12.85	0	2.07	6.21	1.30	**6.68**	**20.78**
Firozabad	Mean (Rs.)	3320	38046	780	15295	15842	0	414	7609	7158	19609	40477
	CV	3.24	1.40	10.24	2.73	2.00	0	12.36	2.76	3.92	1.76	3.31
	Share (%)	2.23	25.61	0.53	10.30	10.66	0	0.28	5.12	4.82	**13.20**	**27.25**
Ghaziabad	Mean (Rs.)	2731	35899	655	38185	31036	3965	1480	7086	4068	29790	79909
	CV	5.61	1.71	11.59	2.72	1.96	13	10.99	1.37	4.82	1.04	1.16
	Share (%)	1.14	15.04	0.27	15.99	13.00	1.66	0.62	2.97	1.70	**12.48**	**33.47**
Pratapgarh	Mean (Rs.)	3330	15425	1250	23170	8850	0	2100	3681	1479	12985	54621
	CV	3.04	1.71	8.02	3.27	3.65	0	11.95	0.89	6.68	1.23	1.41
	Share (%)	2.62	12.16	0.99	18.26	6.97	0	1.65	2.90	1.17	**10.23**	**43.05**
Lalitpur	Mean (Rs.)	3655	7805	300	3642	6065	0	240	4290.5	296.5	6795	82106.36
	CV	2.66	1.89	14.14	4.50	4.04	0	6.55	0.75	5.25	2.12	0.83
	Share (%)	3.17	6.78	0.26	3.16	5.26	0	0.21	3.72	0.26	**5.90**	71.28
Total	Mean (Rs.)	5095	25647	598	23282	14759	661	1346	6257	2603	16550	56691
	CV	2.66	1.98	12.06	3.91	2.92	31	12.17	2.20	5.90	1.71	1.62
	Share (%)	3.31	**16.64**	0.39	**15.10**	**9.57**	0.43	0.87	4.06	1.69	**10.74**	**36.78**

Source: Author's own calculation based on primary data.

Table 4-6: Crop-wise ratio of farmers (in %) who reported negative return from cultivation

Crop	Varanasi	Gorakhpur	Firozabad	Ghaziabad	Pratapgarh	Lalitpur
Wheat	27	39	37	17	24	02
Paddy	21	29	19	22	22	××
Maize	33	14	14	25	××	16
Musterd	17	07	35	××	14	××
Groundnut	××	25	××	××	××	××
Pea	××	50	××	33	××	2
Bajra	82	××	33	80	××	××
Millets	100	××	19	××	××	××
Potato	05	××	18	8	××	××
Arhar	25	××	××	××	××	××
Coriander	50	××	××	××	××	××
Gram	33	××	××	××	××	02
Lobia	100	××	××	××	××	××
Barley	××	××	××	××	××	100
Soya	××	××	××	××	××	04
Chili	××	××	33	××	××	××
Jowar	××	××	××	50	××	××
Sugarcane	××	××	××	02	××	××
Urad	××	××	××	67	××	××
Ladyfinger	××	××	××	67	××	××

Source: Author's own calculation based on primary data.

Table 4-7: *Gross and net return earned from different crops in firozabad district*

Crop	Sown Area	Production	Quantity Sold	Quantity Kept for Own Consumption	Total Losses	Price Received by Farmers	Gross Return	Total Expenditure	Net Return
	(In Acre)	(In Q)	(In Q)	(In Q)	(In Q)	(In Rs/Q)	(In Rs)	(In Rs)	(In Rs)
Wheat	1.39	26	14	7	4	985	21474	14647	6827
Paddy	1.62	25	18	7	0	1102	27633	14765	12868
Bajra	2.07	18	13	3	2	770	12568	11276	1292
Maize	0.61	9	6	2	1	1008	7763	4109	3654
Millets	2.06	19	15	4	0	888	16766	12627	4139
Mustard & Rapeseeds	0.76	4	2	2	0	2076	9053	6032	3021
Groundnut	0.20	2	1	1	0	7000	14000	3300	10700
Potato	1.87	168	152	4	11	348	54579	29968	24611
Chili	0.57	4	4	0	0	1650	6155	6567	-412
Garlic	0.77	14	11	0	3	2079	24091	15754	8337

Source: Author's own calculation based on primary data.

Table 4-8: Gross and net return earned from different crops in Ghaziabad district

Crop	Sown Area (In Acre)	Production (In Q)	Quantity Sold (In Q)	Quantity Kept for Own Consumption (In Q)	Total Losses (In Q)	Price Received by Farmers (In Rs/Q)	Gross Return (In Rs)	Total Expenditure (In Rs)	Net Return (In Rs)
Wheat	0.82	23	9	8	6	1438	24177	9270	14907
Paddy	0.81	17	10	6	1	1323	21547	8479	13069
Bajra	6.33	4	2	1	1	1280	4045	5370	-1325
Maize	0.45	10	5	4	1	1100	9834	3394	6440
Millets	1	12	7	4	1	1400	15400	2800	12600
Mustard	0.97	5	4	1	0	3500	16905	6539	10366
Potato	0.93	75	49	6	20	488	27056	15601	11455
Chilli	0.5	20	19	1	0	2800	56000	22700	33300
Arhar	0.2	3	2	1	0	3000	8100	2400	5700
bottle gourd	0.35	13	12	1	0	450	5850	4325	1525
Cabbage	1	230	225	1	4	230	51980	13200	38780
Carrot	0.45	35	31	3	1	2250	76500	5650	70850
Cauliflower	0.7	94	84	8	2	850	78200	7562	70638
Jowar	0.35	3	1	1	0	700	1575	2100	-525
Ladyfinger	0.37	8	7	1	0	1050	8033	9250	-1218
Mango	7.5	625	600	15	10	500	307500	103500	204000
Moong	0.35	3	2	0	1	4000	9800	3450	6350
Pea	0.51	11	9	2	0	1733	18772	6100	12672
Sugarcane	1.45	356	344	6	6	288	100735	25145	75590
Urad	0.33	2	1	1	0	2500	4575	7117	-2542

Source: Author's own calculation based on primary data.

Table 4-9: Gross and net return earned from different crops in Pratapgarh district

Crop	Sown Area (In Acre)	Production (In Q)	Quantity Sold (In Q)	Quantity Kept for Own Consumption (In Q)	Total Losses (In Q)	Price Received by Farmers (In Rs/Q)	Gross Return (In Rs)	Total Expenditure (In Rs)	Net Return (In Rs)
Wheat	1.46	26	19	6	2	1161	28778	14460	14318
Paddy	1.48	37	28	6	3	1091	36940	15468	21472
Musterd	0.81	5	4	1	0	3529	18772	7793	10979
Potato	0.89	64	57	4	3	430	26415	10186	16229
Pea	1	40	35	5	0	1000	40000	10000	30000
Amla	5	180	180	0	0	800	144000	20000	124000

Source: Author's own calculation based on primary data.

Table 4-10: Gross and net return earned from different crops in Varanasi district

Crop	Sown Area (In Acre)	Production (In Q)	Quantity Sold (In Q)	Quantity Kept for Own Consumption (In Q)	Total Losses (In Q)	Price Received by Farmers (In Rs/Q)	Gross Return (In Rs)	Total Expenditure (In Rs)	Net Return (In Rs)
Wheat	1.67	24	16	6	1099	2	24245	13651	10594
Paddy	1.91	33	25	6	1038	2	32477	17213	15264
Bajra	0.81	8	5	3	255	0	1871	5436	-3565
Maize	4	31	28	1	983	2	28517	12900	15617
Millets	0.4	5		5	0	1	0	2950	-2950
Musterd	1.07	13	5	2	3017	7	20574	9085	11488
Potato	1.25	108	98	7	474	3	49813	19268	30544
Garlic	0.5	20	8	0	2500	12	20425	6867	13558
Arhar	3	8	5	2	3625	0	26753	12325	14428
Ladyfinger	0.75	25	24	2	1100	0	27500	11000	16500
Pea	1.33	87	86	1	2333	0	203396	20200	183196
Sugarcane	1.33	227	203	22	307	2	69001	30333	38667
Tomato	0.57	43	38	2	715	2	28958	13060	15898
Brinjal	1	72	60	2	600	10	37200	13000	24200
Spinach	0.15	22	19	2	400	2	8000	3075	4925
Redish	0.23	59	55	2	600	2	33900	10900	23000
Pumpkin	0.45	55	52	2	500	1	27000	5000	22000
Coriander	0.17	9	1	0	4567	8	2831	1733	1098
Cucumber	0.45	16	14	1	900	1	13500	6100	7400
Gram	1.93	11	10	1	4167	0	46167	41017	5150
Pulse	2	4	3	1	4500	0	18000	15500	2500
Onion	0.4	11	10	1	825	0	8663	4800	3863

Source: Author's own calculation based on primary data.

Table 4-11: Gross and net return earned from different crops in Gorakhpur district

Crop	Sown Area (In Acre)	Production (In Q)	Quantity Sold (In Q)	Quantity Kept for Own Consumption (In Q)	Total Losses (In Q)	Price Received by Farmers (In Rs/Q)	Gross Return (In Rs)	Total Expenditure (In Rs)	Net Return (In Rs)
Wheat	1.69	18	11	6	1	930	15443	10622	4822
Paddy	2.5	24	16	7	0	978	22607	11571	11036
Maize	0.84	11	7	3	1	1093	10994	5193	5801
Mustard	0.5	4	2	1	0	2964	9901	5400	4501
Groundnut	0.41	3	2	1	0	2425	6669	4425	2244
Potato	0.74	57	45	6	7	824	41682	10355	31327
Chilli	0.5	8	8	0	0	4000	30400	7800	22600
Arhar	1	7	5	1	1	4000	24600	4600	20000
Cauliflower	0.5	40	38	1	1	400	15600	7900	7700
Pea	0.3	5	4	1	1	1150	5175	3875	1300
Sugarcane	1.57	363	358	1	3	290	104235	28743	75492
Tomato	0.3	20	19	1	1	800	15600	5650	9950
Gram	0.55	4	2	1	1	4000	12520	3950	8570
Banana	0.3	14	14	0	0	630	8820	7000	1820
Brinjal	0.5	18	16	1	1	2000	34000	8450	25550

Source: Author's own calculation based on primary data.

Table 4-12: Gross and net return earned from different crops in Lalitpur district

Crop	Sown Area (In Acre)	Production (In Q)	Quantity Sold (In Q)	Quantity Kept for Own Consumption (In Q)	Total Losses (In Q)	Price Received by Farmers (In Rs/Q)	Gross Return (In Rs)	Total Expenditure (In Rs)	Net Return (In Rs)
Wheat	2.67	38	28	6	3	1492	51607	23060	28547
Paddy	0.7	1	1	0	0	1625	1463	6375	-4913
Maize	1.7	15	13	1	1	1204	16952	10160	6792
Musterd	1.6	9	7	2	0	3820	33616	10600	23016
Groundnut	1.14	7	7	0	0	2914	20808	8971	11837
Potato	2	100	95	5	0	700	70000	19000	51000
Jowar	1.5	14	10	3	0	950	12588	8350	4238
Moong	1.5	5	4	1	0	5500	23375	10100	13275
Pea	1.48	45	42	3	0	1287	57524	12799	44726
Urad	3.31	16	15	1	1	3479	54659	20869	33790
Coriander	1.25	4	4	0	0	6500	26000	6350	19650
Gram	1.9	10	8	1	1	4147	37070	12924	24146
Barley	1.5	37	35	3	0	1000	37000	11950	25050
Lentil	1.42	7	6	1	0	3158	20589	9747	10842
Soya	2	12	11	1	0	3265	39534	15821	23713
Till	1	3	3	0	0	4000	12000	5300	6700

Source: Author's own calculation based on primary data.

Figure 4-3: Return on principal crops grown in Uttar Pradesh in 2003-04 & 2013-14
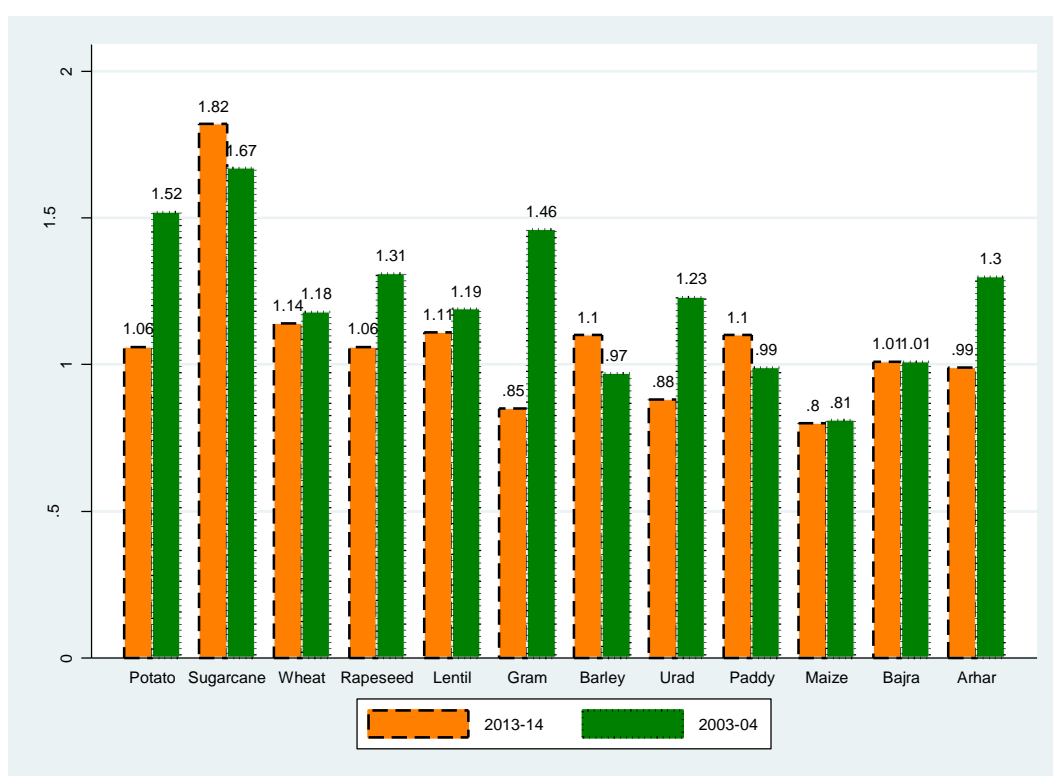
Source: Author's own calculation using data collected from the Commission of Agriculture Cost and Prices, Government of India.

Table 4-13: Price Spread & Yield Gap of major crops in Uttar Pradesh

Crop	Price Received (PR)	Price Prevailing (PP)	Yield Sample Average	Yield State Average	Price spread
	(In Rs/Q)		(In Kg/Ha)		(Ratio between PP & PR)
Wheat	1176	1629	4770	2835	0.28
Paddy	1102	1944	5493	2295	0.43
Maize	1100	1456	3129	1734	0.24
Bajra	739	1065	2221	1903	0.31
Tur	3642	3919	1563	867	0.07
Gram	4143	5000	1297	916	0.17
Mustard	2934	3387	1638	1127	0.13
Potato	451	535	19774	24500	0.16
Sugarcane	288	255	62717	59768	-0.13
Urad	3455	3734	1235	550	0.07

Source: Author's own calculation using both primary data and secondary data collected from the Directorate of Economics and Statistics, Government of India.

Table 4-14: Distribution of households engaged in livestock activities (in %)

District	Farmers
Varanasi	72
Gorakhpur	53
Firozabad	78
Ghaziabad	80
Pratapgarh	96
Lalitpur	55

Source: Author's own calculation based on primary data.

Table 4-15: Distribution of households with negative livestock income (in %)

District	Farmers
Varanasi	40
Gorakhpur	69
Firozabad	45
Ghaziabad	61
Pratapgarh	55
Lalitpur	33
Total	51

Source: Author's own calculation based on primary data.

Table 4-16: Determinants of livestock income

Dependent variable: '1' if net income from livestock activities, otherwise '0'		
Explanatory Variables	Odds Ratio	Z-Stat
AGENCY (Base category '0' for own consumption)		
1. Milkman	2.89	4.88
2. Diary	1.71	2.31
3. Shop	1.07	0.13
4. Consumer	2.45	2.64
Family size (In Number)	0.99	-0.2
Size of land holdings (In Acre)	0.98	-0.55
District (Base category '1' for Varanasi)		
2. Gorakhpur	0.25	-4.77
3. Firozabad	0.69	-1.5
4. Ghaziabad	0.55	-1.77
5. Pratapgarh	1.26	0.89
6. Lalitpur	1.88	2.06
Intercept	0.95	-0.16
Number of obs	689	
LR chi2(11)	74.43	
Pseudo R2	0.0785	
Log likelihood	-436.70	

Source: Author's own calculation based on primary data.

Table 4-17: Status of Kisan Credit Card in Uttar Pradesh

		District						Total
		Varanasi	Gorakhpur	Firozabad	Ghaziabad and Hapur	Pratapgarh	Lalitpur	
KCC	Yes	44	60	81	110	96	133	524
	No	156	140	119	90	104	67	676
	Total	200	200	200	200	200	200	1200

Source: Author's own calculation based on primary data

Table 4-18: Progress of Soil Health Card: Ground-reality

Village (District, State)	Whether soil has been tested in this village	Whether farmers have received soil health card
Villages nearby National Capital Region (NCR)		
Tiyala (Hapur, Uttar Pradesh)	No	No
Pratapur (Firozabad, Uttar Pradesh)	No	No
Distant villages from NCR		
Pata Pachaura (Lalitpur, Uttar Pradesh)	No	No
Jarawal (Lalitpur, Uttar Pradesh)	Yes	No

Source: Collected by authors through field survey in these villages.

Table 4-19: Status of Distribution of Soil-Health Card

		District						Total
		Varanasi	Gorakhpur	Firozabad	Ghaziabad and Hapur	Pratapgarh	Lalitpur	
Soil Health Card	Yes	0	2	6	10	1	3	22
	No	35	0	73	4	49	10	171
	Total	35	2	79	14	50	13	193

Source: Author's own calculation based on primary data

Table 4-20: Farmers' Perception of climate change in Uttar Pradesh (Absolute term)

	long-term changes in the average temperature over the last 20 years	long term changes in the average rainfall over the last 20 years	long term changes in rainfall variability over the last 20 years	changes in incidences of climate variability induced diseases in human over the last 20 years	changes in incidences of climate variability induced diseases in livestocks over the last 20 years
Household Data for Climate Change Determinants in Absolute Terms					
			Varanasi		
Increase	187	2	153	78	52
Decrease	1	142	31	89	98
Stayed the same	3	36		21	35
Don't know	9	20	16	12	15
			Pratapgarh		
Increase	179	4	119	88	62
Decrease	10	168	51	86	102
Stayed the same	3	18		16	17
Don't know	8	9	30	10	19
			Lalitpur		
Increase	144	0	140	42	22
Decrease	7	105	31	116	108
Stayed the same	20	64		9	22
Don't know	29	31	27	33	48
			Gorakhpur		
Increase	193	81	120	127	121
Decrease	0	113	75	41	36
Stayed the same	4	3		10	20
Don't know	3	3	5	22	23
			Ghaziabad and Hapur		
Increase	196	20	167	177	120
Decrease	4	178	5	14	72
Stayed the same	0	0		8	8
Don't know	0	2	28	1	0
			Firozabad		
Increase	192	2	138	155	124
Decrease	1	191	24	35	42
Stayed the same	0	0		7	23
Don't know	7	7	38	3	11

Source: Author's own calculation based on primary data

Table 4-21: Farmers' Perception of climate change in Uttar Pradesh (in Percentage term)

	long-term changes in the average temperature over the last 20 years	long term changes in the average rainfall over the last 20 years	long term changes in rainfall variability over the last 20 years	changes in incidences of climate variability induced diseases in human over the last 20 years	changes in incidences of climate variability induced diseases in livestocks over the last 20 years
Household Data for Climate Change Determinants in Percentage of Total Households					
Varanasi					
Increase	93.5	1	76.5	39	26
Decrease	0.5	71	15.5	44.5	49
Stayed the same	1.5	18		10.5	17.5
Don't know	4.5	10	8	6	7.5
Pratapgarh					
Increase	89.5	2	59.5	44	31
Decrease	5	84	25.5	43	51
Stayed the same	1.5	9		8	8.5
Don't know	4	4.5	15	5	9.5
Lalitpur					
Increase	72	0	70	21	11
Decrease	3.5	52.5	15.5	58	54
Stayed the same	10	32		4.5	11
Don't know	14.5	15.5	13.5	16.5	24
Gorakhpur					
Increase	96.5	40.5	60	63.5	60.5
Decrease	0	56.5	37.5	20.5	18
Stayed the same	2	1.5		5	10
Don't know	1.5	1.5	2.5	11	11.5
Ghaziabad and Hapur					
Increase	98	10	83.5	88.5	60
Decrease	2	89	2.5	7	36
Stayed the same	0	0		4	4
Don't know	0	1	14	0.5	0
Firozabad					
Increase	96	1	69	77.5	62
Decrease	0.5	95.5	12	17.5	21
Stayed the same	0	0		3.5	11.5
Don't know	3.5	3.5	19	1.5	5.5

Source: Author's own calculation based on primary data

Table 4-22: Farmers' Perception of contribution of agricultural practices to climate change

	Perception of Households towards contribution of Agricultural Practices towards Climate Change	
	No of Households who are aware that agricultural practices can contribute to climate change	Percentage of Households who are aware that agricultural practices can contribute to climate change
Varanasi		
Yes	36	18
No	151	75.5
Pratapgarh		
Yes	41	20.5
No	155	77.5
Lalitpur		
Yes	37	18.5
No	161	80.5
Gorakhpur		
Yes	65	32.5
No	135	67.5
Ghaziabad and Hapur		
Yes	122	61
No	78	39
Firozabad		
Yes	57	28.5
No	143	71.5

Source: Author's own calculation based on primary data

5 STRATEGY FOR DOUBLING THE FARMERS' INCOME

This chapter dwells on the strategy to double the farmers' income in Uttar Pradesh by 2022. The strategy is based on the observations made in the course of this study and the suggested investments by the state government. The strategy is based on the incremental capital output ratio (ICOR) for agriculture sector in UP, calculated using information on capital expenditure on different services in agriculture sector and value of agricultural output. Data on capital expenditure for last five year was collected from the State Finance Report provided by the Reserve Bank of India, whereas data on value of agricultural output was collected from Centre Statistical Origination, New Delhi.

5.1 INVESTMENT REQUIRED FOR DOUBLING FARMERS' INCOME BY 2022

ICOR was calculated by dividing the total capital expenditure incurred by the state government on different services in the agriculture sector by the change in the value of agricultural output. Information on capital expenditure and value of agricultural output for the last ten years, starting from 2004-05, for Uttar Pradesh are presented in Table 5.1. The latest information on the variable is available for the year 2014-15. ICOR for the period 2004-05 to 2014-15 is estimated at 0.22 for the state. The advance estimate of the value of agricultural output for the year 2016-17 is about Rs. 296092.67 crore at current prices, according to the Directorate of Economics and Statistics, the Government of Uttar Pradesh, Lucknow. To double the income of the farmer households by 2022, the value of agricultural output should also reach Rs. 592185.34 crore at 2016-17 prices. To achieve this level of value of agricultural output in the year 2022-23 with ICOR of 0.22, investment of an amount of Rs. 655 billion at 2016-17 prices would be required, indicating the requirement of a total investment of Rs. 131 billion per year at 2016-17 prices. Capital expenditure for the year 2014-15 was about Rs. 55 billion. It means more than double of the current investment in agriculture would be required.

The pattern of capital expenditure presented in Table 5.2 clearly indicates that irrigation, food storage and warehousing, forestry and wild life, and crop husbandry were the key sectors of public investment. High investment in irrigation appears to have translated into high net irrigated area in the state. A diligent analysis of the data obtained from The

Statistical Diary – Uttar Pradesh (2015 and 2007) published by the Directorate of Economics and Statistics, Government of Uttar Pradesh, helps in understanding the progress and contribution of different irrigation sources across all districts in Uttar Pradesh. Tables 5.3 and 5.4 show the district-wise Net Irrigated Area (in hectare) by different sources such as canals, government tube-wells, private tube-wells, and other irrigation sources, along with Net Area Sown (in hectare) and the Irrigation Ratio (Percentage of Net Irrigated Area to Net Area Sown) for two years 2004-05 and 2013-14, respectively in Uttar Pradesh.

From the above tables, it can be observed that the Irrigation Ratio in Uttar Pradesh, across all districts, has increased from around 78 per cent in 2004-05 to around 84 per cent in 2013-14. In addition, the number of districts with more than 80% Irrigation Ratio has increased from 46 (around 61 per cent of all districts) to 55 (around 73 percent of all districts) from the year 2004-05 to 2013-14.

Irrigation, mainly micro-irrigation, and warehousing should remain the focus areas of the government investment in Uttar Pradesh as these are still the major challenge for the agriculture development in the state. Nevertheless, investment portfolio should be diversified to include animal husbandry, agricultural marketing and food processing sector as these offer opportunities for income growth for the farmers in Uttar Pradesh.

5.2 STRATEGY SUGGESTED BY THE STATE GOVERNMENT

The Government of Uttar Pradesh prepared a strategy to double the farmer's income by 2022. This strategy includes the following aspects:

1. Reduction in cost of cultivation
2. Productivity growth
3. Food processing and grading
4. Agriculture diversification
5. Minimise post-harvest losses

In order to reduce the cost of cultivation and boost productivity, the major focus of the government is on the judicious use of fertilisers (soil health card fulfil that objective), promotion of farm mechanization through custom hiring centre and farm machinery bank, promotion of organic farming, and distribution of solar pump and sprinklers for irrigation. The state has also identified suitable districts for different crops and is promoting their

cultivation on the basis of that. It has identified 31 districts for wheat, 23 districts for paddy and 20 districts for coarse cereals. This would help the state in harnessing the comparative advantages of its different agro-climatic regions. However, one important aspect of productivity is missing here, which is seed. Seed is basically transporter of technology in the agriculture sector. To achieve high productivity growth, adoption of hybrid and improved seeds need to be promoted. During the field survey of this study and interactions with farmers, we found that input dealer was the major source of information on improved seeds for the farmers in the state and most of the time farmers were misguided by these dealers. Both availability and price of hybrid and improved seeds were the major concerns for the farmers.

Grading of agricultural produce and promotion of food processing industry would also help the farmers in getting a better price for their produce. It would also provide employment to rural workforce, which, in turn, would reduce the burden on agriculture sector.

To reduce the post-harvest losses, the Government of Uttar Pradesh is focusing on warehousing, reforms in agricultural marketing, extension of market yards and cold chain. All these aspects are very important as the state is lacking in these facilities.

The state is also encouraging agricultural diversification by promoting production of fruits and vegetables, milk and milk products, and fish, egg and meat. The state has set the target of 221.74 lakh ha of cultivated area under fruits, which is currently about 132 lakh ha. Similarly, a target of 9.1 per cent of growth in milk production is set in the state. Though, several targets have been set, strategy to achieve them is yet unclear.

5.3 PLAN OF ACTION BASED ON THE STUDY OBSERVATIONS

5.3.1 REDUCING OUTPUT GAP BY IMPROVING EFFICEINCY

Yield improvement is important for increasing crop production as the cultivated area under crop cannot increase much because of the limited availability of land. Technological progress and improvement in technical efficiency can help improve crop yield. Since technological progress is a long-term phenomenon, enhancing technical efficiency is essential for yield growth in the short run. Temporal pattern of technical efficiency of principal crops grown in Uttar Pradesh is shown in Table 5.5. It reveals high technical inefficiency in the production of each of the principal crops in the state. In fact, technical

inefficacy of many crops, for example, gram, lentil, potato etc., seems to have increased over the years. Comparison of the potential and the actual output of principal crops presented in Table 5.6 indicates improvement by more than 10 per cent in the output of most crops by recovering technical efficiency. In other crops, like arhar and gram, output improvement of an additional 50 per cent was likely through technical efficiency. It clearly shows substantial gains in output and/or a decrease in the cost of production with available technology and resources.

Identification of the problem though is important, more important is the prescription to control the problem. However, the kind of data available in the state from the best possible sources does not provide the scope to do so. Because of this limitation, we use the results of the available studies conducted at the micro level in India to identify the factors for reducing technical inefficiency. Results collected from different studies (Kalirajan, 1981; Kalirajan and Sand, 1985; Kalirajan, 1991, etc.) suggest that access to extension services, level of experience, access to credit facilities and farm size were important determinants of technical efficiency and they have a positive impact on crop productivity. Education and awareness also have a significant role in increasing technical efficiency because both educated and aware farmers tend to be more responsive in the adoption and utilization of farm inputs and technology. Coelli and Battese (1996) found that farmers with higher years of schooling achieved more efficiency. Demonstration at field level and technical assistance through regular agricultural extension services would be extremely helpful here. Extension services in Uttar Pradesh are in a very poor condition; this was reflected during the interactions with the farmers in the field. Except for farmers in Ghaziabad district, not a single farmer in our sample said that extension agent had approached him or her.

5.3.2 INCREASING PRODUCTIVITY BY ADOPTING HYBRID SEEDS

Seed is the actual carrier of technology in the agriculture sector. Unfortunately, the adoption of the improved variety of seeds in Uttar Pradesh is very limited. In a recent field study (Tripathi and Mishra, 2017) conducted in eastern Uttar Pradesh and Bihar, It was observed that more farmers in Bihar adopted hybrid seeds than the eastern Uttar Pradesh. About 82 and 77 per cent farmers in Bihar were found to be using hybrid seed varieties of rice and maize, respectively. Whereas these ratios are very low in the case of Eastern Uttar Pradesh – 45 per cent in the case of rice and 49 per cent in the case of maize. Both supply and

demand side factors were responsible for poor adoption of the improved variety of seeds in Uttar Pradesh, as is seemed from interaction with farmers. There is a problem in both availability and distribution of quality seeds. Besides, the farmers themselves were unaware of the improved verities of seeds. Input dealers were found to be the major source of their information on the quality of seeds.

Several incidences were quoted by the farmers in the field survey about how they were cheated by the input dealers. In several cases, the farmers were encouraged to buy the inferior quality of seeds by providing them with the wrong and misleading information.

Table 5.7 indicates that education of the head of a household, access to institutional credit facility and availability of own irrigation facility increase the probability of adoption of hybrid seeds in Uttar Pradesh. More importantly, the National Food Security Mission (NFSM) is an important determinant in the adoption of hybrid seeds in the state as it provides the subsidy to the farmers to buy hybrid seeds. NFSM is a Centrally Sponsored Scheme and was launched in 2007-08.

5.3.3 INCREASING OUTPUT BY BETTER ACCESS TO IRRIGATION

In Uttar Pradesh, about 87 per cent of the net cropped area is irrigated and the tube-wells were the major source of irrigation. Tube-wells account for about 71 per cent of the total irrigated area in the state. Nevertheless, irrigation is still a major challenge for the farmers in Uttar Pradesh except for the eastern region of the state. Different challenges were noticed in different locations – districts belonging to Bundelkhand and Vindhyachal regions do not have enough water for irrigation, in these districts, irrigated area is less than 40 per cent of the net sown area which is much lower than the state average. On the other hand, districts belonging to the western region of the state are left with limited water resources due to excessive water consumption in these districts.

Fast declining water table and the poor maintenance of the canal system was the cause of deficient irrigation in the state. An acute decline in the level of ground water was observed in each of the sample village of this study. This is corroborated by a comparison of the current water level with the ten-year average ground water level in each region. The information is provided in Ground Water Year Book Uttar Pradesh (2014-15) published by Central Ground Water Board, Government of India. Information on Water Table was collected from 1241 monitoring wells spread across the state. In the ground water data of

10 years, there was a declining trend in the pre-monsoon water level in 51.4% of the monitoring wells and a declining trend in 50.6% of the monitoring wells in the post-monsoon season. Though the water table is falling all over the state, a higher decline was noted in the districts of western, north-western and southern parts and along Yamuna River.

Excess use of ground water coupled with low rainfall due to climate change led to a fast decline in the water table. On the other hand, corruption and political negligence seemed to be the prime reason for poor maintenance of the canals. There was a big hope from Pradhanmantri Krishi Sichai Yojana (PMKSY), launched in 2015 with a mission to provide irrigation to all *"har khet ko pani"* and improving water use efficiency "per drop more crop". Data provided over PMKYS portal also reflects a significant progress of the scheme. However, a large section of the farmers is yet to achieve the benefits of this programme. Hence the scheme needs to be implemented in a focused manner as the current government has done in the implementation of Jan Dhan Yojana (JDY).

Irrigation security depends on water availability, accessibility and the water holding capacity of soil. In UP, ground water is a major source of irrigation. However, the age-old practice of flooding for irrigation coupled with the use of electricity or diesel operated pumps lead to excessive water withdrawal that exacerbates the fall in the water table. This practice not only leads to a very high cost of irrigation, it but it also deteriorates the water holding capacity of the soil, which further increases the cost of irrigation as more irrigation is required for soil with a poor water holding capacity. Land degradation and climate change are the major reasons of the deteriorating water holding capacity of a soil.

5.3.4 INCREASING THE FARM PRODUCTIVITY THROUGH GROUP/COLLECTIVE FARMING AND ADOPTING MODEL LEASE ACT

Our interactions with the farmers in UP revealed the rapidly reducing size of the operational landholding of the farmers. This is also confirmed by the NSS of Household Ownership and Operational Holdings. As per the latest NSS survey on land holdings for the year 2012-13, as many as 83.5 percent of farm holdings in UP are marginal (below 1 hectare), while 8.36 percent are small (between 1 and 2 hectares). These figures were 73.13 in the case of marginal holdings and 11.39 percent in the case of small holdings in the year 1971-72. Percentage of the households in each category, except for marginal, has been declining in

the last four decades. Continual fall in the size of the operational land holding in UP is a major threat to enhance the farmers' income, as is reflected from Chand et al. (2011). Chand et al. (2011) have clearly shown that while the small farm in India is superior in terms of production performance, it is weak in terms of generating adequate income or livelihood sustenance. The study further said that tiny holdings below 0.8 ha do not generate enough income to keep a farm family out of poverty despite high productivity.

Land fragmentation was mainly responsible for the persistent decline in the size of operational holdings. Operational landholding of a majority of farmers tends to be economically unviable, which in turn, leads to rural distress and migration, as was clearly reflected from the Focus Group Discussions with the farmers. The main factor contributing to land fragmentation was the traditional system of inheritance that leads to the division of a family land among the sons in successive generations.

This could be addressed through collective farming (Agarwal, 2010; Dev, 2012). In order to provide the institutional support to collective or joint farming, leasing of agricultural land should be permitted in the state. It is currently banned in the state except for a few cases. According to the Uttar Pradesh Zamindari Abolition Land Reforms Act, 1950, the state allows leasing out only by a disabled person and the agriculture-related educational institution. A disabled person is defined as an unmarried/divorced/separated woman, a widow or a woman whose husband is incapable of cultivating due to physical or mental infirmity or a minor whose father suffers from infirmity or person who is a lunatic or an idiot or blind or a student of a recognized educational institution whose age does not exceed 25 years and whose father suffers from infirmity or is a serving member of the armed forces or a person under detention or imprisonment.

Nevertheless, the expert committee constituted by Niti Aayog to review the existing agricultural tenancy laws of the various states has suggested the enactment of a Model Land Leasing Act, 2016, to permit and facilitate leasing of agricultural land to improve agricultural efficiency and equity, access to land by the landless and semi-landless poor, occupational diversity and to promote accelerated rural growth and transformation. The Act also provides recognition to farmers cultivating the agricultural land on lease to enable them to access loans through credit institutions, insurance, disaster relief and other support services provided by the government, while fully protecting the land rights of the owners. This law will also be helpful in the consolidation of the land holdings. This law is yet to be

adopted in Uttar Pradesh state. However, some progressive states such as Gujarat, Odisha and Punjab have adopted the above model act.

5.3.5 BETTER REALIZATION OF PRICES

The farmers in Uttar Pradesh get a low price for their farm produce mainly because of two reasons – cobweb phenomena and inefficient marketing system. Potato in the state clearly reflects cobweb phenomena. In 2016, farmers received a good price which encouraged them to allocate more land and input to potatoes in 2017. It led to a bumper production in 2017 which, in turn, collapsed potato price. Almost every farmer complained that the cost incurred on cultivating the crop was greater than the price they received from the market, leading to heavy losses. The farmers in Firozabad, a major potato producing state, told us that the total cost incurred in potato production, including cultivation and marketing cost, was about Rs 400 per quintal and the price received by them was about Rs 160 per quintal, indicating about 150 per cent loss in the production of potato.

Intermediaries continue to play a significant role in agriculture marketing system in the state. More than 80 per cent of the sample households were not able to directly sell their produce in the Mandi because of the low marketed surplus and long distance between the farm and the market. Farmers are also resource poor and hence they need cash immediately after harvesting. It forces them to sell their produce instantly after harvesting. E-NAM scheme launched recently seemed unable to fix this problem.

Unless there is an efficient agriculture marketing system, farmers in the state would continue to face the problem of poor returns for their farm produce.

The agriculture marketing system in the state should be based on the following principals.

1. *Market Intelligence*: There should be a system for keeping an eye on the market forces (supply and demand) of each agricultural commodity as they play a role in price determination of the commodity. It will help to know the gap between supply and demand in advance to take immediate action. As in the case of a surplus, the price of the commodity would crash and the farmers may not get remunerative price. In such a situation, the government can intervene to protect the farmers by adopting a deficiency payment system. Recently, the Government of Madhya Pradesh had

adopted this policy on a pilot basis to help the farmers. Though there were some issues like delay in payment etc., farmers seem to have benefited largely.

2. *Market infrastructure:* A good marketing infrastructure, which includes marketing yard, storage facility (both godown and cold storage), advance weighing system, proper grading and sorting facility, and digital display, is the prerequisite of an efficient marketing system.

3. *Transparency:* Selling and buying agriculture produce at APMC yard involves several steps, such as auctioning, weighing, payment etc. There should be transparency in each of these steps.

4. *Farmer's Access to Market Yard:* There should be direct access to the market yard for farmers, suggesting the abolition of intermediaries from the agricultural marketing system.

Table 5-1: Public investment and value of agricultural output in Uttar Pradesh

Year	Pubic Investment (In Lakh Rs.)	Value of Agricultural Output (In Crore Rs.)
2004 – 2005	183299	70167.1
2005 – 2006	187282	76603.67
2006 – 2007	222160	82320.34
2007 – 2008	322749	92623.09
2008 – 2009	522770	117897.8
2009 – 2010	666649	133945.6
2010 – 2011	171231	152998.1
2011 – 2012	199749	167985.8
2012 – 2013	278518	196405.5
2013 – 2014	347394	221487.7
2014 – 2015	549949	227044.4

Table 5-2: Capital expenditure including plan and non-plan on different services of agriculture sector

Year	Agriculture and Allied Activities	Crop Husbandry	Soil and Water Conservation	Animal Husbandry	Dairy Development	Fisheries	Forestry and Wild Life	Plantations	Food Storage and Warehousing	Agricultural Research and Education	Co-operation	Others	Major and Medium Irrigation and
1995 - 1996	18429.015	413	-2	378	920	261	13	0.005	-12793	0.005	3274	0.005	25965
1996 - 1997	32034.015	-458	0.005	1480	813	8	109	0.005	-23148	0.005	2155	1	51074
1997 - 1998	50537.02	-575	0.005	577	290	1	-745	0.005	8374	0.005	261	0.005	42354
1998 - 1999	43663.025	-170	0.005	423	724	0.005	-16	0.005	-3297	0.005	3292	0.005	42707
1999 - 2000	124520.03	6106	0.005	212	379	0.005	0.005	0.005	55529	0.005	1093	0.005	61201
2000 - 2001	122446.025	2959	0.005	657	-122	0.005	0.005	0.005	38582	995	-1961	0.005	81336
2001 - 2002	175903.02	21457	0.005	448	152	0.005	158	0.005	74262	1000	1417	0.005	77009
2002 - 2003	132391.02	25666	0.005	560	234	0.005	4076	507	28153	0.005	376	0.005	72819
2003 - 2004	91431.015	14925	0.005	407	-227	0.005	4490	353	-4851	2102	135	0.005	74097
2004 - 2005	183299.015	373	0.005	684	144	0.005	5371	491	87270	715	385	0.005	87866
2005 - 2006	187282.015	2081	0.005	3659	55	0.005	14742	509	572	1275	262	0.005	164127
2006 - 2007	222162.015	827	0.005	4994	743	0.005	15627	502	-41323	3516	-36	0.005	237312
2007 - 2008	322749.015	866	891	4734	0.005	0.005	20346	587	75313	100	704	0.005	219208
2008 - 2009	522771.01	1879	315	3786	-91	0.005	24455	562	232298	-1104	472	0.005	260199
2009 - 2010	666649.015	-9454	0.005	1223	-69	0.005	18815	562	407379	16732	359	0.005	231102
2010 - 2011	171230.02	362	0.005	804	0.005	0.005	11499	50	-121224	26771	-2020	0.005	254988
2011 - 2012	199749.02	24374	0.005	1262	0.005	0.005	13246	50	-65682	17993	-3981	0.005	212487
2012 - 2013	278519.025	11825	0.005	706	0.005	0.005	17304	0.005	46266	12628	121	0.005	189669
2013 - 2014	347393.025	9279	0.005	6229	0.005	0.005	23678	0.005	2235	9359	1085	0.005	295528
2014 - 2015	603861.02	38335	1054	8878	0.005	0.005	27898	0.005	4887	8549	2671	0.005	511589
2015 - 2016	672273.02	38530	1313	3731	0.005	0.005	35190	0.005	3768	9690	46400	0.005	533651

Table 5-3: Districtwise net irrigated area (in hect) by different sources, net area sown (in hect) and percentage of net irrigated area to net area sown in Uttar Pradesh (Year 2004-05)

District	Canal	Govt. tubewell	Private tubewell	Other sources	Net irrigated area	Net Area Sown	Percentage of Net Irrigated Area to Net Area Sown
Agra	26949	3834	206302	2688	239773	280282	85.55
Aligarh	31592	4886	262732	116	299326	301904	99.15
Allahabad	118219	17243	93220	11604	240286	325836	73.74
Ambedkar Nagar	23659	4807	128469	7	156942	166806	94.09
Amethi	**	**	**	**	**	0	**
Amroha	2	321	167647	1401	169371	170803	99.16
Auraiya	54084	2619	62252	400	119355	143882	82.95
Azamgarh	54282	4914	223031	653	282880	303368	93.25
Baghpat	4678	1176	103145	35	109034	110238	98.91
Bahraich	6687	2645	155789	1415	166536	324931	51.25
Ballia	29829	10537	131050	69	171485	222543	77.06
Balrampur	4084	934	63067	4800	72885	212154	34.35
Banda	81436	9729	20545	11861	123571	351472	35.16
Barabanki	81278	4235	158037	666	244216	290140	84.17
Bareilly	37718	2024	242554	6753	289049	328235	88.06
Basti	0	7483	122736	5326	135545	209644	64.65
Bijnor	8919	5025	159988	86699	260631	336654	77.42
Budaun	19	5241	266490	105828	377578	414995	90.98
Bulandshahar	25102	4983	220816	12814	263715	298371	88.38
Chandauli	108118	5733	11677	1910	127438	135466	94.07
Chitrakoot	12849	116	12655	20046	45666	173850	26.27
Deoria	23779	8600	135622	9842	177843	198548	89.57
Etah	33884	6481	153184	115800	309349	327724	94.39
Etawah	60855	3993	54847	738	120433	147078	81.88
Faizabad	16729	9496	96164	15	122404	135122	90.59
Farrukhabad	2532	3277	117313	476	123598	151975	81.33
Fatehpur	46574	7518	134059	1253	189404	290361	65.23
Firozabad	16884	1477	154603	246	173210	180954	95.72
Gautam Buddha Nagar	12105	2502	35826	21861	72294	118709	60.90
Ghaziabad	20436	2284	104497	7856	135073	146268	92.35
Ghazipur	48264	7013	155249	132	210658	253207	83.20
Gonda	7652	21608	156210	2235	187705	299826	62.60
Gorakhpur	5882	11146	181958	2605	201591	252909	79.71
Hamirpur	36807	11211	26100	29326	103444	300719	34.40
Hapur	**	**	**	**	**	0	**
Hardoi	67057	5156	294442	6994	373649	420016	88.96
Hathras	12970	1567	133466	132	148135	148768	99.57
Jalaun	146629	10846	19462	18484	195421	350296	55.79

District	Canal	Govt. tube-well	Private tube-well	Other sources	Net irrigated area	Net Area Sown	Percentage of Net Irrigated Area to Net Area Sown
Jaunpur	67112	14566	168914	18	250610	279074	89.80
Jhansi	80839	2790	7812	122810	214251	341378	62.76
Kannauj	15515	3387	107720	159	126781	143088	88.60
Kanpur Dehat	66992	6682	85807	1156	160637	220463	72.86
Kanpur Nagar	31472	6164	94894	1637	134167	188046	71.35
Kasganj	**	**	**	**	**	0	**
Kaushambi	15192	4622	72366	30	92210	132022	69.84
Kheri	21633	3116	365004	156	389909	486382	80.17
Kushinagar	59474	1921	85890	19819	167104	223166	74.88
Lalitpur	74917	0	26256	123679	224852	277994	80.88
Lucknow	27916	7793	86975	541	123225	138148	89.20
Mahoba	33261	50	1126	76749	111186	238301	46.66
Mahrajganj	29502	1573	127145	5728	163948	201849	81.22
Mainpuri	51048	3634	110493	137	165312	167057	98.96
Mathura	107646	0	159103	140	266889	270885	98.52
Mau	9302	1642	94641	233	105818	125244	84.49
Meerut	33785	5117	146943	170	186015	198480	93.72
Mirzapur	69666	8890	12710	20595	111861	200331	55.84
Moradabad	8827	4080	150146	115818	278871	316322	88.16
Muzaffarnagar	76823	7555	237592	413	322383	325927	98.91
Pilibhit	56889	680	159929	7694	225192	235092	95.79
Pratapgarh	81810	384	102906	22	185122	215672	85.83
RaeBareli	109474	6405	118319	107	234305	271836	86.19
Rampur	1727	996	185821	4282	192826	194780	99.00
Saharanpur	43652	10900	200425	69	255046	274202	93.01
Sambhal	**	**	**	**	**	0	**
Sant Kabir Nagar	2293	4731	87209	5875	100108	121598	82.33
Sant Ravidas Nagar	10190	15616	29297	924	56027	68634	81.63
Shahjahanpur	10471	188	317846	309	328814	347014	94.76
Shamli	**	**	**	**	**	0	**
Shrawasti	211	1844	47532	3952	53539	130567	41.01
Siddharth Nagar	13975	1824	126103	16797	158699	235083	67.51
Sitapur	25165	4830	311805	18265	360065	435965	82.59
Sonbhadra	34419	198	34	3885	38536	168525	22.87
Sultanpur	65092	10126	159606	191	235015	283956	82.76
Unnao	76255	3842	193578	1052	274727	304248	90.30
Varanasi	10803	24081	49094	1278	85256	97543	87.40

Table 5-4: District-wise net irrigated area (in hect) by different sources, net area sown (in hect) and percentage of net irrigated area to net area sown in Uttar Pradesh (Year 2013-14)

District	Canal	Govt. tubewell	Private tubewell	Other sources	Net irrigated area	Net Area Sown	Percentage of Net Irrigated Area to Net Area Sown
Agra	21875	4480	224719	1511	252585	279154	90.48
Aligarh	25364	4881	273259	56	303560	304013	99.85
Allahabad	111736	20234	95164	12920	240054	301820	79.54
Ambedkar Nagar	22706	10672	125055	0	158433	167009	94.86
Amethi	63208	4060	64207	0	131475	147441	89.17
Amroha	0	394	131744	38643	170781	171951	99.32
Auraiya	51368	1964	72279	220	125831	146188	86.07
Azamgarh	41817	3776	242138	95	287826	300335	95.83
Baghpat	2237	730	104942	0	107909	107919	99.99
Bahraich	3448	3507	162325	0	169280	328244	51.57
Ballia	25103	9287	145435	0	179825	216978	82.88
Balrampur	0	144	80203	24741	105088	212662	49.42
Banda	60596	15454	60439	16043	152532	345470	44.15
Barabanki	72694	1291	124099	39581	237665	258858	91.81
Bareilly	15841	1003	193887	109641	320372	330438	96.95
Basti	278	7230	121207	48166	176881	209096	84.59
Bijnor	22963	6999	177967	100114	308043	325657	94.59
Budaun	0	6156	189287	142953	338396	350510	96.54
Bulandshahar	23642	2863	266205	6717	299427	299427	100.00
Chandauli	104530	9032	9713	5744	129019	136852	94.28
Chitrakoot	12473	73	31938	6754	51238	173312	29.56
Deoria	28777	19960	134395	1187	184319	197302	93.42
Etah	28562	8080	149228	0	185870	185870	100.00
Etawah	65981	4381	61518	517	132397	147209	89.94
Faizabad	32499	14749	107805	95	155148	173068	89.65
Farrukhabad	2965	6467	130107	0	139539	149276	93.48
Fatehpur	39607	5229	163585	653	209074	289406	72.24
Firozabad	13835	582	159364	938	174719	182874	95.54
Gautam Buddha Nagar	13883	304	24475	14444	53106	53143	99.93
Ghaziabad	7675	1177	38505	3806	51163	51169	99.99
Ghazipur	52674	10067	156827	0	219568	254006	86.44
Gonda	16144	25252	197536	11919	250851	286831	87.46
Gorakhpur	2082	10196	200888	714	213880	245970	86.95
Hamirpur	33669	17520	74393	25147	150729	292810	51.48
Hapur	**	**	**	**	**	86998	**
Hardoi	52086	3498	339251	85	394920	433834	91.03
Hathras	11424	44	137658	0	149126	149138	99.99
Jalaun	168628	17278	41966	20678	248550	351155	70.78

District	Canal	Govt. tubewell	Private tubewell	Other sources	Net irrigated area	Net Area Sown	Percentage of Net Irrigated Area to Net Area Sown
Jaunpur	64662	5517	178474	5	248658	278948	89.14
Jhansi	125470	1541	21436	122649	271096	336325	80.61
Kannauj	9496	4517	125734	35	139782	153407	91.12
Kanpur Dehat	58222	10068	89694	76	158060	221926	71.22
Kanpur Nagar	23143	6344	90107	521	120115	187710	63.99
Kasganj	12832	2845	76455	49543	141675	143139	98.98
Kaushambi	13503	5796	72984	8	92291	127668	72.29
Kheri	19535	10639	397707	83	427964	480273	89.11
Kushinagar	41094	3315	111482	12814	168705	223745	75.40
Lalitpur	96960	643	69942	121670	289215	304979	94.83
Lucknow	23164	4067	102436	50	129717	137801	94.13
Mahoba	35030	165	4883	87138	127216	239018	53.22
Mahrajganj	31962	948	126906	8127	167943	201218	83.46
Mainpuri	48321	6699	130020	20	185060	186405	99.28
Mathura	103770	0	164294	0	268064	268743	99.75
Mau	10322	500	106379	0	117201	121801	96.22
Meerut	32218	2268	160871	0	195357	195360	100.00
Mirzapur	63481	9722	14614	18201	106018	190911	55.53
Moradabad	11678	11537	62222	96847	182284	186347	97.82
Muzaffarnagar	57352	3018	141330	15165	216865	219517	98.79
Pilibhit	36266	223	192879	3	229371	232839	98.51
Pratapgarh	63495	10	53556	42157	159218	183788	86.63
RaeBareli	82259	4601	116904	50	203814	224310	90.86
Rampur	450	4075	75720	109976	190221	191285	99.44
Saharanpur	40877	9834	205362	0	256073	272841	93.85
Sambhal	**	**	**	**	**	201260	**
Sant Kabir Nagar	2419	4486	88892	8676	104473	121096	86.27
Sant Ravidas Nagar	10682	17876	26918	0	55476	69086	80.30
Shahjahanpur	9553	892	234912	77739	323096	351317	91.97
Shamli	**	**	**	**	**	102653	**
Shrawasti	0	0	70921	25	70946	132293	53.63
Siddharth Nagar	7340	946	150525	13533	172344	235666	73.13
Sitapur	17583	2884	378587	162	399216	445421	89.63
Sonbhadra	26328	0	1144	5412	32884	146126	22.50
Sultanpur	31628	10467	108279	34	150408	177629	84.68
Unnao	70667	2649	222075	1525	296916	313832	94.61
Varanasi	8376	20453	53359	898	83086	95812	86.72

Table 5-5: Temporal pattern of technical efficiency of principal crops in Uttar Pradesh

Name of Crop	Efficiency 2003 – 2004	Efficiency 2008 – 2009	Efficiency 2013 – 2014
Wheat	0.79	0.89	0.86
Arahar	0.65	0.75	0.79
Bajra	0.65		0.69
Barley	0.69	0.72	0.99
Gram	0.59	0.99	0.61
Lentil	0.72	0.83	0.73
Maize		0.64	0.99
Mustard	0.60	0.59	0.67
Paddy	0.76	0.72	0.83
Pea		0.73	0.75
Potato	0.62	0.76	0.69
Sugarcane	0.72	0.77	0.78
Urad	0.94	0.99	0.99

Source: Author's own calculation applying Stochastic Production Function Approach on plot wise data collected form the Commission of Agricultural Cost and Price, Government of India.

Table 5-6: Ratio between potential and actual output for each of principal crops

Name of Crop	Ratio 2003 – 2004	Ratio 2008 – 2009	Ratio 2013 – 2014
Wheat	1.10	1.05	1.06
Arahar	1.82	1.40	10.49
Bajra	1.15		1.20
Barley	1.22	1.20	1.00
Gram	1.75	1.01	5.06
Lentil	1.95	1.23	1.86
Maize		1.27	1.00
Mustard	4.62	1.97	1.73
Paddy	1.12	1.13	1.07
Pea		1.29	1.27
Potato	1.18	1.15	1.15
Sugarcane	1.07	1.05	1.05
Urad	2.71	0.98	0.97

Source: Author's own calculation applying Stochastic Production Function Approach on plot wise data collected form Commission of Agricultural Cost and Price, Government of

Table 5-7: Determinants of adoption of hybrid crop

Variables	Hybrid rice (0=N & 1=Y)	Hybrid maize (0=N & 1=Y)
State dummy (0=B & 1=EUP)	1.12	17.19
NFSM district (0=N & 1=Y)	0.60	18.50
Age_Household Head	-0.14	0.03
Age2_Household Head	0.01	-0.01
Education_Household Head	0.21	0.24
Wealth Index	-0.10	-0.10
Access to Institutional Credit (0=N & 1=Y)	1.15	-0.11
Role women in adoption decision	-0.29	-0.09
Off-farm employment	-0.38	2.32
Household size	-0.04	0.02
Land size	-0.01	0.04
Availability of own irrigation facility	0.01	-0.01
Access to storage facility	-0.83	0.89
Timely availability of fertilizer	0.30	0.20
Intercept	0.68	-20.05
Pseudo R2	27.00	0.38
LR	87.34	132.56
Number of obs	244.00	259.00

Source: Author's own calculation applying Logistic Regression Approach on household data collected form Cereal Systems Initiative for South Asia (https://www.csisa.org).

The approach of the Government of India to farmers' welfare appeared to have shifted away from Raising Agriculture Output (RAO) approach towards Income Enhancement (IE) approach. The advantage of IE approach is that it gives equal importance to both production and post-production components of agricultural development and farmers' welfare. Against this backdrop, the present study is an attempt to evolve a specific strategy for doubling the income of farmers in Uttar Pradesh taking into account their needs and constraints information collected from 1200 agricultural households from 48 villages in the state. This strategy has taken into account the current income level of farmers in the state and its composition.

The multi-stage sampling procedure was applied to select 1200 sample households in this study. First, all nine agro-climatic zones of UP were divided into three groups on the basis of agricultural productivity – high (Western plain, Southwestern semiarid, Mid-western, and Tarai & Bhabhar zone), medium (Mid-plain or central, North-eastern plain and Eastern plain) and low (Vindhyan and Bundelkhand zones). From the first group, two zones (Western plain and southwestern semi-arid zone) with the highest level of agricultural productivity were chosen. From the second group, all three zones were chosen for the purpose of the study as there is a negligible difference in agricultural productivity across these zones. Finally, Bundelkhand zone was chosen from the third category of agro-climatic zones because it has the least agricultural productivity.

After the selection of the agro-climatic zones, one sample district was chosen from each of the sample zones following the criteria of vulnerability to climate change as it has become an important determinant of agriculture production in the state. The following districts were selected: Lalitput (Bundelkhand agro-climatic zone), Pratapgarh (Central zone), Varanasi (Eastern plain zone), Gorakhpur (North-eastern plain zone), Firozabad (South-western semi-arid zone), and Ghaziabad (Western plain zone). Though a district with a median level of climate change vulnerability was chosen from each sample agro-climatic zone, selected districts showed different levels of vulnerability to climate change. From each sample district, two blocks were selected randomly and from each selected block, two sets of villages were chosen; each set had two villages. One set of villages was selected on the basis

of irrigation ratio and the other one set of villages was chosen on the basis of availability of agricultural marketing facilities.

6.1 SUMMARY OF THE FINDINGS

- *Kharif* and *Rabi* seasons are the major seasons in the state. In the *Jayad* season, the farmers prefer to keep their land fallow. During the study period, not a single farmer was found to be cultivating any crop during the *Jayad* season in the districts of southwestern semi-arid region (Firozabad), central zone (Pratapgarh), and North-eastern plain zone (Gorakhpur). In the eastern plain, western plain and Bundelkhand, a few farmers were observed to be sowing crops in the *Jayad* season.

- Between *Kharif* and *Rabi* season, *Rabi* season appeared to be the prime agriculture season.

- Wheat was the major crop in *Rabi* season in all parts of UP. Paddy was an important crop for *Kharif* season at the aggregate state level. But, it was not true in each part of the state, as is reflected from our data. Urad was the principal crop of *Kharif* season in Bundelkhand region of the state. Similarly, *bajra* was the major crop in the southwestern semi-arid zones.

- Access to irrigation and rainfall were identified as the main determinants of cropping pattern.

- The second principal crop in both the seasons varied from region to region within the state. Potato and paddy were the second principal crop in the *Rabi* and *Kharif* seasons, respectively, in Firozabad. Sugarcane in *Kharif* season and potato in *Rabi* season were the second principal crop in Ghaziabad. The central part of Uttar Pradesh represented by Pratapgarh district showed a unique feature: it followed a single cropping system in both the seasons. Bundelkhand region of the state, represented by Lalitpur, grew maize and gram as the second principal crop in the *Kharif* season and the *Rabi* season, respectively. Potato was the second principal crop in the *Rabi* season in the eastern Uttar Pradesh as was reflected from both sample districts (Varanasi and Gorakhpur). The eastern districts of Varanasi and Gorakhpur grew two different second principal crops in the *Kharif* season: bajra was sown in Varanasi and maize in Gorakhpur.

- Crop profitability at the aggregate state level indicated that sugarcane was the most money-making crop in the state except for the Bundelkhand and Central regions. Crop profitability varied significantly across the agro-climatic zones of the state.

- In terms of relative profitability, the importance of crops changes over regions of the state. Sugarcane, mustard, rapeseed, and potato were identified as the most profitable crops in the western part of the state, as is reflected from both the sample western districts in the study (Firozabad and Ghaziabad). Cereals, particularly paddy, was the most profitable crop in the central part of the state, as is shown by Pratapgarh district of the central region of Uttar Pradesh. Similarly, wheat was the most profitable crop in Bundelkhand region. In the eastern region, sugarcane and potato were the most lucrative crops in the region.

- 71 per cent of the total sampled households were found indebted; the highest number of them belonged to the western districts of Ghaziabad and Firozabad. The share of indebted households in these districts was 93 per cent and 82 per cent respectively. A lesser number of sample households were found indebted in the eastern and Bundelkhand districts compared to the western and central districts.

- Non-institutional sources such as relatives and moneylenders were still important sources of credit for agricultural households. About 40 per cent of the outstanding amount came from these sources in each sample districts, except for Lalitpur.

- It was also noted that about 60 per cent of the indebted farmers had taken the loan for agricultural purposes such as agricultural machinery, fertilizers, seed etc. Non-agricultural proposes also played an important role.

- Average annual household income for the agriculture year 2016-17 was estimated as Rs. 153488 in Uttar Pradesh. Per-capita household income in the state was Rs. 25659.

- There is inter-region variation in the average annual household income in Uttar Pradesh. The highest average annual income was reported by agricultural households of the western plain regions (Ghaziabad) followed by north-eastern plain zone (Gorakhpur) of the state. The lowest average annual household income was reported by Bundelkhand region followed by districts of the central zone and eastern plain zone of the state.

- Income of the agricultural households belonging to general caste category was found to be much higher than the income of households of other categories. Similarly, the

- agricultural households with large land holdings reported much higher income than the households with other land categories.

- A weak correlation exists between per-capita farm income and the size of land holdings. However, a negative correlation between per-capita annual non-farm income and size of landholdings was evident.

- Farm income was observed as the chief source of earnings of agricultural households in UP. It contributed around 55 per cent of the total income for the sampled agricultural households. The rest 45 per cent of total income came from non-farm sources such as wage/salaried employment, business etc. The share of farm income in the total income was much higher in Bundelkhand region in comparison to other regions of the state.

- Among sources of non-farm income, earnings from the wages accounted for almost 50 per cent of the total non-farm income of agricultural households. These wages were earned from casual employment, indicating lack of the formal employment opportunities in the rural manufacturing and service sectors in the state. There was no significant spatial variation in the share of earning from wages in total non-farm income in this state. Other 40 per cent of total non-farm income was contributed by income from salary and business. Remaining 10 per cent of the non-farm income come from remittances, subsidies, and property selling.

- Net annual income from cultivation for the agriculture year 2016-17 was estimated as Rs. 56691 per household at the aggregate state level. The highest net cultivation income per household was observed in the districts of western plain and Bundelkhand regions. The lowest net annual cultivation income was reported by agricultural households in the north-eastern plain (Gorakhpur) followed by the southwestern semi-arid and the eastern plain zones of the state.

- The farmers in the state largely belong to the marginal and small categories. During the survey and the focus group discussions, it was noticed that these farmers majorly grow food crops such as wheat, paddy etc. mainly to meet the food requirements of the households, even though these crops were less lucrative than the commercial crops such as sugarcane, potato, fruits and vegetables.

- The second significant causal factor of the low cultivation income was the realization of a low price for the farm produce.

- The survey revealed 5 to 10 per cent of post-production loss in most of the commodities such as paddy, wheat, and potato etc. This caused a substantial loss in income earned from cultivation.

- Livestock activities (*i.e.* dairy, poultry etc.) were the secondary activities for agricultural households. It was observed that not all sample households were engaged in the livestock activities. The proportion of the households engaged in these activities was 72 per cent in Varanasi, 53 per cent in Gorakhpur, 78 per cent in Firozabad, 80 per cent in Ghaziabad, 96 per cent in Pratapgarh, and 55 per cent in Lalitpur.

- Among the sample households engaged in the livestock activities, about 51 per cent of households earned negative net income from these activities, indicating more expenditure on livestock than the return from the sector. This share was even higher in Gorakhpur and Ghaziabad districts.

- The average annual net income from the livestock activities per agricultural household was about Rs. 16550. It varies from Rs. 11308 in Gorakhpur to Rs. 29790 in Ghaziabad.

- Buying agency played an important role in determining the net income from the livestock activities. Likelihood of a positive net return from the livestock activities was much higher in the case of direct selling to consumers. Selling livestock products to milkman also had a high probability of a positive net profit from the livestock activities.

- There were limited opportunities in the rural non-farm employment in the state, though people desire to shift away from the agriculture sector.

- Among the survey sample households, not a single farmer was found to be aware of the FASAL insurance scheme. Farmers who had taken a loan through Kisan Credit Card knew that the premium amount for FASAL Insurance Scheme was charged to their loan, but did not know any of its purpose or benefits or whether it was life insurance or general insurance, what was the insured sum amount, when they can claim it, etc.

- The benefit of Soil Health Mission has reached only about 4.75 per cent of the sample households, who confirmed that the soil of their field was tested. Only 1.83 per cent of the survey sample agriculture household had received soil health

card so far. It was also very disappointing that the only 43.67per cent farmers had Kisan Credit Card in the study area.

- Close to 90 per cent of the households in five out of six districts perceived a change in the average temperature, with 98 per cent of the households in the district of Ghaziabad acknowledged this change.

- More than 50 percent of the households across all six districts perceived a decrease in the average rainfall. In Firozabad district as high as 95.5 percent households, in Ghaziabad district 89 per cent, and in Pratapgarh district 84 per cent households perceived a reduction in the average rainfall.

- A majority of the households in the districts of Ghaziabad (71.5 percent) and Firozabad (62 percent) also admitted observing longer periods of drought, whereas less than 50 households across all six districts perceived an increase in floods.

- In the districts of Gorakhpur, Ghaziabad and Firozabad, a large number of households reported an increase in the cases of diseases such as malaria, dengue, chikungunya, tuberculosis, typhoid, cholera, and jaundice. The households in the same three districts also reported an increase in the cases of diseases observed amongst their livestock.

- With an exception of Ghaziabad district, the majority of the households in every other surveyed district were unaware of the effects of agricultural practices on climate variability.

- While most of the surveyed households expect improved agricultural inputs, innovative methodologies, and enhanced irrigation, some had even shown an inclination towards better machinery, utilization of clean energy, multiplication of plantation and other land development initiatives. The survey also captured the opinion of the households on how a lack of access to capital, credit, information, inputs, and land constrained their farm productivity and income generation.

- ICOR for UP for the period 2004-05 to 2014-15 was estimated at 0.22.

- To double the farmers' income by 2022, the value of agriculture output must reach Rs. 592185.34 crore at 2016-17 prices. To achieve this level of value of agriculture output in the year 2022-23 with ICOR of 0.22, investment of an amount of Rs. 655 billion at 2016-17 prices would be required, indicating the requirement of a total investment of Rs. 131 billion per year at 2016-17 prices.

- Capital expenditure for the year 2014-15 was about Rs. 55 billion. It meant more than double of the current investment level on agriculture would be required.

- Irrigation, food storage and warehousing, forestry and wildlife, and crop husbandry are the key sectors of public investment. The irrigated area in the state has shown increasing trend and high investment on irrigation would result in productive outcome.

- Irrigation, mainly micro-irrigation, and warehousing should remain the focus areas of government investment in Uttar Pradesh as these were still the major challenge for agricultural development in the state. Nevertheless, investment portfolio should diversify towards animal husbandry, agricultural marketing and food processing sectors as these appeared to be the major stimulating factors for the growth of the farmers' income in the state.

6.2 KEY AREAS OF POLICY CONCERN & SOLUTIONS

Crop diversification away from food crops to commercial crops and fruits and vegetables need to be promoted for increasing the farmers' income from cultivation. Food crops were found to be less lucrative than the commercial crops. The farmers were found allocating more land to cereals such as rice and wheat to meet their domestic requirement. Uneconomic size of land holding of the most of farmers in UP appeared as a major factor which discourage farmers from diversify to commercial crops. It also causes to low level of marketable surplus, which, further, decreases farmers' bargaining power in the market. Here, **group/collective farming and adoption of Model Lease Act has potential to solve the above problem.** Viability of small land holdings can be improved by promoting group/collective farming and adopting Model Lease Act suggested by NITI Aayog. **Promotion of Farmer Producers Organization (FPO) could also be effective.** But, all FPOs in UP were found concentrating on input supply and marketing. They should be encouraged to shift focus on production too to harness the advantage of economies of scale. **Financing FPOs appeared as a key challenge in the state.**

Further, increased crop productivity will also help in crop diversification and thus increasing farmers' income. In order to increase crop productivity in the state, the focus should be on adoption of quality seeds and improvement of production efficiency. Also, Western, Bundelkhand, and Central regions of UP need irrigation supports as it emerged as a major challenge of agriculture growth in these regions. As farmers throughout the state, barring

eastern zone, were facing the severe decline in water-table. Improved access to irrigation would increase agriculture production. **Water conservation and use of micro irrigation need to be promoted in the state. Idea of farmers' school and financial support would be helpful here.**

Adoption of hybrid and improved seeds would significantly increase crop productivity. Use of hybrid and improved seeds was low throughout the state mainly because of lack of awareness, lack of availability and accessibility, and high price. **Input support in form of subsidy will assist in increasing farmers accessibility to quality seeds. In order to increase availability, the focus should be on production of quality seeds and its marketing. Input supply mechanism needs to be improved.** Technical inefficiency was observed in the cultivation practices of the most crops in Uttar Pradesh. This inefficiency had increased in the last two decades. Due to high technical inefficiency, output gap (the difference between potential and actual output) was high. Improved technical efficiency would increase agriculture output and reduce the cost of production. **Proper extension services and demonstration of application of best practices would be effective and to tap the potential of these channels, farmers' school at panchayat level would be useful.**

In Uttar Pradesh, farmers remain forced to sell their produce for prices that are much lower than Minimum Support Price (MSP). It is mainly due to inadequate government procurement system, poor market infrastructure and road connectivity, and involvement of the intermediaries. **Improved public procurement and agricultural marketing system would improve farmers income.** A sound procurement machinery needs to be erected in the state, which includes opening enough procurement centres and increasing procurement targets. **Since benefits of government procurement and MSP reach to paddy and wheat farmers largely, market intervention and price support schemes like price deficiency payment scheme would benefit farmers of other than the above crops.** Adequate infrastructure (roads, transportation services, godowns, cold storage etc.) should also be created and put in place to encourage farmers to get their produce to the mandis.

The state lacked non-farm employment opportunities in the rural areas. **Promoting agriculture value addition industry could be a better option here as it does not require huge investments and high skills.** Besides, a well-developed food processing sector helps in the reduction of wastage, improves value addition, promotes crop diversification, ensures a better return to the farmers as well as increase export earnings. Nonetheless, the food

processing sector in UP faces several challenges – inadequate supply chain, lack of related infrastructures (*i.e.* cold storage, power supply, market etc.), lack of finance, and absence entrepreneurial skill. **Recently, the Government of Uttar Pradesh came up with a scheme called one district one product and introduced new food processing policy. These initiatives could be effective in promoting food processing sector in the state, if these are implemented properly at ground level without any corruption.**

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