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Farm Productivity and Rural Poverty in Uttar Pradesh: A Regional Perspective

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Abstract

The agricultural productivity levels and variations in agricultural performance have been analysed across districts and regions in the state of Uttar Pradesh with the aim of identifying factors that affect land and labour productivity and in turn, rural poverty. The performance of agriculture in Uttar Pradesh has been found to vary considerably across districts and regions and has strong linkages and implications for poverty reduction. Irrigation and fertilizer-use are the major determinants of the level and variations of agricultural productivity in the state. Econometric analysis has indicated strong linkages between agricultural productivity and poverty. An increase of 10 per cent in land productivity would reduce poverty by 4.3 per cent. The dependence of workers on agriculture has shown inverse relationship and 10 per cent reduction in labour force could result in 7.7 per cent reduction in poverty. The study has highlighted the need for strengthening the non-farm employment and income opportunities along with improved farm productivity through resource diversification towards high-value crops like fruits and vegetables. Region-specific development strategies of generating non-farm activities along with improving land productivity are required for reducing rural poverty in Uttar Pradesh. The policy imperatives include public investment in irrigation and incentives to encourage agricultural diversification and intensive-use of inputs like fertilizer.

Key words: Agriculture, productivity variations, poverty linkages, Uttar Pradesh

JEL Classification: Q12

Introduction

Uttar Pradesh is the most populous and densely populated sate of India. The state constitutes about 16 per cent population and 7.3 per cent of the geographical area of the country (GoI, 2001). It is the 2nd largest state-economy and contributes about 8 per cent to country's gross domestic product (GoI, 2009). The economy is predominantly agriculture covering a sizeable part of the highly fertile Upper Gangetic Plain. About 79 per cent population lives in the rural areas and 62 per cent of the total workers are employed in agriculture (GoUP, 2009). The state is known for its wide diversity and variations in natural resources, climate, soil, topography and institutional and socioeconomic conditions across its regions. Over the years, these have led to uneven performance of the agricultural sector and disparities in the rural and economic development across regions. These regional disparities and inequities have been the major policy concerns of the decision-makers. This study has analysed the productivity levels and variations in performances of agriculture across districts and regions and their linkages with rural poverty. The aim was to identify factors affecting land and labour productivity and in turn, poverty reduction. It will ascertain scope for agricultural productivity growth and help in designing location-specific strategies and interventions

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for enhancing performance of agriculture and reducing poverty in the state.

The agricultural productivity growth is considered an important strategy for rural poverty reduction in the developing countries (World Bank, 2008). Inclusive market-oriented agricultural growth can contribute to higher income for farm families, creation of rural non-farm employment, higher wages and thereby reduced poverty. Harnessing new income and employment opportunities for small farms from production of high-value crops and livestock products and food processing and value addition may lead to a pathway of rural poverty reduction. Enabling conditions may be created for greater participation and higher net share of small producers in the entire food value chain and additional income from non-farm activities. Linkages between agricultural production and consumption demand for rural goods and services and rural non-farm employment may help in enhancing farm income and investment, reduce dependence of labour force on agriculture and in turn, pathways to reduce poverty (Chand *et al*., 2009).

A number of studies have pointed out close relation between agricultural productivity growth and poverty reduction in the rural areas (Bhalla and Singh, 2001; Chand *et al*., 2009a; Chaudhuri and Gupta, 2009; Prabha *et al*., 2009; 2010; Thirtle *et al*., 2001; Mellor, 2001). There is, however, paucity of work based on disaggregated study and district level analysis to deal with performance of agriculture and poverty reduction. In the present study, an attempt has been made to establish linkages between agricultural productivity, labour force dependence on agriculture and rural poverty in Uttar Pradesh.

Data and Methodology

The study is based on district level panel data from Uttar Pradesh collected for the period 2005-06 to 2007-08. The data were obtained from various secondary sources, viz. (i) *Statistical Abstracts of Uttar Pradesh*, Directorate of Economics and Statistics, Government of Uttar Pradesh, Lucknow (2009), (ii) *Agriculture Statistics at a Glance*, Ministry of Agriculture and Rural Development, Government of India, New Delhi (2010), (iii) *National Accounts Statistics*, Central Statistical Organization, Government of India, New Delhi (2009), and (iv) *Fertilizer Statistics*, The Fertilizer Association of India, New Delhi (2009). Tabular analysis was carried out to provide linkages between agricultural productivity, pressure of population and labour force and poverty at district and regional levels. Simultaneous equation model was used to see the effects of various factors on agricultural productivity and poverty.

$$PVR = \alpha_1 + \beta_{11}* PRD + \beta_{12}*AGW + \xi_1 \quad \ldots(1)$$

$$PRD = \alpha_2 + \beta_{21}* NPK + \beta_{22}*IRG + \beta_{23}*FVA + \xi_2 \quad \ldots(2)$$

where,

PVR = Rural poverty (%),

PRD = Productivity per hectare of net area sown,

AGW = Agricultural workers per hectare of net area sown,

NPK = Fertilizer use per hectare of net area sown,

IRG = Per cent net cropped area irrigated,

FVA = Share of fruits and vegetables in total crop area,

α_i and β_i = Parameters to be estimated, and

ξ_i = Error-terms.

Results and Discussion

Structure and Performance of Agriculture

Uttar Pradesh is predominantly a small landholding state with large regional variations in average farm size, and land and labour productivity. About 92 per cent holdings are small occupying 63 per cent cultivated area in the state (Table 1). Across regions, the number of small farm holdings is highest in the Eastern region, about 95 per cent cultivating 72 per cent of land. The average size of landholding in Uttar Pradesh is 0.80 ha and for small farm category, it is only 0.55 ha. Across regions, the average size of farm holding is lowest in Eastern region, 0.64 ha, and highest in Bundelkhand region, 1.49 ha.

The performance of agriculture varied considerably across the regions in the state. During Triennium Ending (TE) 2007-08, the average foodgrain yield in Uttar Pradesh was 2115 kg/ha. It was highest in Western region (2577 kg/ha) and lowest in Bundelkhand region (1067 kg/ha). During the same period, the share of agriculture in net state domestic product (NSDP) was about 29 per cent, and it varied from the lowest of 26 per cent in Central region to the

Table 1. Structure and performance of agriculture in Uttar Pradesh

Region	Small farm holdings		Average holding size		Foodgrain production (kg/ha) TE 2007-08	Agriculture	
	Number (%) 2005-06	Area (%) 2005-06	Small farms (ha) 2005-06	All farms (ha) 2005-06		Share in NSDP (%) TE 2007-08	Growth rate (%) 1999-2000 to 2007-2008
Western	89.21	59.06	0.61	0.92	2577	31.64	2.19
Central	93.18	69.55	0.56	0.76	2130	26.02	2.19
Bundelkhand	77.80	38.14	0.73	1.49	1067	27.46	1.24
Eastern	94.81	72.13	0.48	0.64	1997	27.00	1.35
Uttar Pradesh	91.77	63.18	0.55	0.80	2115	29.01	1.91

highest of 32 per cent in Western region. The average annual growth rate in the NSDPAg in Uttar Pradesh during the period 1999-00 to 2007-08 was 1.91 per cent. This growth rate in agriculture varied from 1.24 per cent in Bundelkhand region to 2.19 per cent in Western region during this period.

Regional Variations in Agricultural Productivity

The average agricultural productivity in Uttar Pradesh during TE 2007-08 was of about ₹ 37,000/ha. The lowest productivity region was Bundelkhand, < ₹ 15,000/ha, and the highest was Western region, > ₹ 50,000/ha. Productivity across all the 70 districts of the state during this period ranged from the lowest of about ₹ 8,000/ha for the Chitrakootdham district of Bundelkhand region to more than ₹ 98,000/ha for the Ghaziabad district of Western region, which is more than 12-times that of low productivity districts.

The districts were also classified into three major productivity categories, viz. low, average and high. The lower and upper limits of class interval for the average productivity category were formed by respectively deducting 0.25-times standard deviation and adding standard deviation of productivity to the mean of productivity of all the districts. The low productivity class included all the districts with productivity less than the lower limit of the average class interval while the high productivity class included districts having productivity equal to or more than the upper limit of the average class interval (Table 2).

The districts having productivity less than Rs 33022/ha were classified as low, more than ₹ 33,022/ ha but less than ₹ 50,569/ha were classified as average, and districts with productivity more than ₹ 50,569/ha were classified as high productivity. There were 32, 27, and 11 districts, respectively in low, average and high productivity classes.

Low productivity districts accounted for nearly half (46%) of the NSA and contributed less than one-third (about 31%) of the NSDPAg. The districts with high productivity accounted for only 13.5 per cent of NSA and contributed more than 25 per cent of

Table 2. Distribution of districts across productivity classes and regions

Productivity category	Range (₹ / ha NSA)	Number of districts	Per cent districts	Share in NSA (%)	Share in NSDPAg (%)
Low	< 33022	32	45.7	46.1	30.7
Average	33022-50569	27	38.6	40.3	44.0
High	> 50569	11	15.7	13.6	25.3
Western region	50938	26	37.1	36.7	51.1
Central region	33652	10	14.3	18.4	16.9
Bundelkhand region	14477	7	10.0	11.7	4.6
Eastern region	30189	27	38.6	33.2	27.4
Uttar Pradesh	36610	70	100	100	100

Table 3. Distribution of districts in different regions according to agricultural productivity in Uttar Pradesh

Region	Category of agricultural productivity (₹/ha NSA)			
	Low <33022	Average 33022 - 50569	High >50569	Overall
Western region	2	14	10	26
Central region	5	4	1	10
Bundelkhand region	7	0	0	7
Eastern region	18	9	0	27
Overall	32	27	11	70

NSDPAg. The average productivity category included 39 per cent of total districts, accounting for 40 per cent NSA, and contributing 44 per cent of the agricultural output. The average productivity of the state was ₹ 36,610/ha and ranged between ₹ 14,477/ha and ₹ 50,938/ha, respectively in Bundelkhand and Western regions. The low productivity Bundelkhand region accounted for 12 per cent of NSA but contributed only 5 per cent to the state output. The high productivity Western region accounted for 37 per cent land and contributed more than 51 per cent to the state output. The Central and Eastern regions together accounted for more than 51 per cent of NSA and contributed less than 45 per cent to NSDPAg. The standard deviation in productivity of all the districts was ₹ 17,548/ha and the coefficient of variation was 46.9 per cent.

Regional Analysis of District Productivity and Poverty

The agricultural productivity in Uttar Pradesh varies considerably across districts within a region with a mixture of pocket of districts with low productivity. In Table 3, distribution of districts according to productivity status for each region is presented. Table 3 shows that high productivity districts in Uttar Pradesh are mainly concentrated in the Western region and as we move from west to east, the levels of agricultural productivity of districts decline. The Western region has 2, 14 and 10 districts respectively under low, average and high productivity categories. In the Central region, 50 per cent districts are under the low productivity category and only one district is having high productivity. All the districts in the Bundelkhand region have low productivity. The highest poverty-stricken Eastern region has two-third districts with low productivity and no district comes under the high productivity category.

Table 4. Correlation between land productivity and poverty across different regions of Uttar Pradesh

Region	Correlation coefficient
Western n	-0.50
Central	-0.19
Bundelkhand	-0.65
Eastern	-0.06

The correlations between land productivity and poverty in different regions are provided in Table 4. Bundelkhand has the maximum correlation between land productivity and poverty reduction (-0.65). This indicates that enhancement of land productivity had a greater impact on poverty reduction in Bundelkhand region. It may be noted that population density is low in this region, leading to high per worker productivity and less poverty. The Eastern region, on the other hand, had the lowest correlation between agricultural productivity and poverty (-0.06). This may be due to high population density in Eastern Uttar Pradesh along with low land productivity. The net effect is lower per worker productivity and relatively higher poverty. Most of the beneficial effects of land productivity growth are eaten away by population growth in Eastern Uttar Pradesh. These phenomena of differing correlations between land productivity and poverty across regions are also supported in graphical presentations [Figures 1(a), 1(b), 1(c), and 1(d)]. The trend line of relationship between land productivity and poverty reveals strong effects of farm productivity on rural poverty reduction in Bundelkhand, Western, and Central regions. A relatively weak association between improved farm productivity and poverty reduction is seen in Eastern region.

A detailed analysis of land productivity and poverty district-wise is provided in the subsequent discussion.

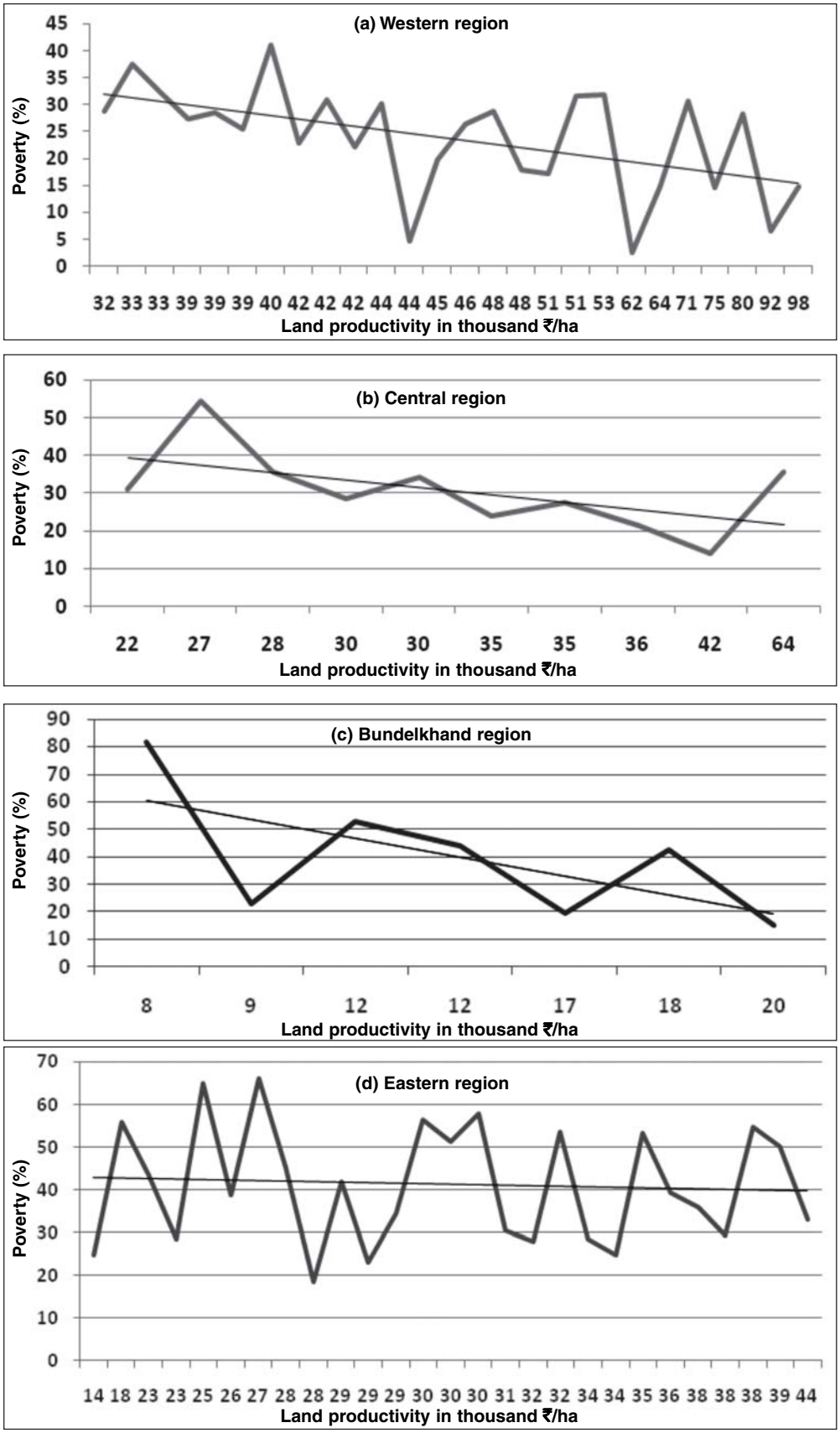


Figure 1. Land productivity and poverty across regions in Uttar Pradesh

Western Region

Western region is agriculturally most progressive region in the state. The region comprises average to high productivity districts, except Auraiya and Shahjahanpur districts [Figure 2(a)]. The agricultural output varied from the lowest of ₹ 31,726/ha in Auraiya district to the highest of ₹ 98,118/ha in the Ghaziabad district. The low productivity districts like Shahjahanpur, Mathura, and Auraiya have the highest percentage of rural population living below poverty. The high productivity districts like Ghaziabad and Meerut have a lower percentage of people living below poverty.

Central Region

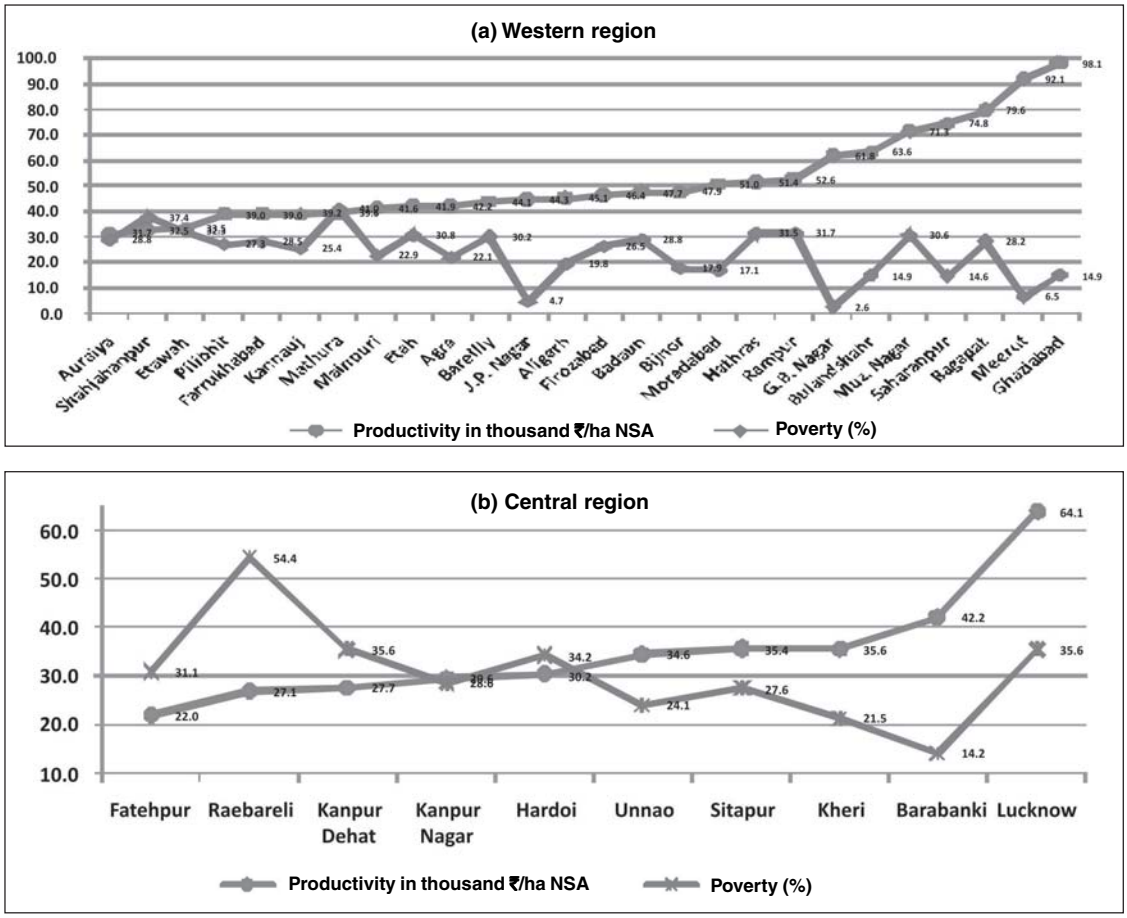
The Central region comprises districts of low to average productivity, except Lucknow [Figure 2(b)]. The productivity of this region varied from the low of ₹ 22,043/ha in Fatehpur district to the high of ₹ 64,061/ha in Lucknow. The percentage of rural population living below poverty line is highest in Raebareli (54.4%) and lowest in Barabanki (14.2%) districts. The divergence between land productivity and rural poverty is more pronounced, as we move from low productivity districts to higher productivity districts.

Bundelkhand Region

This region is the dry pocket of the state and consists of only low productive districts. Chitrakoot is having the lowest productivity with less than ₹ 8000/ha. The highest productivity in the region is found to be ₹ 20,403/ha in Jalaun district [Figure 2(c)]. There is a very high disparity in rural poverty between low productivity and high productivity districts. The rural poverty is 81.5 per cent in Chitrakoot district and only around 15 per cent in Jalaun district. A slight improvement in land productivity will have a very high impact on rural poverty reduction in this region.

Eastern Region

This region has the maximum number of districts of the state. The population pressure as well as poverty



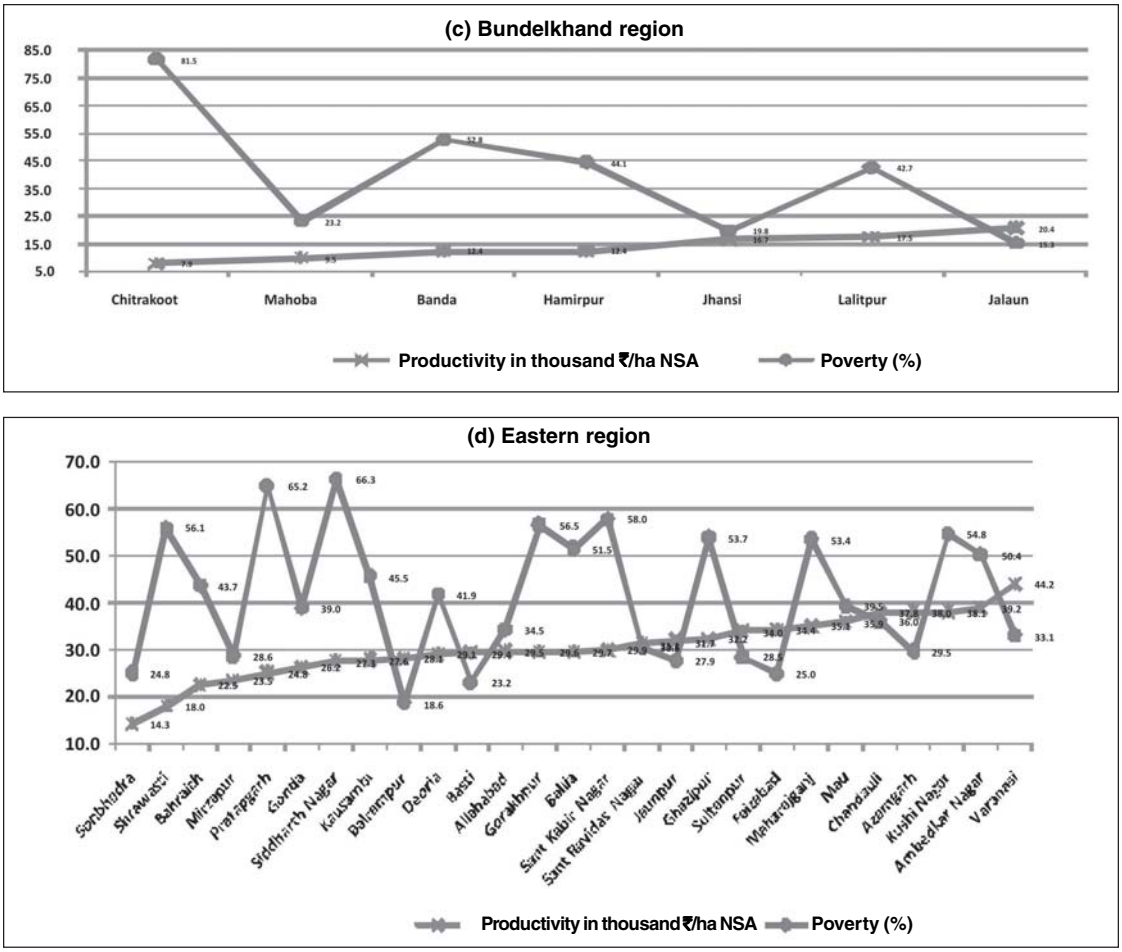


Figure 2. Land productivity and poverty across districts in different regions of Uttar Pradesh

in this region is also highest amongst all the 4 regions. The agricultural productivity in the region varied from ₹ 14,250/ha in Sonbhadra to ₹ 44,192/ha in Varanasi districts [Figure 2(d)]. The difference in rural poverty between low agricultural productivity and high productivity districts is, however, small. Two neighbouring districts of Siddhartha Nagar and Balrampur have almost the same land productivity but there is contrast in incidence of rural poverty. Siddhartha Nagar has the highest percentage of rural poverty (~ 67%) in the state, whereas Balrampur has the lowest percentage of rural population (18.6%) living the below poverty in the state. Population pressure on land and relatively slow progress in land productivity are the major reasons for high incidence of rural poverty in Eastern Uttar Pradesh. Not only there is hugh potential for land productivity improvements but also significant impact on reduction in rural poverty can be made by easing population pressure on land through generation of non-farm employment opportunity.

Determinants of Agricultural Productivity

In this section, important factors affecting agricultural production and productivity have been identified. Agricultural productivities have been measured per hectare NSA and per agricultural worker. Productivity pattern and factors influencing land and labour productivities like level of irrigation, fertilizer use, cropping intensity, and area under high-value crops like fruits and vegetables have been examined (Table 5).

Agricultural productivity per worker and land productivity are closely related and follow similar pattern. The variations in land productivity are, however, higher than labour productivity. Irrigation and fertilizer use are having strong and positive association

Table 5. Factors affecting land and labour productivity across regions and productivity classes in Uttar Pradesh

Productivity category	Productivity/ ha NSA (₹)	Fertilizer use/ha NSA (kg)	Productivity/ average worker (₹)	Net irrigated area (%)	No. of average workers per sq km NSA	Area under F&V (%)	Cropping intensity (%)	Rural poor (%)
Productivity class								
Low	24353	196	16550	67.5	147	2.5	145.1	40.3
Average	40042	258	25652	88.9	156	5.0	160.0	29.2
High	68059	310	46293	91.3	147	6.1	160.6	20.8
Region								
Western	50938	283.0	36523	91.2	139	5.7	160.5	23.3
Central	33652	228.0	20562	82.6	164	4.1	152.8	30.5
Bundelkhand	14477	56.6	17600	49.8	82	1.5	123.7	37.0
Eastern	30189	253.1	16767	75.0	180	2.9	155.8	41.1
Uttar Pradesh	36610	152	24276	79.5	151	3.1	153.2	33.3

with agricultural output per hectare. The value of crop output per hectare is also influenced by other factors such as cropping intensity and area under fruits and vegetables.

The fertilizer-use was 196 kg/ha under the low productivity category, 258 kg/ha under average and 310 kg/ha under high productivity classes (Table 5). The irrigated area was 68 per cent, 89 per cent and 91 per cent, respectively under the low, average and high productivity districts. Area under fruits and vegetables followed a similar pattern, it was only 2.5 per cent of the gross cropped area (GCA) in the low productivity class, 5 per cent under average and 6.1 per cent under high productivity categories. Likewise, area sown more than once was only 45 per cent in the low productivity district, 60 per cent under average and high productivity districts. The land productivity of average category was 64 per cent higher than of the low productivity districts and it was 70 per cent higher under high productivity category over the districts under average class. The labour productivity was 55 per cent higher in the average category than low productivity class and it was 80 per cent higher in high productivity class over districts under average productivity category. These results indicate that as we move from low productivity class to average productivity category, the labour-use increases faster than the land productivity. On the other hand, it is slower when we move from average to high productivity districts and therefore, increase in labour productivity is faster.

Large variations in land and labour productivity and use of production inputs were found across the regions as well and showed pattern and linkages similar to productivity classes discussed above. Land productivity per hectare net area sown in Uttar Pradesh ranged between low of ₹ 14,500 in Bundelkhand region and high of ₹ 51,000 in Western region. The low productivity Bundelkhand region uses only 57 kg of fertilizer per hectare, has only 50 per cent of net sown area irrigated, allocates only 1.5 per cent of total cropped area to fruits and vegetables and 24 per cent area is sown more than once. Whereas, in the high productivity Western region, fertilizer-use is 283 kg/ha, more than 90 per cent area is irrigated, nearly 6 per cent of total cropped area is under fruits and vegetables, and 61 per cent area is sown more than once.

The results show a strong association between agricultural productivity and population below poverty line across districts under productivity classes and regions. In 32 low productivity districts, labour productivity was only one-third of high productivity districts and 40 per cent population was living below poverty line. On the other hand, only one-fifth population was living below poverty line in 11 high productivity districts.

Across regions, low productivity Bundelkhand has 37 per cent populations living below poverty as compared to only 23 per cent population line in high productivity Western region. The Eastern region of the state has the highest (41.1%) percentage of population below poverty line. The region has highest number of agricultural workers (180) per square km of NSA and the lowest labour productivity (₹ 16,767/ha) amongst the regions. This indicates the population pressure and dependence of labour on agriculture to be one of the major causes of rural poverty. This important observation was substantiated by econometric analysis given in the subsequent section.

Estimates of Elasticity of Productivity and Poverty with Respect to Various Factors

Linkages across input-use, agricultural productivity, workforce, and rural poverty were estimated using two stage simultaneous equation econometric model (Table 6). All the variables included in the model were found to be significant.

The elasticity estimates indicated that per hectare productivity had an inverse relationship with poverty and 1 per cent increase or decrease in agricultural productivity will lead to 0.43 per cent decrease or increase in rural poverty respectively (Table 7). On the other hand, 1 per cent increase in rural work force on agricultural land will result in 0.77 per cent increase in rural poverty. The analysis indicates that increasing productivity of agricultural sector as well as shift of rural workforce from farm to non-farm activities within rural areas are critical for alleviation of rural poverty. Irrigation and fertilizer are found to be the most important factors for improving agricultural productivity. One per cent increases in net irrigated area and fertilizer-use would increase agricultural productivity by 0.77 per cent and 0.27 per cent, respectively. Similarly, the increase in area under fruits

Table 6. Estimates of econometric model

	Coefficient	Standard error	t-statistic	Probability
C(1) Intercept for Eq. (1)	3.256716	0.670162	4.859598	0.0000
C(2) Productivity per ha	-0.426500	0.149620	-2.850551	0.0051
C(3) Average worker per ha	0.767610	0.267567	2.868857	0.0048
C(4) Intercept for Eq. (2)	2.408621	0.218230	11.03709	0.0000
C(5) Irrigation	0.770806	0.135869	5.673157	0.0000
C(6) Fruit & vegetable area	0.063981	0.053193	1.202812	0.0312
C(7) Fertilzer	0.272069	0.070228	3.874064	0.0002
Determinant residual covariance		0.000502		
Equation: PVR = C(1) + C(2)*PRD + C(3)*AGW Instruments: C AGW RAN IRG FVA NPK Observations: 70				
R-squared	0.293723	Mean dependent var		1.464167
Adjusted R-squared	0.272640	S.D. dependent var		0.249861
S.E. of regression	0.213095	Sum squared resid		3.042430
Durbin-Watson stat	1.191894			
Equation: PRD = C(4) + C(5)*IRG + C(6)*FVA + C(7)*NPK Instruments: C AGW RAN IRG FVA NPK Observations: 70				
R-squared	0.686417	Mean dependent var		4.527008
Adjusted R-squared	0.672163	S.D. dependent var		0.207849
S.E. of regression	0.119008	Sum squared resid		0.934756
Durbin-Watson stat	1.431003			

Table 7. Estimates of elasticity of land productivity and rural poverty: 2005-06 to 2007-08

Elasticity of rural poverty		Elasticity of land productivity	
Variable	Coefficient	Variable	Coefficient
Land productivity	-0.427	Fertilizer use	0.272
Agricultural worker	0.768	Fruits and vegetables area	0.064
		Irrigation	0.771

and vegetables has a positive impact on agricultural output per hectare with elasticity of 0.06. This result has important policy implications for resource diversification towards high-value crops.

Summary and Conclusions

In Uttar Pradesh, the performance of agriculture varies considerably across districts and regions and has strong linkages and implications for poverty reduction. Agricultural growth and rural development in the state call for a regionally differentiated strategy. The study has analysed the performance of agricultural productivity of the regions and districts of the state along with their characteristics and better understanding of their linkages with poverty. The analysis has highlighted the important features of those districts that have been stuck in low productivity. There are 32 districts in the state where the agricultural productivity is low. These districts have low irrigation, low fertilizer-use and less area allocated to high-value fruits and vegetable crops.

Irrigation and fertilizer-use have been found to be the major determinants of level and variations of agricultural productivity across districts and regions. Results show that 1 per cent increase in irrigated area would increase agricultural productivity by 0.77 per cent. Similarly, 1 per cent increase in fertilizer-use would increase agricultural output by 0.27 per cent. This indicates that development of irrigation and application of fertilizer are critical for development of agricultural particularly in low productivity states.

The other important finding of the study is the linkages between agricultural productivity and poverty. One per cent increase in land productivity reduces poverty by 0.43 per cent. The effect of dependence of workers on agriculture has inverse relationship and 1 per cent reduction in labour force has resulted in 0.77 per cent reduction in poverty. The study has highlighted the need for reducing pressure on land by shifting labour force from farm to non-farm activities in the rural areas. Districts having low productivity also offer opportunities for raising agricultural productivity in the state through resource diversification towards high-value commodities like fruits and vegetables and intensive use of production inputs. Rural poverty reduction would require appropriate development strategy and specific interventions through proper delineation of districts and setting of research and development priorities. Creating non-farm employment opportunities within rural areas along with improving land productivity may be the appropriate development strategy for reducing rural poverty in Uttar Pradesh.

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