Ind. Jn. of Agri. Econ.
Vol.71, No.1, Jan.-March 2016

Disadvantaged Agricultural Regions: Is there a Way Forward?*

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I

INTRODUCTION

Technological interventions, institutional changes, infrastructure development and policy supports during the past six decades have brought a significant improvement in performance of Indian agriculture. However, inequality and regional disparities still remains a serious issue in the development process. Although some studies have observed some convergence in agricultural growth at state level (Birthal *et al.,* 2009; Kumar, 2014), this could not improve level of agricultural development much in some regions. Chand *et al.,* (2011) observed that crop productivity in some of the most-productive districts in India is more than 30-times the productivity in some of the districts with low productivity. These regional variations are result of the inter-play of many factors such as natural resource endowments, agro-ecological conditions, irrigation development, level of policy support, institutional factors, historical factors and demographic features (Somasekharan, 2011; Srivastava *et al.,* 2014).

The level of agriculture performance has direct implications for overall economic development, particularly in rural areas where agriculture is a predominant sector. Therefore, it becomes pertinent to delineate the poor performing region, analyse underlying reasons and identify effective and specific interventions. A few attempts have been made earlier, based on district-level studies, to examine regional variations in agricultural performance and productivity (Bhalla and Alagh, 1979; CMIE, 2000; Bhalla and Singh, 2001; Chand *el al.,* 2011). The data used in these studies are prior to 2004-05 and Indian agriculture has witnessed historical growth in output after that (Chand, 2014). Further, many districts have been bifurcated in the recent years necessitating fresh estimations for developmental planning at disaggregated level. In this backdrop, the present paper identifies determinants of agricultural productivity and rural poverty using the recent district-level data. Based on a set of identified

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*Keynote paper presented at the 75th Annual Conference of the Indian Society of Agricultural Economics held at Punjab Agricultural University, Ludhiana, Punjab, November 19-21, 2015.

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We thank Dr Ranjit Kumar, Principal Scientist, International Crop Research Institute for Semi-Arid Tropics (ICRISAT), Hyderabad for providing district level data on many variables used in this paper. We also acknowledge the research assistance provided by Jaspal Singh, Research Associate at NIAP, New Delhi.

features, disadvantaged regions are delineated and outcome indicators of well-being are estimated. The results would aid in developing location specific strategies for balanced growth and development.

II

DATA AND METHODOLOGY

In the context of agriculture development, a region may be considered as advantaged or disadvantaged based on several criteria such as natural resources endowments and its productive utilisation, infrastructure development, level of technological adoption, natural resource degradation (man-made or natural), demographic pressure, etc. The outcome of these features is reflected in level of economic conditions and well-being of the resident population.

In the present paper, disadvantaged regions are conceptualised in terms of determinants and outcomes represented by agricultural productivity and rural poverty. Three-step procedure has been adopted to study agriculturally disadvantaged regions. The procedure involves (1) identification of determinants of agricultural productivity and rural poverty, (2) delineation of homogenous region based on identified determinants, and (3) comparison and assessment of outcome indicators in the delineated homogenous regions.

The study is based on the axiom that level of agricultural productivity and rural poverty reveal agricultural advantage/disadvantage enjoyed by a region. It was hypothesised that agricultural productivity is a significant factor in determining level of household income and poverty in rural India. Besides, agriculture income of a household was hypothesised to be a function of both productivity as well as number of persons dependent on same size of the land or conversely land-man ratio. Accordingly, poverty was hypothesised to be affected by agricultural productivity and number of workers per hectare of net sown area (labour to land ratio). Further, agricultural productivity itself depends on various production inputs, infrastructure, topographic and climatic factors. These relationships were estimated by using a two-stage simultaneous equation model as given below;

$$RURALPOOR = \alpha_0 + \beta_1.AGRILPRODTY + \beta_2.WORKERPERLAND + \varepsilon \quad ....(1)$$

$$AGRILPRODTY = \delta_0 + \gamma_1.CROPINTENSITY + \gamma_2.IRRICOV + \gamma_3.FERTUSE + \gamma_4.RAINFALL + \gamma_4.PROBLEMSOIL + \gamma_5.GWDEV + \theta \quad ....(2)$$

where,

RURALPOOR = rural poverty (per cent)
AGRILPRODTY = agricultural productivity (Rs/ ha of net sown area)
WORKERPERLAND = agricultural workers per ha of net sown area
CROPINTENSITY = cropping intensity (per cent)

IRRICOV = irrigation coverage (share of gross irrigated area in gross sown area)
FERTUSE = fertiliser use (kg/ha)
RAINFALL = annual rainfall (mm)
PROBLEMSOIL = share of problem soil in total area (per cent)
GWDEV = groundwater development (per cent)

The paper uses district level data on above variables obtained from various sources. The district level data set used in the analysis includes 487 districts of the country which covers about 94 per cent of the net sown area of the country. District-wise rural poverty rate was estimated using unit-level consumption expenditure survey data of National Sample Survey organisation for the year 2011-12. The average monthly per capita consumption expenditure (MPCE) was compared with state specific official poverty line to estimate district-level poverty estimates. Agricultural productivity was computed by taking sum of output of selected agricultural commodities[1] multiplied by state level implicit prices of respective agricultural commodities, divided by net sown area. The output prices data was generated by dividing the state level value of output of each crop estimated by Central Statistical Organisation (CSO), by output of the crop for the year 2010-11.

The value of output for the crops considered in the study was multiplied by ratio of GCA_t/GCA_c, where GCA_t is the reported gross cropped area and GCA_c is the sum of area under crops considered in the study to arrive at estimate of value of crop output for GCA_t. This figure was then divided by net sown area to arrive at per hectare productivity. The advantage of taking productivity per hectare of net sown area instead of gross cropped area is that it provides estimate of productivity based on the output of the whole year (Chand *et al.*, 2011).

The worker per unit land was estimated as a ratio of cultivators and agricultural labours to net sown area which indicates the pressure of work force on agricultural land. Cropping intensity is the share of gross cropped area in net sown area. Similarly, irrigation coverage was estimated as the share of gross irrigated area in gross cropped area. The district wise data for estimating these variables along with fertiliser use and annual rainfall was obtained from the data set with International Crop Research Institute for Semi-Arid Tropics (ICRISAT), Hyderabad for the year 2010-11 and 2011-12.

For the problematic soil, we relied upon the district-wise degraded and waste land statistics of National Bureau of Soil Survey and Land Use Planning (NBSS&ULP), Nagpur for the year 2009-10. NBSS&ULP classifies problematic soils into 14 categories and estimates area under each. The data on district-wise level of groundwater development was collected from central groundwater board for the year 2011.

From the above analysis, determinants of agricultural productivity and rural poverty were identified which were further used to delineate homogenous regions using k-means cluster analysis. K-means cluster analysis is an algorithm to classify or group objects based on attributes/features into k number of groups, k is positive integer number. The grouping is done by minimising the sum of squares of distances between data and the corresponding cluster centroid. In k-means cluster analysis, first number of cluster K is determined and cetroid or centre of these clusters is assumed. Any random objects as the initial centroids or the first k objects can serve as the initial centroids. Then the k-means algorithm will do the following three steps until convergence.

1. Determine the centroid coordinate
2. Determine the distance of each object to the centroids
3. Group the objects based on minimum distance (find the closest centroid)

Distance between each object and centroid is obtained by estimating Euclidean distance [distance(x,y) = $\{\Sigma_i (x_i - y_i)^2\}^{½}$] which the geometric distance in the multidimensional space. The procedure is repeated till the convergence criterion is obtained.

In this paper, variables used for clustering are cropping intensity, irrigation coverage, fertiliser use, rainfall, problem soil, groundwater development and worker per unit land. The cluster analysis was done in two stages. The cluster analysis was done in two stages. First, 487 districts were delineated into four clusters. Thereafter, cluster exhibiting disadvantaged districts (based on clustering variables) was further classified into two sub-clusters for prioritisation and better targeting.

III

RESULTS AND DISCUSSION

Rural Poverty: Incidence and Determinants

The poverty is an important outcome indicator of economic development of a region. In India, incidence of poverty is assessed by comparing monthly per capita consumption expenditure (MPCE) with official poverty line. Presently, poverty line for the rural areas varies from Rs.695 for Odisha to Rs.1301 for Puducherry with all India average of Rs.816 per capita per month (Government of India, 2013).The estimated mean MPCE by rural households varied considerably, from Rs.561 to Rs.4000 across the districts during 2011-12 (Figure 1). It is to be noted that in 90 per cent of the districts, mean MPCE in rural areas was less than Rs 1900 during 2011-12. Using the state specific poverty line, we have estimated district-wise incidence of poverty among rural households for the year 2011-12. The estimated rural poverty varied from almost nil in a few districts to as high as 87 per cent with the mean value of 26 per cent during 2011-12.

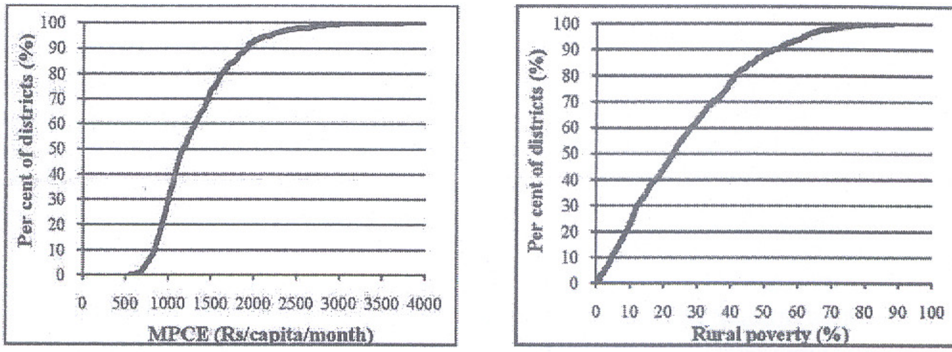

Figure 1. Cumulative Distribution Curve of Monthly Per Capita Expenditure and Poverty in Rural Areas across Districts during 2011-12.

The incidence of poverty is the result of a complex set of inter-related factors such as natural resources endowments and their productive utilisation, infrastructural development, demographic pressures, occupation diversity and various other socio-economic drivers prevailing in the region. The growth in agricultural sector, a dominant employer in the rural areas, exerts a significant influence on the poverty. The present paper, test the effect of agricultural productivity and demographic pressure (labour to land ratio) on rural poverty. Given the endogeniety of the independent variable 'agricultural productivity', two stage simultaneous equations model was fitted and the estimated parameters are presented in Table 1.

TABLE 1. ESTIMATED PARAMETERS OF TWO STAGE LEAST SQUARE REGRESSION ANALYSIS

Stage 1		Stage 2	
Parameter (1)	Coefficient (2)	Parameter (3)	Coefficient (4)
Dependent variable		Dependent variable	
Rural poverty (per cent)		Agricultural productivity (000, Rs./ha)	
Independent variables		Independent variables	
Intercept	38.600***	Intercept	-29.920***
	(2.182)		(5.116)
Agricultural productivity	-0.332***	Cropping intensity (per cent)	0.310***
(Rs. 000/ha)	(0.0391)		(0.030)
Worker per ha	1.399***	Irrigation coverage (per cent)	0.0232***
	(0.297)		(0.039)
		Fertiliser use (kg/ha)	0.075***
			(0.010)
		Rainfall (mm)	0.006***
			(0.002)
		Problem soil (per cent)	-0.148***
			(0.034)
		Groundwater development	0.155***
		(per cent)	(0.022)
R^2	0.1646	R^2	0.5511
F-value	47.68***	F-value	98.22***
No. of observations	486	No. of observations	486

Figures within parentheses are standard error of estimated coefficients, ***significant at 1 per cent level of significance.

As expected, estimated coefficient of agricultural productivity was negative and significant indicating an inverse association between improvement in agricultural productivity and rural poverty. Further, elasticity estimates (Table 2) show that one per cent increase/decrease in land productivity would result in 0.80 per cent decrease/increase in rural poverty. On the other hand, a decline of one per cent in pressure of work force on agricultural land results in 0.17 per cent decrease in the rural poverty. These results indicate that improvement in agricultural productivity through technological and policy interventions, and employment diversification away from agriculture sector towards non-farm sectors would contribute positively in reducing poverty among rural households.

TABLE 2. ESTIMATED ELASTICITY PER HECTARE OF AGRICULTURAL PRODUCTIVITY AND RURAL POVERTY WITH RESPECT TO VARIOUS FACTORS

Elasticity of rural poverty		Elasticity of agricultural productivity	
Variable	Coefficient	Variable	Coefficient
(1)	(2)	(3)	(4)
Per ha productivity	-0.80	Cropping intensity	1.08
Agril. worker/ha	0.17	Irrigation coverage	0.18
		Fertiliser use	0.20
		Rainfall	0.13
		Extent of problem soil	-0.09
		Groundwater development	0.19

In the second stage of the model, determinants of agricultural productivity came out to be significant and were as per the expectations. The effect of change in cropping intensity on agricultural productivity (Rs./ha) was strongest among other factors. Thus, agricultural productivity can be improved by bringing fallow land under cultivation in a year. Similarly, one per cent increase/decrease in fertiliser use, groundwater use, irrigation coverage, and rainfall would result in 0.20 per cent, 0.19 per cent, 0.18 per cent and 0.13 per cent increase/decrease in agricultural productivity, respectively. It is to be noted that irrigation development has a stronger effect on agricultural productivity as compared to rainfall. This implies that adverse effects of rainfall variation on agricultural productivity can be mitigated by improving irrigation infrastructure in the country. Thus, access to irrigation would reduce the dependency of crop production on monsoon. However, the pattern of irrigation development has remained uneven across the geographical regions (Srivastava *et al.*, 2011) and unsustainable water resource development in north-western part coexists with its under-utilisation in eastern region of the country (Srivastava *et al.*, 2014). This accentuates the regional disparity in agricultural performance and therefore emphasises location specific strategies for equitable development in the country. The occurrence of problem soils adversely affects agricultural productivity as indicated by negative elasticity coefficient.

Delineation of Homogenous Regions and their Characterisation

The homogenous geographical regions exhibiting similarity in determinants of rural poverty and agricultural productivity were delineated using the k-means cluster (multivariate) analysis. The number of districts in each cluster and mean value of clustering variables are presented in Table 3. Based on relative values of clustering variables, these clusters were termed as highly advantaged, moderately advantaged, less advantaged, and disadvantaged. The disadvantaged region was further sub-divided into categories namely less disadvantaged and highly disadvantaged regions. (Table 3, Figure 2).

TABLE 3. HOMOGENOUS REGIONS AND MEAN VALUE OF CLUSTERING VARIABLES

Clustering variables	First stage clustering			Second stage clustering		
	Highly advantaged	Moderately advantaged	Less advantaged	Disadvantaged	Less disadvantaged	Highly disadvantaged
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Crop intensity (per cent)	188	156	144	135	137	132
Irrigation coverage (per cent)	74	65	49	29	33	21
Fertiliser use (Kg/ha)	236	209	148	107	130	60
Rainfall (mm)	632	918	1056	1148	1206	1032
Problem soil (per cent)	16	35	41	41	39	44
Groundwater development (per cent)	138	74	65	51	51	52
Agricultural productivity (Rs./ha)	119345	72570	45257	26477	30524	18443
Agricultural worker per sq. km	156	222	240	304	312	288
No. of districts	35	88	158	206	137	69

Out of total 487 districts used in the study, only 35 appeared as highly advantaged based on clustering variables. Total area under this region has been estimated as 7.3 million ha (Mha). Distribution of area under various categories show that Punjab and Haryana occupies about 70 per cent of area in highly advantaged category (Table 4). The highly advantaged districts record highest per hectare agricultural productivity, cropping intensity, irrigation coverage, fertiliser use, and level of groundwater development among all the regions. At the same time, these districts have least problematic soil as well as work force pressure on agriculture land. Interestingly, this cluster is the most productive even with least rainfall among other clusters. It is primarily because of better irrigation infrastructure and higher dependence on groundwater offsetting the adverse effects of deficit rainfall. However, excessive dependence on groundwater resources led to its exploitation which is revealed by 135 per cent (> 100 per cent) level of groundwater development. There is an urgent need for judicious and sustainable use of groundwater resources for irrigation in agriculturally advantaged regions of the country.

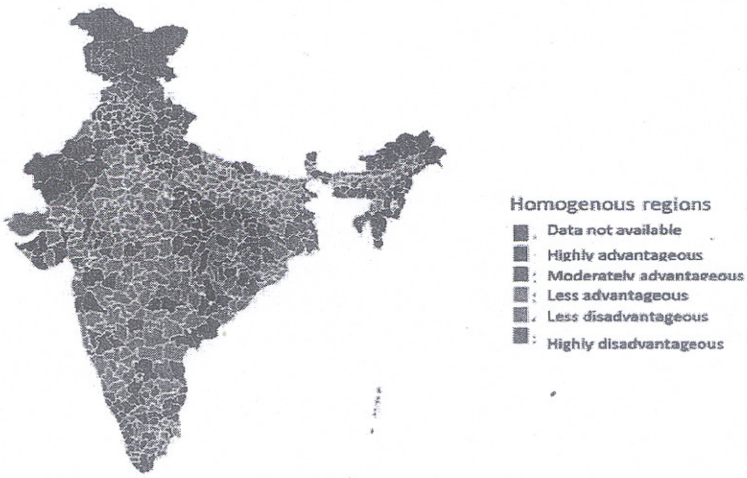

Figure 2. Delineation of Homogenous Regions based on Determinants of Agricultural Productivity and Rural Poverty.

TABLE 4. DISTRIBUTION OF HOMOGENOUS NET SOWN AREA ACROSS THE STATE (PER CENT)

	Advantaged region			Disadvantaged region		
State	Highly advantaged	Moderately advantaged	Less advantaged	Less disadvantaged	Highly disadvantaged	Total disadvantaged
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Andhra Pradesh	-	12.6	9.5	7.7	5.0	6.7
Assam	-	-	1.9	4.7	0.5	3.1
Bihar	6.2	-	5.8	6.7		4.1
Chhattisgarh	-	-	0.9	5.7	4.7	5.3
Gujarat	7.4	8.7	12.3	2.6	1.6	2.2
Haryana	25.9	4.9	0.3	-	-	-
Himachal Pradesh	0.5	-	-	0.1	0.2	0.1
Jharkhand	-	0.1	0.1	0.8	3.5	1.8
Karnataka	-	7.3	3.9	13.0	8.4	11.2
Kerala	-	1.2	0.5	0.6		0.4
Madhya Pradesh	-	0.7	6.4	22.5	20.3	21.7
Maharashtra	5.9	9.7	20.5	15.6		9.6
Orissa	-	-	2.0	6.0	11.3	8.0
Punjab	43.2	3.1	-	-	-	-
Rajasthan	-	-	14.1	9.4	40.4	21.3
Tamil Nadu	-	8.8	3.8	2.2	0.0	1.4
Uttar Pradesh	7.9	26.0	16.1	2.4	4.2	3.1
Uttarakhand	-	1.0	0.2	-	-	-
West Bengal	2.9	15.8	1.7	-	-	-
Sum (000 ha)	7297	25575	44117	34710	21491	56200

Out of total 487 districts covered by the study, 206 districts were found to be disadvantaged based on relative values of clustering variables. Total disadvantaged area in the country has been estimated as 56.2 Mha which is about 42 per cent of the net sown area (Table 4). About 40 per cent of the total disadvantaged area lies in Madhya Pradesh and Rajasthan. The low cropping intensity, poor irrigation coverage and groundwater use, low fertiliser use, and large area under problematic soils across the districts of this cluster result into low agricultural productivity (Table 3). Moreover, better water resources endowment in several districts in this region, through high rainfall, is not productively utilised possibly because of poor irrigation infrastructure in these districts. The expansion of water storage capacity and expansion of irrigation network would go a long way in improving agricultural productivity in the region. The consequences of low land productivity and high workforce pressure in this region are reflected through lowest worker productivity (Rs./agril. worker) and highest rural poverty among various clusters (Table 4).

The disadvantaged districts were further sub-grouped into two clusters namely less disadvantaged and highly disadvantaged regions. These less and more disadvantaged regions comprise 137 and 69 districts with the estimated area of 34.7 Mha and 21.5 Mha, respectively. Among the states, Rajasthan occupies largest area (40per cent) of the most disadvantaged region followed by Madhya Pradesh. The most disadvantaged region lagged behind other regions in terms of most of the performance indicators. Incidentally, the pressure of workforce on agricultural land in highly disadvantaged region was comparatively low than the less disadvantaged regions. This might be because of distress-led withdrawal of worker from agriculture sector and their migration to better off regions of the country. The lowest value of performance indicators in disadvantaged regions warrants prioritisation of existing developmental schemes and policies towards these districts. State wise list of disadvantaged districts is given in Appendix 1.

Within state distribution of net sown area among identified homogenous regions revealed a glaring picture (Table 5). In some of the states like Jharkhand, Chattishgarh, Odisha, and Madhya Pradesh, more than 80 per cent of the net sown area came out to be disadvantaged based on the selected indicators. On the other hand, in a few states like Punjab, Haryana, West Bengal, and Uttarakhand, none of the districts was found disadvantaged in the present context. This indicates inequality in the agricultural development and rural poverty across the geographical regions.

Outcome Indicators in Delineated Homogenous Regions

The outcome of variation in agricultural productivity (and its determinants) and pressure of workforce on agricultural land was assessed by examining worker productivity (Rs./agril. worker) and rural poverty in the delineated regions. The average annual worker productivity varied from Rs.11,575 in highly disadvantaged region to Rs.1,08,418 in highly advantaged region. Similarly, mean rural poverty rate varied from only 13 per cent in highly advantaged region to 40 per cent in the most disadvantaged districts of the country. Thus the results indicated poor performance of disadvantaged regions in terms of worker productivity and rural poverty.

TABLE 5. WITHIN STATE DISTRIBUTION OF NET SOWN AREA AMONG HOMOGENOUS REGIONS (PER CENT)

	Advantaged region			Disadvantaged region			Net sown
State	Highly advantaged	Moderately advantaged	Less advantaged	Less disadvantaged	Highly disadvantaged	Total disadvantaged	area (000 ha)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Andhra Pradesh	-	28.80	37.71	23.86	9.63	33.49	11170
Assam	-	-	32.86	63.28	3.86	67.14	2590
Bihar	8.49	-	47.95	43.56	0.00	43.56	5327
Chhattisgarh	-	-	11.23	58.96	29.81	88.77	3373
Gujarat	5.76	23.55	57.52	9.59	3.58	13.17	9402
Haryana	57.32	38.15	4.53	-	-	-	3293
Himachal Pradesh	33.05	-	-	32.38	34.57	66.95	117
Jharkhand	-	2.74	3.36	24.88	69.02	93.90	1102
Karnataka	-	18.84	17.47	45.52	18.18	63.70	9880
Kerala	-	43.03	28.48	28.49	0.00	28.49	726
Madhya Pradesh	-	1.23	18.59	51.51	28.68	80.18	15178
Maharashtra	2.48	14.32	52.09	31.11	0.00	31.11	17396
Orissa	-	-	16.08	38.71	45.21	83.92	5357
Punjab	79.94	20.06	-	-	-	-	3946
Rajasthan	-	-	34.25	17.97	47.78	65.75	18192
Tamil Nadu	-	47.78	35.82	16.40	0.00	16.40	4709
Uttar Pradesh	3.60	41.41	44.14	5.19	5.66	10.85	16075
Uttarakhand	-	74.77	25.23	-	-	-	347
West Bengal	4.23	80.82	14.95	-	-	-	5009
Total	5.48	19.20	33.12	26.06	16.14	42.20	133190

TABLE 6. THE LEVEL OF WORKER PRODUCTIVITY AND RURAL POVERTY IN THE DELINEATED HOMOGENOUS REGIONS

	Advantaged region			Disadvantaged region		
Clustering Variables	Highly advantaged	Moderately advantaged	Less advantaged	Less Disadvantaged	Highly Disadvantaged	Total Disadvantaged
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Worker productivity (Rs./agril. worker)	108418	40862	24679	16740	11575	15010
Rural poverty (per cent)	13	19	25	30	40	33

IV

CONCLUSIONS AND POLICY IMPLICATIONS

There exists wide regional variations in agricultural performance and economic development in India because of inter-play of several inter-related factors such as natural resources endowments and their productive utilisation, infrastructural development, demographic pressures, employment diversity and various other socio-economic drivers prevailing in the region. The econometric analysis reveals a positive effect of improvement in agricultural productivity on reduction in rural poverty and economic disadvantage of a region. On the other hand, demographic pressure on agricultural land adversely affects rural poverty. The results underscores the need of improvement in agricultural productivity, and acceleration in employment diversification away from agriculture sector towards non-farm sectors for reducing poverty among rural households in the disadvantaged regions of the country.

The variation in agricultural productivity across districts was found to be dependent on many factors such as cropping intensity, irrigation coverage, fertiliser use, rainfall, groundwater development and occurrence of problematic soil. The above factors except occurrence of problematic soils exert a positive effect on agricultural productivity, though with varying degree. Based on these features, districts were delineated into homogenous regions to identify disadvantaged regions for development and implementation of location specific strategies for economic development.

Surprisingly, most of the districts were found to be concentrated in the disadvantaged category. The total area under disadvantaged regions was estimated as 56.2 Mha which is about 42 per cent of the net sown area. The disadvantaged regions are characterised with low cropping intensity, poor irrigation coverage and groundwater use, low fertiliser use, and large area under problematic soils. Further, the poor irrigation and water storage infrastructure in this region resulted into sub-optimal utilisation of rainfall. The expansion of water storage capacity and irrigation network would go a long way in improving agricultural productivity in the region.

For prioritisation and better targeting disadvantaged regions were further divided into two sub-regions namely less disadvantaged and highly disadvantaged regions with the estimated area of 34.7 Mha and 21.5 Mha, respectively. Among the states, Rajasthan occupies largest area (40 per cent) of the most disadvantaged region followed by Madhya Pradesh. The most disadvantaged region lagged behind other regions in terms of most of the performance indicators. The results lead us to conclude that there is an urgent need to adopt location specific strategies focusing on intensive use of land, expansion of irrigation and water use, promotion of fertiliser, to develop disadvantaged region of the country. Non-farm rural employment to reduce dependence on agriculture is also important to address development of disadvantaged region.

NOTE

1. Rice, wheat, sorghum, pearl millets, maize, finger millets, barley, gram, pigeon pea, black gram, green gram, horse gram, moth, lentil, groundnut, sesamum, rapeseed and mustard, soybean, linseed, castor, safflower, Niger, Sugarcane, potato and onion.

REFERENCES

Bhalla, G.S. and Y. Alagh (1979), *Performance of Indian Agriculture: A District Wise Study*, Sterling Publishers Pvt. Ltd., New Delhi.

Bhalla, G.S. and G. Singh (2001), *Indian Agriculture: Four Decades of Development*, Sage Publications India Pvt Ltd, New Delhi.

Birthal, P.S., H. Singh and S. Kumar (2009), "Agriculture, Economic Growth and Regional Disparities in India", *Journal of International Development*, Vol. 21, pp.1-13.

Chand, R. (2014), *From Slowdown to Fast Track: Indian Agriculture Since 1995*, Working paper 01/2014, ICAR-National Centre for Agricultural Economics and Policy Research, New Delhi-110 012.

Chand, R.; S.S. Raju, S. Garg and L.M. Pandey (2011), *Instability and Regional Variation in Indian Agriculture*, Policy Paper 26, National Centre for Agricultural Economics and Policy Research (NCAP), New Delhi.

CMIE (2000), *District Level Estimates*, Centre for Monitoring Indian Economy Pvt. Ltd., Mumbai.

Government of India (2013), *Press Note on Poverty Estimates, 2011-12*, July 22, Planning Commission, Government of India.

Kumar, S., A.L. Kamble and K.R. Chaudhary (2014), "Agricultural Growth and Economic Convergence in Indian Agriculture", *Indian Journal of Agricultural Economics*, Vol.69, No.2, April-June 211-228.

Srivastava, S.K.; R.C. Srivastava, R.R. Sethi, A. Kumar and A.K. Nayak (2014), "Accelerating Groundwater and Energy Use for Agricultural Growth in Odisha: Technological and Policy Issues", *Agricultural Economics Research Review*, Vol.27, No.2, pp.259-270.

Somasekharan, J., S. Prasad and V.P.N. Roy, (2011), "Convergence Hypothesis: Some Dynamics and Explanations of Agricultural Growth Across Indian States", *Agricultural Economics Research Review*, Vol.24, No.2, pp.211-216.

Srivastava, S.K.; S. Ghosh, A. Kumar and P.S.B. Anand (2014), "Unravelling the Spatio-Temporal Pattern of Irrigation Development and Its Impact On Indian Agriculture", *Irrigation and Drainage*, Vol.63, No.1, pp.1-11.

APPENDIX 1. STATE-WISE LIST OF DISADVANTAGED DISTRICTS IN INDIA DURING BE 2011-12

State (1)	Less disadvantaged districts (2)	Highly disadvantaged districts (3)
Andhra Pradesh	Adilabad, Cuddapah, Mahabubnagar, Rangareddy, Srikakulam, Visakhapatnam	Anantapur
Bihar	Arwal, Aurangabad, Begusarai, Bhagalpur, Darbanga, Gaya, Jamui, Katihar, Khagaria, Kishangunj, Madhubani, Mungair, Muzaffarpur, Nalanda, Purnea, Saran, Supaul,	–
Gujarat	Baroda, Bulsar, Dahod	Dangs, Panch, Mahals
Karnataka	Bangalore (Rural), Bidar, Bijapur, Chamarajanagara, Chickballapur, Chickmagalur, Chitradurga, Gadag, Haveri, Koppal, North Kannara, Raichur, Udupi, Yadgir	Gulbarga, Kolar, Ramanagar, Tumkur
Madhya Pradesh	Ashoknagar, Betul, Bhind, Burhanpur, Damoh, Datia, Dhar, Guna, Gwalior, Indore, Jabalpur, Khargone, Mandsaur, Neemuch, Raisen, Rajgarh, Ratlam, Sagar, Ahjapur, Sheopur Kalan, Shivpuri, Tikamgarh, Vidisha	Alirajpur, Anuppur, Balaghat, Barwani, Chhatarpur, Dindori, Jhabua, Katni, Khandwa, Mandla, Panna, Rewa, Satna, Seoni, Shahdol, Sidhi, Singrauli, Umaria
Maharashtra	Amravati, Beed, Chandrapur, Gadchiroli, Jalna, Nagpur, Nanded, Thane, Wardha, Yeotmal	–
Orissa	Bhadrak, Dhenkanal, Gajapati, Jajapur, Kalahandi, Kendrapara, Khordha, Mayurbhanj, Nabarangapur, Puri, Rayagada, Sambalpur	Koraput,Bolangir, Angul, Baudh, Deogarh, Ganjam, Jharsuguda, Keonjhar, Malkangiri, Nayagarh, Nuapada, Phulbani, Sundergarh
Rajasthan	Ajmer, Banswara, Bhilwara, Jalore, Jhunjhunu, Pratapgarh, Rajsamand, Sikar, Udaipur	Barmer, Bikaner, Churu, Dungarpur, Jaisalmer, Jodhpur, Nagaur, Pali
Tamil Nadu	Coimbatore, Kamarajar, Karur, P. Mutthuramalingam, Ramanthapuram, The Nilgiris	–
Uttar Pradesh	Hamirpur, Jalaun, Mirzapur	Banda, Chitrakut, Mahoba, Sonabadra
Chhattisgarh	Bijapur, Bilaspur, Janjgir (Champa), Kanker, Koriya, Narayanpur, Raipur, Rajnandgoan, Surguja	Dantewada, Kawardha (Kabirdham), Korba, Mahasamund, Raigarh
Jharkhand	Chatra, Devghar, Dhanbad, Godda, Hazaribagh, Khodrama, SanthalParagana, Sariakela / Kharsawan	Bokaro, Gadva / Garhwa, Giridih, Gumla, Latehar, Pakund / Pakur, Palamu, Ranchi, Sahebganj, Simdega, Singhbhum East, Singhbhum West
Assam	Barpeta, Bongalgaon, Chirang, Darrang, Dhemaji, Dhubri, Dibrugarh, Jorhat, Karbi-Anglong, Karimganj, Marigaon, N.C.Hills, Nagaon, Sibsagar, Tinsukia	Udalguri
Himachal Pradesh	Solan	Shirmaur
Kerala	Idukki	–