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RESEARCH ARTICLE

LAND INEQUALITY AND AGRICULTURAL SUSTAINABILITY IN UTTAR PRADESH, INDIA: A REGIONAL ANALYSIS

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ABSTRACT

By using agricultural census input survey data 2010-11and Gini coefficient, the land inequality was calculated. Agricultural sustainability also evaluated using indicators approach of four economic regions, namely, eastern, western, Bundelkhand, and western. Further, the degree of agricultural sustainability among the operational landholdings also calculated. The calculated agricultural sustainability indices for different economic region show that farmers in Bundelkhand region were highly sustainable, whereas farmers in western region were least sustainable. In Bundelkhand region, farmers have opted sustainable management practices by utilizing of agricultural resources, viz., agricultural machinery, credit, livestock, biological insect-pest management, and sustainable use of seeds, to develop a sustainable agricultural production system, where each and every resource was efficiently utilized. In other words, these resource-poor farmers have adopted the farming system in such a way that their total returns should be maximized from the available resources. The present study suggests that there is a need of micro-level policy interventions for the reduction of chemical fertilizer use. The excess of chemical fertilisers not only deteriorating soil health, but also causes long-chronical diseases such as cancer. Therefore, judicious use of chemical fertilisers has a win-win situation. This not only reduces the input cost, but also beneficial to soil and human health. Further, continuously increasing population and fragmentation in the land are two major reasons for inequality among the operational landholdings. This can be dealt through community participation. The present study also found that high yielding regions are least sustainable such as western region. Therefore, the present study suggests that judicious of common property resources, including land and water, the degree of sustainability would be an increase in Uttar Pradesh.

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INTRODUCTION

Climate related uncertainties manifesting as drought, floods, temperatures fluctuation, and crop disease, posing the greatest challenge to agricultural production and food security (IFPRI, 2009). There are significant indications of climate related problems already being recorded in the many regions, and resulted net reductions of yield, particularly, in major parts of Africa and Asia (Ringler *et al.,* 2010). Though it is now clear that climate change adversely affecting to the most vulnerable occupation i.e., agriculture, but it is difficult to determine the actual scale or degree of the impact (Cline, 2007). The simulation results based on the general circulation estimation show that the world will need to produce 70 percent more food in 2025 that what is being produced today (FAO, 2011).The situation is more critical for developing countries, including India.The short- term projection results show that food demand in India is expected to increase significantly (Nanda, 2018).

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The major influencing factors are continuously increasing population, climate change, income inequality, urbanisation, and dietary changes (Praduman and Joshi, 2016). The total area under farming has declined from 159.59 million hectares in 2010-11 to 157.14 million hectares in 2015-16. During the same period, the number of operational holdings increased by 5.33 percent from 138 million in 2010-11 to 146 million in 2015-16 (Agricultural Census, 2015-16). Further, the area not available for cultivation is also continuously converting for industrial and domestic purposes (Ghosh and Sreerupa, 2007).The mean land size of operational holdings also declined from 1.5 hectares to 1.08 hectares. Nearly 87 percent of the landholdings in the country consisted of small and marginal holdings (0 to 2 hectares), while their share in the operated area was only 47.34 percent. This reflects that the pressure on the increasing farming population on agricultural land, which is a critical factor of production that is also limited in supply (Viswanathan *et al.,* 2012). The other perpetual challenge for Indian agriculture is the availability of water.

Major cereal crops like rice, wheat and sugarcane have a high-water requirement. However, more than 60 percent cropped area under rainfed conditions, erratic rainfall and continuously increasing temperature are adding an additional layer of water insecurity in the agro-based system (Abraham, 2013). Therefore, there is a growing concern among the researchers and policymakers that how to feed food demand and sustains livelihoods of the continuously increasing population, where natural resources are finite and rapidly deteriorating, and how to use natural resources efficiently to make Indian agriculture sustainable (Rao and Rogers, 2006; Praduman and Surabhi, 2006; Palanisami *et al.,* 2010; Sundaram, 2013; Ghate, 2012; Viswanathan *et al.,* 2012 and Kothari, 2013). Sustainable agriculture techniques enable higher resource efficiency. These techniques help to produce greater agricultural output, while using lesser land, water and energy, ensuring profitability for the farmer (Viswanathan *et al.,* 2012). These essentially include methods that, among other things, protect and enhance the crops and soil, improve water absorption and use efficient seed treatments (Vyas, 2002). In other words, sustainable agriculture seeks the integrated use of a wide range of pest, nutrient, agroforestry, soil and water management technologies (Pretty *et al.,* 1992). After the depth reviewedon sustainable water use in agriculture (Palanisami *et al.,* 2010), economic viability of agricultural sustainability (Khor, 2012 and Kavi Kumar, 2016), sustainability of non-farm sector (Negi *et al.,* 2012), temporal and spatial variations in growth and its determinants (Parappurathu and Ramesh, 2012), agrarian transition (Viswanathan *et al.,* 2012), sustainable mobility of agriculture (Ghate, 2012), critical for green growth (Sundaram, 2013), food security and climate change in rainfed agriculture (Nanda, 2018), and local solutions for local problems (Gapalan, 2016 and Gautam, 2016), there are two critical questions have raised; (i) what would happen if agricultural production systems shifted to sustainable agriculture?, and (ii) would this mean a new threat to food security, particularly at local level, or can current future population be fed by sustainable agriculture?

The estimated results show that sustainable agriculture is expected to bring a decline in productivity, as the production levels are so much higher than in most of Africa, Asia and Latin America (Scherr, 1995, Hewitt and Smith, 1995). This can be compensated with a sharp decline in input cost. In the longer-term (five to ten years), evidence suggested that the yields in sustainable agriculture will rise to former levels (Faeth 1993 and 1995). The calculated results also indicate that the widespread adoption of sustainable agriculture would have a significant redistributive effect on productive capacity. Low and medium yielding countries, including India would benefit more in terms of food production that the high yield countries (Pretty *et al.,* 1992). In totality, efficient use of natural resources couple with modern technology under the umbrella of sustainability, Indian agriculture not only would reduce the pressure on scarce natural resources, but also would secure livelihoods of the nearly half of the India's population. Therefore, sustainable agriculture would be win-win situation to Indian economy and the associated population. With the above background, the present study examines the land inequality among the land holdings of most populated and highly diverse agro climatic characteristic state, viz., Uttar Pradesh. Agricultural sustainability of four economic regions namely eastern, central, Bundelkhand, and western was also assessed using agricultural census input survey 2010-11 data and indicator approach developed by United Nations Development Programme (UNPD, 1992). This paper is organised as follows. In the next section, the data set, information about the sources and technical aspects of the estimation model are discussed, which is followed by results and discussion in section III. Concluding remarks are made in the final section.

METHODS AND MATERIALS

Selection of Rational Indicators

The sustainability in agriculture has a function of multiple factors, viz., agricultural machinery sustainability, agricultural credit sustainability, social security, irrigation sustainability, livestock sustainability, seed sustainability, fertiliser sustainability, and pest-control sustainability (Rao and Rogers, 2006 and Rai *et al.,* 2008). The selected indicators should justice among landholders, living today and between present and future generations, which is a key part of sustainability (Fredericks, 2012). Therefore, the present study uses district-level of agricultural machinery, agricultural credit, social security, irrigation, livestock, seed, fertilisers and pest-control data, to develop the integrated composite agricultural sustainability indices for different operational land holdings and economic regions.

Agricultural Machinery Sustainability Index: Sustainable agricultural mechanization refers to all farming and procession technologies from basic tool to motorized equipment (FAO, 2018). It does not just look at the technical aspects of farming, it also takes into account the effect that tools have on a farmer's outputs, from crop production along the value change to marketable products, and in turn, the impact this has on a farmer's income. Therefore, it is important to assess the degree of technology namely hand, animal, and power operated opted by the operational holders in the diverse environment. This was captured using district level data of hand operated machines, animal operated machines and power operated machines among the operational land holders.

Agricultural Credit Sustainability Index: Availability and access to adequate, timely and low cost credit from institutional sources is of the great important especially to small and marginal farmers (Mohan R. 2006). It has life support system to majority of marginal and small farmers, which owned more than 80 percent to the Indian agriculture. Easy access to financial services at affordable cost positively affects the productivity, asset formation, income, and food security of the rural poor. Therefore, agricultural credit sustainability was captured using district level data that percentage operational landholders have taken credit from institutional sources.

Irrigation Sustainability Index: Irrigation has a potential role in the agricultural sustainability. By using irrigation as a technological tool, India had increased crop productivity tremendously and neutralised food security concern emerged in the early sixties (Rao and Deshpande, 1986). However, there are major barriers in the path of irrigation security as well as sustainability are; (i) there is uncertainty around the adequacy of water reserves or sources, (ii) irrigation often adversely impacts water quality, as nutrient leaching tends to increase under more intensive production systems, which can be established once limitations imposed by soil moisture stress are removed, and (iii) financial cost of irrigation schemes and systems, and the day-to-day expenses associated with running and managing these systems, is also increasing. Further, climate change heightens both of these challenges and importance of irrigation (IPCC, 2014). Therefore, the irrigation sustainability was captured using district level data of gross irrigated and gross unirrigated cropped area.

Livestock Sustainability Index: In agrarian countries, including India, livestock make a substantial contribution to livelihood security by providing income, food, fuel, manure, draft power and serving as current assets for a vast majority of rural households (Christopher *et al.,* 2004 and Chand *et al.,* 2011). Livestock contributes about 25 percent to the agricultural gross domestic product (GDP) in India (CSO, 2011). Therefore, livestock sustainability index was developed using district level data of the number of livestock owned by the operational holders.

Social Security Index: Social security is also closely associated with agricultural sustainability. The provisional results of the agricultural census 2015-16 revealed that nearly 70 percent of all operational holders fall under the marginal category, but the proportion among scheduled caste population is higher as 78.06 percent of operational holders fall under the marginal category. It is these farmers taken together who comprise the most pauperised sections of the agrarian community in India today. The social security of operational land holders was captured using district level indicators namely average size of household, average age of head of household, illiterates operational land holders, operational land holders has primary education, Junior, Secondary, Senior Secondary, Technical Diploma below graduation and Graduation & above.

Sustainable Insect Pest Management Index: The productivity of crops depends on several management practices. Among them, sound pest and disease management strategies contribute substantially to minimize the losses caused by pests and ultimately stepping up the productivity of any crop (Ignacimuthu, 2003). Therefore, the sustainable insect pest management index was calculated using district level data of total area under soil testing, no. of operational holders adopted pest control, agro-economic and cultural methods adopted for pest control, mechanical method adopted for pest control, biological method adopted for pest control, and chemical method adopted for pest control.

Seed Sustainability Index: Seed are central to farming and food production (Pionetti, 2006). Saving, selecting, reproducing storing and sowing those seeds is often dependent on farmer's knowledge and expertise. Maintaining seed and crop diversity enable rural families to cope with the state's many environmental demands such as soil moisture and temperature tolerance (NITI Aayog, 2015). Therefore, the seed sustainability was captured using district level data, viz., number of operational holding used certified seeds, number of operational holdings used notified seeds, number of operational holdings used hybrid seeds, and number of operational holdings have taken foundation course in agriculture.

Fertiliser Sustainability Index: Agricultural sector has to find the ways to resolve the critical issues such as declining agricultural productivity, environmental crisis arising from unsustainable use of chemical fertilisers by adopting a new sustainable strategy (Nanda, 2018). Therefore, the fertiliser sustainability was captured using district level of that irrigated area treated with chemical fertilisers, irrigated area treated with farm yard manure, unirrigated area treated with chemical fertilisers, and unirrigated area treated with farm yard manure.

Study area

Uttar Pradesh is between latitude 240 -310 N and longitude 770– 840 E. It is the India's fourth largest and the most populated state (Census, 2011). It has a population of about 199,581,477 with the population density of 828 person per KM2. With an area of 243, 290 KM2, Uttar Pradesh covers a large part of the highly fertile and densely populated upper Gangetic Plain region. It also has more than 31 large and small rivers, major one being the Ganges, Yamuna, Sarayu and Ghaghara (GoI, 2017). The climate of Uttar Pradesh is predominantly sub-tropical; however, weather conditions change significantly with location and season (IMD, 2017). Depending on the elevation, the average temperatures vary from between 12.5-17.50C in January to 27.5-32.50C in May and June (IMD, 2017). Rainfall in the state ranges from between 1,000-2,000 millimetre in the east to 600-1,000 millimetre in the west (IMD, 2017). About 90 percent of the rainfall occurs during the southwest monsoon, lasting from approximately June to September (IMD, 2017). Uttar Pradesh consists four economic regions, viz., Western, Eastern, Central and Bundelkhnad (Table 1A).

Geographical location of the regions: Western region located between 26^0 25 N to 30^0 25 N and 77^0 101 E to 80^0 25 E. The total geographical area is 72, 192 K.M.^{2} Central region is located between 25^0 30 N to 28^0 40 N and 79^0 45 E and 81^0 40 E. The total geographical area is 48,843 K.M.^{2} Eastern region located between 23^0 50 N to 28^0 25 N and 81^0 10 E to 84^0 40 E. The total geographical area is 85,804 K.M.^{2}Bundelkhand region located between 24^0 10 N to 26^0 25 N and 78^0 10 E to 81^0 35 E. the total geographical area is 29, 417 K.M.^{2}

Data

The present study uses secondary data collected from the agricultural census 2006-07 and 2010-11, India. Data for agricultural machinery, credit, educational status, irrigational status, livestock, crop- pest control, seed and fertilisers consumption was obtained from agricultural census, input survey 2010-11.

Estimation method

Gini Index: Land inequality was captured by calculating Gini index. Gini index was calculated using equation (1, 2, 3 & 4).

$$A * AA + B * BB + C * CC + D * DD \quad (1)^{1}$$

$$N * BB + A * CC + B * DD + C * AJ \quad (2)^{2}$$

[1]A is cumulative percentage of small land holdings, AA is cumulative percentage area under marginal land holdings, B is cumulative percent of marginal, small and semi-medium land holdings, BB is cumulative area under small land holdings, C is cumulative percentage of marginal, small, semi-medium and medium land holdings, CC is cumulative percentage area under semi-medium land holdings, D is cumulative percentage of marginal, semi-medium, medium and large land holdings and DD is cumulative percentage area under medium land holdings.

[2] Where, N is cumulative percentage of marginal land holdings. AJ is cumulative percentage of area under large land holdings.

$$\frac{N*BB+A*CC+B*DD+C*AJ}{A*AA+B*BB+C*CC+D*DD} \quad (3)$$

$$\frac{1}{\frac{N*BB+A*CC+B*DD+C*AJ}{A*AA+B*BB+C*CC+D*DD}} \quad (4)$$

Indicator Approach: The indicators based approach was adopted for the estimation of composite agriculture sustainability index (Fussel, 2007). The indicator based approach was used in a specific set or combination of indicators (proxy indicators) and measured the agriculture sustainability status by computing indices, average or weightage averages for those selected variables or indicators (Fassel and Klein, 2006).

The suitability of this approach is that it can be applied any scale, such as household, district, and country level (Malone and Engle, 2011). The present study estimates agriculture sustainability index using Iyenger and Sudharshan (1982) and Hahn et al. (2009) methodology, which is as follows.

1. First, we have converted individual data set for particular parameters in standardization values or composite number or index. This value will be lies between 0-1. If the value is close to zero, the agricultural sustainability status of the operational land size in the region is poor, and if it is close to 1, agricultural sustainability status is good.
2. This method known as *composite Z-scores method* and this is a simple descriptive formula to generate to one value for multiple factors (equation 5 & 6).

$$ASI_{ijk} = \frac{K_{ijk} - Min(X_{ijk})}{Max(X_{ijk}) - Min(X_{ijk})} \quad (5)$$

Where, Y_{ijk} is the index for the ith indicator related with to jth district and kth region, K_{ijk} is the actual/observed value of ith indicator for the jth district and kth region, $Max(X_{ijk})$ and $Min(X_{ijk})$ are the maximum and minimum value of ith indicator among all the L (I= 1………4) regions, respectively. If the variable has negative functional relationship, then equation 2 was used.

$$ASI_{ijk} = \frac{Max(X_{ijk}) - K_{ijk}}{Max(X_{ijk}) - Min(X_{ijk})} \quad (6)$$

$$AMSI_k = \frac{\sum_{n=1}^{3} I_k}{3}, ACSI_k = \frac{\sum_{n=1}^{1} I_k}{1}, ISI_k = \frac{\sum_{n=1}^{2} I_k}{2}, LSI_k \frac{\sum_{n=1}^{1} I_k}{1}, SSI_k = \frac{\sum_{n=1}^{9} I_k}{9}, PCSI_k = \frac{\sum_{n=1}^{6} I_k}{6}, Seed\ Sustainabiltiy\ Index_k = \frac{\sum_{n=1}^{4} I_k}{4}, and\ FSI_k = \frac{\sum_{n=1}^{4} I_k}{4} \quad \text{..............(7)}^{3}$$

The composite index for each region was calculated as a weighted mean of the eight indices obtained from above equation, i.e.,

$$ASI_k = \frac{W_i*AMSI_k+W_i*ACSI_k+W_i*ISI_k+W_i*LSI_k+W_i*SSI_k+W_i*PCSI_k+W_i*Seed\ Sustainabiltiy\ Index_k+W_i*FSI_k}{8} \quad (8)$$

Where, 'W_i' denotes the weight calculated by using equation (9) & (10)

$$[W_i = \frac{K}{\sqrt{Var(Cid)}}] \quad (9)$$

$$Where, [K = \frac{1}{\left\{\sum_{i=1}^{n} \frac{1}{\sqrt{Var(Cid)}}\right\}}] \quad (10)$$

[3]Where, AMSI, ACSI, ISI, LSI, SSI, PCSI & FSI stands agricultural machinery sustainability index, agricultural credit index, irrigation sustainability index, livestock sustainability index, social security index, crop-pest sustainability index, and fertilisers sustainability index.

RESULTS

Marginalisation in Operational Land Holdings

The calculated results show that 75.74 percent marginal farmers (less than one hectare land) have owned only 40.09 percent cropped area in Uttar Pradesh in 2005-06 (Table 1). These figures were changed slightly in 2010-11. In 2010-11, 77.40 percent marginal farmers have owned only 42.22 percent cropped area. At regional level, western region has occupied 71.01 & 73.12 percent marginal farmers with 33.25 & 35.47 percent in 2005-06 and 2010-11. Similarly, central region has occupied 79.20 & 80.80 percent marginal farmers with 43.80 &45.47 percent cropped area in 2005-06 and 2010-11.Bundelkhand region has completely dry region with least natural resources adaptive capacity. In this region, marginal operational land holders was 56 & 58.28 percent with occupied area was 17.06 & 18.73 percent. Eastern region has occupied 82.71 & 83.87 percent marginal operational land holders with 49.47 & 51.78 percent area in 2005-06 to 2010-2011. In totality, farming in Uttar Pradesh has in the hand of marginal farmers.

Inequality in the Operational Land Holdings

The inequality in the operational land holdings across the regions has calculated using Gini index (Table 2). The present study confirms the persistence of substantial inequality in the number and distribution of area under various size of holdings in the Uttar Pradesh. Though, inequality has declined marginally from 2005-06 to 2011-12, yet the inequality of numbers and area of operational holding by different size holdings is still substantial at the state, regional level. The increase in the number of farms and substantial fragmentation may lead to marginal decline of inequality in the distribution of land among various classes (Singh, 2006).

Region wise Agricultural Sustainability

The agricultural sustainability was evaluated using an indicator approach for the various regions and Uttar Pradesh as a whole (Table 3). The agricultural machinery sustainability index scores revealed that the eastern region was highly sustainable, whereas the central region was least sustainable. The agricultural credit index revealed that Bundelkhand region has highest credit security, whereas western region has lowest credit security. After the adoption of Green Revolution, irrigation has a prominent role in the Indian agriculture. The calculated irrigation sustainability index scores show that eastern region has the highest irrigation security, whereas western region has the lowest irrigation security. Climate change adversely affecting to the Indian agricultural system (Goswami *et al.,* 2006). Therefore, non-farm income has not only secured livelihoods, but also added an additional layer of adaptive capacity in the agro-based system. The calculated index scores revealed that Bundelkhand region has highest livestock security, whereas the western region has lowest livestock security. Further, the calculated social security index scores show that the central region has the highest social security, whereas the eastern region has the lowest social security. Sustainable insect pest management also has a positive relationship with agricultural sustainability. Therefore, sustainable insect pest management index was calculated. It revealed that the Bundelkhand region has a highest adaptive capacity to manage crop- pests using sustainable measurement, viz., agro-economic & cultural, mechanical and biological, whereas western region has a lowest adaptive capacity. Seeds sustainability is also equally important for sustainable agricultural practices.

The calculated index scores show that farmers in the Bundelkhand region were highest used recommended seeds varieties, whereas in the eastern region farmers were used lowest recommended seeds varieties. Fertiliser consumption has been increased tremendously especially in rice and wheat crops in Uttar Pradesh (GoI, 2015). However, the majority of farmers were used chemical fertilisers, which were initially played a positive role, but in long-term they have potential adverse impact on crop production and soil health (Nayak, 2009). The calculated results revealed that farmers in the eastern region were used combination of chemical and bio-fertilisers, whereas in the Bundelkhand region, majority of farmers were used chemical fertilisers to boost farm productivity. In totality, the calculated agricultural sustainability index scores revealed that the Bundelkhand region was highly sustainable, whereas the western region was least sustainable.

Land size and Region wise Social Security Index

The calculated social security index scores show that marginal farmers were highly secured, whereas medium farmers were least secured in the eastern (Table 4). As per calculated index scores for central region, it was found that small farmers were highly secured, whereas large farmers were least secured. Semi-medium farmers were highly secured, whereas large farmers were less secured in the Bundelkahnd region.

In western region, which has highly productive soil and irrigation resources, it was found that farmers belong to the semi-medium operational land size have highest social security, whereas small farmers have least social security. In totality, marginal and small farmers highly secured, whereas large farmers were least secured.

Land size and Region wise Agricultural Machinery Sustainability Index

Region-wise status of agricultural machinery sustainability among the operational land sizes across the regions has summarized in table 5. The calculated index scores show that marginal farmers (0.190) in the eastern region were highly sustainable, whereas medium farmers (0.147) were least sustainable. On the contrary, medium farmers (0.163) were highly sustainable and marginal farmers (0.013) least sustainable in the central region. Further, In the Bundelkhand region, marginal farmers (0.209) were highly sustainable (54 percent using hand-operated agricultural machinery), whereas small farmers (0.148) were least sustainable. On the contrary, marginal farmers (0.137) were least sustainable, whereas small farmers (0.161) were highly sustainable in the western region. In totality, large farmers (0.161) were highly sustainable, whereas marginal farmers (0.161) least sustainable in Uttar Pradesh.

Land size and Region wise Agricultural Credit Security Index

The calculated index scores show that marginal farmers (0.391 & 0.434) were highly secured, whereas medium farmers (0.000& 0.325) were least secured in the eastern and central regions (Table 6). In other words, marginal farmers received highest agricultural credit and medium farmers received least in the eastern and central regions. In the Bundelkhand, medium farmers (0.531) were highly secured, whereas small farmers (0.298) were least secured. On the contrary, medium farmers (0.225) were the least secured and small farmers (0.390) were highly secured in the western region. In totality, marginal farmers (0.392) were highly secured, whereas semi-medium farmers (0.383) were least secured. In other words, marginal farmers received the highest credit from institutional sources, whereas semi-medium farmers received the least credit in Uttar Pradesh.

Land size and Region wise Irrigational Sustainability Index

The irrigational sustainability index was calculated using the net irrigated and unirrigated area (Table 7).Small farmers were highly sustainable (0.332), whereas medium farmers (0.308) were least sustainable in the eastern region. In the central region, small farmers (0.207) were least sustainable, whereas medium farmers (0.273) were highly sustainable. Medium farmers (0.298) were highly sustainable, whereas small farmers (0.198) were least sustainable in the Bundelkhand region. Further, medium farmers (0.320) were highly sustainable, whereas semi-medium farmers (0.204) were least sustainable in western region. In totality, medium farmers were highly sustainable, whereas small farmers were least sustainable in Uttar Pradesh.

Land size and Region wise Livestock Security Index

Livestock added an additional layer in the agricultural sustainability. Itnot only generates employment and income in the off- cropping season, but also provides fuel and food. The calculated livestock security index scores show that medium farmers (0.680) were highly secured, whereas small farmers (0.295) were least secured in the eastern region (Table 8). Further, semi-medium farmers (0.485) were least secured, whereas marginal farmers (0.396) were least secured in the central region. Marginal farmers (0.296) were least secured, whereas medium farmers (0.680) were highly secured in the Bundelkhand region. Furthermore, large farmers (0.245) were least secured, whereas small farmers were highly secured in the western region. In totality, semi-medium (0.411) were least secured, whereas marginal farmers (0.476) were least secured in Uttar Pradesh.

Land size and Region wise Sustainable Insect Pest Management Index

The sustainable management of crop-pest also equally important. Higher use of chemical pesticides not only harmful to the plant and soil, but also causes cancer in the humans. The calculated sustainable insect-pest management index scores show that medium farmers (0.035) were highly sustainable, whereas marginal farmers (0.069) were least sustainable in the eastern region (Table 9).

Table 1. Number and Area under different size of operational Land Holdings

Region	2005-06									
	Number					Area				
	Marginal	Small	Semi-Medium	Medium	Large	Marginal	Small	Semi-Medium	Medium	Large
Western Region	71.01	17.47	8.71	2.70	0.12	33.25	26.04	24.43	14.51	1.76
Central Region	79.20	13.94	5.37	1.42	0.07	43.80	25.87	19.01	9.98	1.34
BundelkahdRegion	56.00	21.75	13.80	7.67	0.77	17.06	20.37	25.40	29.85	7.32
Eastern Region	82.71	11.31	4.64	1.22	0.11	49.47	22.73	17.34	8.52	1.94
Uttar Pradesh	75.74	14.78	6.98	2.33	0.16	40.09	24.16	20.80	12.69	2.25
	2010-11									
Western Region	73.12	16.41	8.01	2.37	0.10	35.47	26.03	23.63	13.34	1.53
Central Region	80.85	12.77	5.03	1.29	0.05	45.47	24.98	18.90	9.48	1.18
Bundelkahd Region	58.28	20.77	13.24	7.00	0.71	18.73	20.31	25.67	28.39	6.90
Eastern Region	83.87	10.74	4.17	1.12	0.10	51.78	22.32	16.13	8.02	1.75
Uttar Pradesh	77.40	13.92	6.44	2.10	0.15	42.22	23.85	20.02	11.88	2.03

Source: Estimated from Agricultural Census, 2006-07 and 2011-12. Note: marginal (less than 1 hectare), small (1-1.99 hectares), semi-medium (2-3.99 hectares), medium (4-9.99 hectares) and large (10 & above hectares).

Table 2. Region wise Gini Index

Region	Gini Index	
	2005-06	2010-11
Eastern Region	0.20	0.19
Central Region	0.18	0.17
Bundelkhand Region	0.25	0.25
Eastern Region	0.17	0.17
Uttar Pradesh	0.20	0.20

Source: Calculated from Agricultural Censuses, 2005-06 & 2010-11.

Table 3. Region wise different Agricultural Sustainability Indices

Indicators	Eastern Region	Central Region	Bundelkhand Region	Western Region	Uttar Pradesh
Social Security Index	0.131	0.167	0.134	0.139	0.143
Agricultural Machinery Sustainability Index	0.169	0.126	0.165	0.149	0.152
Agricultural Credit Security Index	0.386	0.377	0.420	0.315	0.375
Irrigation Sustainability Index	0.319	0.243	0.237	0.267	0.266
Livestock Security Index	0.510	0.423	0.548	0.303	0.446
Sustainable Insect Pest Management Index	0.048	0.062	0.134	0.045	0.072
Seed Sustainability Index	0.065	0.095	0.114	0.070	0.086
Fertilisers Sustainability Index	0.129	0.107	0.102	0.071	0.102
Agricultural Sustainability Index	0.210	0.196	0.221	0.166	0.198

Source: Estimated from Agricultural Census Input Survey, 2010-11.

Table 4. Land size and Region wise Social Sustainability Index

Land Size	Eastern Region	Central Region	Bundelkhand Region	Western Region	Uttar Pradesh
Marginal	0.172	0.171	0.121	0.140	0.151
Small	0.166	0.174	0.132	0.132	0.151
Semi-Medium	0.122	0.168	0.155	0.149	0.149
Medium	0.097	0.165	0.140	0.135	0.134
Large	0.096	0.157	0.120	0.136	0.127

Source: Estimated from Agricultural Census Input Survey, 2010-11.

Table 5. Land size and Region wise Agricultural Machinery Sustainability Index

Land Size	Eastern Region	Central Region	BundelkhandRegion	Western Region	Uttar Pradesh
Marginal	0.190	0.013	0.209	0.135	0.137
Small	0.179	0.144	0.148	0.161	0.158
Semi-Medium	0.152	0.159	0.155	0.139	0.151
Medium	0.147	0.163	0.149	0.160	0.155
Large	0.176	0.153	0.164	0.150	0.161

Source: Estimated from Agricultural Census Input Survey, 2010-11.

Table 6. Land size and Region wise Agricultural Credit Sustainability Index

Land Size	Eastern Region	Central Region	Bundelkh and Region	Western Region	Uttar Pradesh
Marginal	0.386	0.434	0.408	0.341	0.392
Small	0.391	0.341	0.298	0.390	0.354
Semi-Medium	0.286	0.367	0.392	0.387	0.383
Medium	0.000	0.325	0.531	0.225	0.367
Large	0.386	0.418	0.472	0.231	0.377

Source: Estimated from Agricultural Census Input Survey, 2010-11.

Table 7. Land size and Region wise Irrigational Sustainability Index

Land Size	Eastern Region	Central Region	Bundelkh and Region	Western Region	Uttar Pradesh
Marginal	0.319	0.230	0.224	0.266	0.260
Small	0.332	0.207	0.198	0.280	0.254
Semi-Medium	0.309	0.273	0.264	0.204	0.262
Medium	0.308	0.241	0.298	0.320	0.292
Large	0.326	0.263	0.199	0.264	0.263

Source: Estimated from Agricultural Census Input Survey, 2010-11.

Table 8. Land size and Region wise Livestock Security Index

Land Size	Eastern Region	Central Region	Bundelkhand Region	Western Region	Uttar Pradesh
Marginal	0.603	0.396	0.603	0.394	0.476
Small	0.295	0.434	0.295	0.451	0.422
Semi-Medium	0.618	0.485	0.618	0.034	0.411
Medium	0.680	0.403	0.680	0.390	0.496
Large	0.546	0.399	0.546	0.245	0.425

Source: Estimated from Agricultural Census Input Survey, 2010-11.

Table 9. Land size and Region wise Sustainable Insect Pest Management Index

Land Size	Eastern Region	Central Region	Bundelkhand Region	Western Region	Uttar Pradesh
Marginal	0.069	0.057	0.144	0.007	0.069
Small	0.060	0.060	0.090	0.056	0.066
Semi-Medium	0.040	0.067	0.161	0.069	0.084
Medium	0.035	0.092	0.160	0.037	0.081
Large	0.037	0.033	0.115	0.054	0.060

Source: Estimated from Agricultural Census Input Survey, 2010-11.

Table 10. Land size and Region wise Seed Sustainability Index

Land Size	Eastern Region	Central Region	Bundelkhand Region	Western Region	Uttar Pradesh
Marginal	0.093	0.091	0.094	0.095	0.093
Small	0.097	0.101	0.134	0.086	0.105
Semi-Medium	0.067	0.093	0.144	0.082	0.097
Medium	0.048	0.110	0.069	0.055	0.071
Large	0.020	0.079	0.127	0.030	0.064

Source: Estimated from Agricultural Census Input Survey, 2010-11.

Table 11. Land size and Region wise Fertiliser Sustainability Index

Land Size	Eastern Region	Central Region	Bundelkhand Region	Western Region	Uttar Pradesh
Marginal	0.142	0.114	0.112	0.086	0.114
Small	0.138	0.095	0.098	0.097	0.107
Semi-Medium	0.119	0.103	0.107	0.049	0.095
Medium	0.131	0.107	0.103	0.053	0.098
Large	0.115	0.117	0.092	0.072	0.099

Source: Estimated from Agricultural Census Input Survey.

Table 12. Land size and Region wise Agricultural Sustainability Index

Land Size	Eastern Region	Central Region	Bundelkhand Region	Western Region	Uttar Pradesh
Marginal	0.228	0.186	0.226	0.178	0.205
Small	0.226	0.192	0.170	0.198	0.196
Semi-Medium	0.203	0.209	0.239	0.140	0.198
Medium	0.195	0.197	0.252	0.168	0.203
Large	0.196	0.197	0.217	0.147	0.189

Source: Estimated from Agricultural Census Input Survey, 2010-11.

In the central region, large farmers (0.033) were least sustainable, whereas medium farmers (0.092) were highly sustainable in the central region. Marginal farmers (0.090) were least sustainable, whereas semi-medium (0.161) were highly sustainable in Bundelkhand region. Further, marginal farmers (0.007) were least sustainable, whereas semi-medium (0.069) were highly sustainable in western region. In totality, large farmers (0.060) were least sustainable, whereas semi-medium farmers (0.084) were highly sustainable in Uttar Pradesh.

Land size and Region wise Seed Sustainability Index

Seeds are key determinants for agricultural production. Certified and notified seeds according to the soil physiological characteristics will be produced more yield. The calculated seed sustainability index scores show that small farmers (0.097) were highly sustainable, whereas large farmers (0.020) were least sustainable in the eastern and western regions (Table 10). Further, medium farmers (0.069) were least sustainable, whereas semi-medium farmers (0.144) were highly sustainable in the Bundelkhand region. In the western region, large farmers (0.030) were least sustainable, whereas marginal farmers (0.095) were highly sustainable in the western region. In totality, large farmers (0.064) were least sustainable, whereas small farmers (0.105) were highly sustainable in the Uttar Pradesh.

Land size and Region wise Fertiliser Sustainability Index

Fertiliser sustainability has a positive role in soil health, reduction in the fertiliser subsidy, and input cost. The calculated fertiliser sustainability index scores show that marginal farmers (0.142) were highly sustainable, whereas large farmers (0.115) were least sustainable in the eastern region (Table 11). In the central region, small farmers (0.095) were least sustainable, whereas large farmers (0.117) were highly sustainable in the central region. Further, marginal farmers (0.112) were highly sustainable, whereas large farmers (0.092) were least sustainable region in the Bundelkhand region. Furthermore, semi-medium (0.049) were least sustainable, whereas small farmers (0.097) were highly sustainable in western region. In totality, medium farmers (0.098) were least sustainable, whereas marginal farmers (0.114) were highly sustainable in Uttar Pradesh.

Land size and Region wise Agricultural Sustainability Index

By combined all sub-components, agricultural sustainability indices for different economic region and operation landholdings were calculated (Table 12). The calculated index scores show that marginal farmers (0.228) were highly sustainable, whereas medium farmers (0.195) followed by large farmers (0.196) were least sustainable in the eastern region. In the central region, semi-medium farmers (0.209) were highly sustainable, whereas marginal farmers (0.186) followed by small farmers (0.192) were least sustainable. Further, medium farmers (0.252) were highly sustainable, whereas small farmers (0.170) followed by large farmers (0.217) were least sustainable in the Bundelkhand region. In the western region, small farmers (0.198) were highly developed, whereas semi-medium (0.140) farmers were least sustainable. In totality, marginal farmers (0.205) followed by medium farmers (0.203) were highly sustainable, whereas large farmers (0.189) were least agricultural sustainability in Uttar Pradesh.

DISCUSSION

Inequality among the operational holdings added an additional layer in the marginally owned, diversified, climate exposed, sensitive, and less resilient agriculture system. The calculated results show that there is a vast diversity in terms of resource utilization and land ownership. (Raoand Rogers, 2006). However, the degree of inequality has declined from 2005-06 to 2010-11in eastern and central region, but in it was remained constant in Bundelkhand and western regions (Table 2). The calculated agricultural sustainability indices for different economic region show that farmers in Bundelkhand region were highly sustainable, whereas farmers in western region were least sustainable. In Bundelkhand region, farmers have opted sustainable management practices by utilizing of agricultural resources, viz., agricultural machinery, credit, livestock, biological insect-pest management, and sustainable use of seeds, to develop a sustainable agricultural production system, where each and every resource was efficiently utilized. In other words, these resource-poor farmers have adopted the farming system in such a way that their total returns should be maximized from the available resources (Pasha, 1991). The present study also included the debate aboutland ownership sustainability. There is a growing concern among the researchers that marginal farmers are highly unsustainable with the least resources and resilient capacity (Malone and Engle, 2011; Fussel, 2007 and Fassel and Klein, 2006). The cross-sectional analysis revealed that marginal farmers were highly sustainable in terms of agricultural machinery sustainability and fertiliser consumption sustainability. Small farmers were highly sustainable in terms of irrigation sustainability and social security. Medium farmers were highly sustainable in terms of livestock sustainability, whereas semi-medium farmers were highly sustainable in terms of insect-pest management sustainability and seed sustainability. In totality, marginal farmers were highly sustainable in Uttar Pradesh (Table 12).

Conclusion

The present paper explores that relationship between land size and land inequality,and agricultural sustainability in the marginalised agriculture. The present study concludes that marginal farmers have used resources, including common property resources to sustain their livelihoods in the most backward regions namely, the Bundelkhand region. The present study also concludes that the degree of sustainability among the marginal and small farmers comparatively much higher with large farmers. The present study was found that (i) inequality in the western and central region was remained constant (ii) the medium to large farmers have injected much higher chemical fertilisers in the soil comparatively with marginal farmers, and (iii) the degree of sustainability in western region was lower. With these specific findings, the present study suggests that there is a need of micro-level policy interventions for the reduction of chemical fertilizer use. The excess of chemical fertilisers not only deteriorating soil health, but also causes long-chronical diseases such as cancer. Therefore, judicious use of chemical fertilisers has a win-win situation. This not only reduces the input cost, but also beneficial to soil and human health. Further, continuously increasing population and fragmentation in land are two major reasons for inequality among the operational landholdings. This can be dealt through community participation. The present study also found that high yielding regions are least sustainable such as western region. Therefore, the present study suggests that judicious of common property resources, including land and water, the degree of sustainability would be an increase in Uttar Pradesh.

REFERENCES

Abraham, I. 2013. Growth and Sustainability, *Economic and Political Weekly*, Vol. 48, No. 31, pp. 28-29.

Birch, E. and Shipra, N. 2014. India and the Sustainable Cities Goal, *Economic and Political Weekly*, Vol. 49, No. 46, pp. 26-28.

Chand, P., Smita, S., S.K. Sirohi, 2011. Using Sustainable Livestock index for Development of Livestock sector: Case Study of an arid region in India. *Journal of Applied Animal Research,* Vol. 39, No. 3, pp. 234-238.

Chopra, K. 2003. Sustainable use of Water: The Next two decades. *Economic and Political Weekly*, Vol. 38, No. 32, pp. 3360-3365.

Christopher, S., Ranjitha, P. and Jetske B. 2004. Sustainable Livestock Production in Semi-Arid Watersheds. *Economic and Political Weekly*, Vol. 39, No. 31, pp. 3477-3483.

Cline, W. R. 2007. *Global Warming and Agriculture: Impact Estimates by Country*. Washington D.C.: Peterson Institute, pp. 1-15.

CSO, 2010. *National Accounts Statistics*. 2010. Government of India, New Delhi, p. 134139.

Cullet, P. 2005. Seeds Regulations, Food Security and Sustainable Development, *Economic and Political Weekly*, Vol 40, No. 32, pp. 3607-3613.

Dashgupta, P. 2002. Human Well-being and Sustainable Development, *Economic and Political Weekly*, Vol. 37, No. 42, 4289-4294.

Fussel, H. M., Richard and J.T. Klein, 2006. Climate Change Vulnerability Assessment: An Evolution of Conceptual Thinking, Climate Change, Vol. 75, No. 3, pp. 301-329.

Fussel, M. 2007. Vulnerability: a generally applicable conceptual framework for climate change research, Global Climate Change, Vol. 17, No. 2, pp. 155-167.

Gadgil, S. and Sulochana G. 2006. The Indian Monsoon, GDP and Agriculture, *Economic and Political Weekly*, Vol 41, No. 47, pp. 4887-4897.

Gapalan, R. 2016. Science and Scientist in Changing Climate, *Economic and Political Weekly*, Vol. 51, No. 28, pp. 30-35.

Gautam, M. 2016. Making Indian Agriculture More Resilient: Some Policy Priorities. *Economic and Political Weekly*, Vol. 51, No. 8, pp. 24-27.

Ghate, A.K. 2016. Achieving Sustainable Mobility 'Shift' or 'Retain', *Economic and Political Weekly*, Vol. 51, No. 9, pp. 32-37.

Ghosh, D. and Sreerupa, R. 2007. Modern Agriculture and the Ecologically Handicapped: Fading Glory of Boro Paddy Cultivation in West Bengal, *Economic and Political Weekly*, Vol. 42, No. 26, pp. 2534-2542.

GoI, 2011. Agricultural Census, Department of Agriculture, Cooperation and Farmers Welfare, Ministry of Agriculture and Farmers Welfare, New Delhi, India.

GoI, 2017. Annual Report, Indian Meteorological Department of India, Ministry of Earth Sciences, Government of India, New Delhi.

GoI. 2015. *Raising Agricultural Productivity and Making Farming Remunerative of Farmers*. An Occasional Paper, NITI Aayog, Government of India, pp. 1-46.

Gopalan, R. 2001. Sustainable Food Production and Consumption: Agenda for Action, *Economic and Political Weekly,* Vol. 36, No. 14-15, pp. 1207-1225.

Hahn, M.B., Riederer, A. M. and S.O. Foster, 2009. The Livelihood Vulnerability Index: A Pragmatic Approach to Assessing Risks from Climate Variability and Change- A Case Study in Mozambique, Global Environmental Change, Vol. 19, No. 2, pp. 42-53.

IFPRI. 2009. *Climate Change Impact on Agriculture and Costs of Adaptation*. Washington, D.C.: International Food Policy Research Institute, pp. 1-12.

Ignacimuthu, S., 2003. Sustainable Insect Pest Management, *Journal of Scientific & Industrial Research*. Vol. 62, pp. 846-849.

Iyengar, N.S. and P. Sudarshan, 1982. A Method of Classifying Regions from Multivariate Data, Economic and Political Weekly, Vol. 17, No. 51, pp. 1-5.

Jodha, N.S. 1991. Sustainable Agriculture in Fragile Resource Zones: Technological Imperative, *Economic and Political Weekly*, Vol. 26, No. 13, pp. 15-26.

Khor, M. 2012. An Assessment of the Rio Summit on Sustainable Development, *Economic and Political Weekly*, 47, No. 28, pp. 10-14.

Kothari, A. 2013. Development of Ecological Sustainability in India: Possibilities for the Post-2015 Framework, *Economic and Political Weekly*, Vol. 48, No. 30, pp. 144-154.

Kumar, Kavi K.S. 2016. Economics of Sustainable Development, *Economic and Political Weekly*, Vol. 51, No. 3, pp. 34-36.

Malone, L. Elizabeth and Nathan L. Engle, 2011. Evaluating regional vulnerability to climate change: purposes and methods, WIREs Climate Change, Vol. 2, pp. 462-474.

Moench, M. 1992. Chasing the Watertable: Equity and Sustainability in Groundwater Management, *Economic and Political Weekly*, Vol. 27, No. 51-52, pp. 171-177.

Mohan, R. 2006. Agricultural Credit in India Status, Issues and Future Agenda, *Economic and Political Weekly*, Vol. 41, No. 11, pp. 1013-1021.

Nanda, M. 2018. Addressing India's Food Security: Is Phosphorus the Missing Link, *Economic and Political Weekly*, Vol. 53, No. 15, pp. 17-19.

Negi, D.S. and Pratap, S. Birthal, 2012. Livestock for Higher, Sustainable and Inclusive Agricultural Growth, *Economic and Political Weekly*, Vol. 47, No. 26- 27, pp. 89-99.

Ninan, K.N. and Chandrashekhar, H. 1993. Green Revolution, Dryland Agriculture and Sustainability, *Economic and Political Weekly*, Vol. 28, No. 12-13, pp. 2-8.

Palanisami, K., Ruth Meinzen-Dick, Mark. G. 2010. Climate Change and Water Supplies: Options for Sustaining Tank Irrigation Potential in India, *Economic and Political Weekly*, Vol. 45, No. 26 & 27, pp. 183-190.

Palmer-Jones, R.W. 1992. Sustainability Serendipity: Groundwater Irrigation, Growth of Agricultural Production and Poverty in Bangladesh, *Economic and Political Weekly*, Vol 27, No. 39, pp. 128-140.

Parappurathu, S. and Ramesh C. 2012. Temporal and Spatial Variations in Agricultural Growth and Its Determinants, *Economic and Political Weekly*, Vol. 47, No. 26- 27, pp. 55-64.

Pasha, S. Ajmal, 1991. Sustainability and Viability of Small and Marginal Farmers: Animal Husbandry and Common Property Resource, *Economic and Political Weekly*, Vol. 26, No. 13, pp. 27-29.

Patil, S.G. and Gary, W. Vanloon, 2006. Theory and Practice of Agricultural Indicators, *Economic and Political Weekly*, Vol. 41, No. 34, pp. 3703-3705.

Perveen, S. 2004. Population Growth and Sustainable Development, *Economic and Political Weekly*, Vol. 39, No. 7, pp. 329-633.

Phadke, Anant R.S. 1992. Science and Sustainable Development, *Economic and Political Weekly*, Vol 27, No. 45, pp. 2411-2413.

Pionetti, C. 2006. *Diversity in the Drylands: Women and Farming in South India*. Gatekeeper Series. International Institute of Environmental and Development, London, No. 126, pp. 1-26.

Praduman, K., Surabhi, M. 2006. Agricultural Productivity Trends in India: Sustainability Issues. Vol. 71, pp. 71-88.

Pretty, J., John, T., Fiona, H. 1996. *Sustainable Agriculture: Impacts on Food Production and Challenges for Food Security*. Gatekeeper Series No. 60, pp. 1-24.

Rao, C.H. Hanumantha, 1998. Agricultural Growth, Sustainability and Poverty Alleviation: Recent Trends and Major Issues of Reform, *Economic and Political Weekly*, Vol 33, No. 29-30, pp. 1943-1948.

Rao, Hanumantha C.H. 2002. Sustainable use of Water for Irrigation in Indian Agriculture. *Economic and Political Weekly*, Vol. 37, No. 18, pp. 1742-1745.

Rao, N. H., P. P. Rogers, 2006. Assessment of Agricultural Sustainability. *Current Science*, Vol. 91, No. 4, pp. 439-448.

Rao, V.M. and R.S. Deshpande, 1986. Agricultural Growth in India: A Review of Experiences and Prospects, *Economic and Political Weekly*, Vol. 21, No. 38 & 39, pp. 101-112.

Reddy, V. Ratna, 1995. Environment and Sustainable Agricultural Development: Conflicts and Contradictions, *Economic and Political Weekly*, Vol. 30, No.12, pp. 21-29.

Ringler, C., T. Zhu, X. Cai, J. Koo, and D. Wang. 2010) *Climate Change Impacts on Food Security in Sub-Saharan Africa: Insights from Comprehensive Climate Change Scenarios*. IFPRI Discussion Paper No. 1042. Washington, DC: International Food Policy Research Institute, pp. 1-20.

Sanwal, M. 2008. Sustainable Development: Perspective of Climate Change, *Economic and Political Weekly*, Vol. 43, No. 15, pp. 49-54.

Shah, T. 1992. Sustainable Development of Groundwater Resource: Lessons from Junagadh District, *Economic and Political Weekly*, Vol. 27, No. 10-11, pp. 515-520.

Singh, G. and G.S. Bhall, 1997. Recent Development in Indian Agriculture: A State Level Analysis, *Economic and Political Weekly*, Vol. 32, No. 13, pp. 1-18.

Singh, N. 2017. Sustainability Crisis: A Critical Evaluation of Green Energy, *Economic and Political Weekly*, Vol. 52, No. 3, pp. 66-69.

Singh, S. 2001. Green Revolution: In Light and Shade, *Economic and Political Weekly*, Vol. 36, No. 42, pp. 3996-3998.

Sundaram, K. Jomo, 2013. A Global Green New Deal for Sustainable Development, *Economic and Political Weekly*, Vol. 48, No. 34, pp. 17-19.

Viswanathan, P.K., Gopal, B. Thapa, Jayant, K. Routray, Makbul, M. Ahamad, 2012. Agrarian Transition and Emerging Challenges in Asian Agriculture: A Critical Assessment, *Economic and Political Weekly*, Vol. 48, No. 4, pp. 41-50.

Vyas, V.S. 2002. Our Agrarian Future: A Medium-term Perspective on Asian Agriculture, *Economic and Political Weekly*, Vol 37, No. 50, pp. 5017-5027.

APPENDIX

Table 1A. Economic Region wise Districts of Uttar Pradesh

Economic Region	Districts
Eastern Region	Allahabad, Ambedkar Nagar, Azamgarh, Behraich, Balia, Balrampur, Chandauli, Deoria, Faizabad, Gazipur, Gonda, Gorakhpur, Jaunpur, JyotibaPhulu Nagar, Kausambi, Kusi Nagar, Mahamayanagar, Maharajpur, Mau, Mirjapur, Pratapgarh, SantKabeer Nagar, SantRavidas Nagar, Sharavasti, Sidharth Nagar, Sonbhadra, Sultanpur, Vanarasi, Basti
Central Region	Barabanki, Fatehpur, Hardoi, Kanpur Dehat, LakhimpurKheri, Lucknow, Raibareli, Sitapur, Unnao
Bundelkhand Region	Banda, Chitrakoot, Hamirpur, Jalaun, Jhansi, Lalitpur, Mahoba
Western Region	Agra, Aligarh, Auraiya, Badaun, Baghpat, Bareilly Bijnor, Bulandsahar, Etah, Farukhabad, Firozabad, GoutamBudh Nagar, Gaziabad, Etawah, Kannauj, Mainpuri, Mathura, Meerut, Moradabad, Muzaffarnagar, Pilibhit, Rampur, Saharanpur, Sahajahanpur

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