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LINKING LAND DISTRIBUTION WITH FOOD SECURITY: EMPIRICAL EVIDENCE FROM PAKISTAN

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ABSTRACT

Equitable distribution of rural lands amongst farming communities plays a pivotal role in food production and contributes to adequate calorie intake. Based on land distribution, this study estimates the disparities of operational farmland holdings at the district level in Pakistan, and ranks the districts in terms of land distribution in descending order. It also investigates the impact of land distribution, farm fragmentation, and land-use intensity on various aspects of food security (i.e., food availability, food access, and food absorption) by employing Pearson correlation and econometric models. The results from show that food security is heigthened with the improvement in distribution of land (i.e., operational land holdings) and land-use intensity, while food security declines with an increase in farm fragmentation. Therefore, land reform policies which aim to reduce disparity in land distribution and fragmentation would strongly contribute to enhancing food security in Pakistan.

Keywords: Land distribution, food security, land fragmentation, Pakistan

INTRODUCTION

The number of chronically undernourished people across the world went from 979 million in 1990 to 867 million in 2012 (FAO, 2013). Just like with the Millennium Development Goals (MDGs), the importance of poverty, food security, malnutrition, and hunger have been duly acknowledged and incorporated in the Sustainable Development Goals (SDGs) (UNDP, 2019).

As per the global hunger index score, Pakistan ranks 106th out of 117 nations with 20.5 percent of its population being undernourished (Global Hunger Index, 2018). Although 59.5% of the country's population lives in rural areas where food grains are mainly produced, a large proportion of the farming population has failed to meet the food requirements of the rest of the people living in urban areas (Government of Pakistan, 2017). In regards to the food production systems and fulfilling the nutritional requirements of the population, land is one of the most important production factors. However, land distribution disparities have been observed to be negatively associated with economic growth (Alesina & Rodrik, 1994; Spalding, 2017). The relationship between farm size and productivity has been well debated in the literature especially during the 1960s and 1970s, and as a result of many studies (Mazumdar, 1965; Bardhan, 1973; Berry and Cline, 1979), a convincing argument was developed that productivity has a tendency to decrease with a rise in farm size. For example, Platteau (1992) observed that small farms were more efficient and have more per acre yield because family labor supported agricultural production, which required less intensive supervision and lower transaction costs. This is called the inverse farm-size productivity relationship which guided governments to introduce land reforms restricting farm size in order to enhance efficiency and productivity growth in agriculture.

Jayne *et al*. (2003) found that economic growth was an essential condition in Eastern and Southern African countries in order to tackle the widespread poverty accompanying landless populations. Similarly, Vollrath (2006) explored the association between distribution of land and productivity in agriculture by performing a time series analysis across 62 countries, and the results revealed a strong association between landholding and agricultural output. Moreover, increased access to land resulted in the reduction of poverty and food insecurity (Muraoka *et al*., 2018). In a detailed study, Chirwa (2004) inspected the connections between access to land, poverty, and economic growth in Malawi, and concluded that enhanced access to land was inhibitive of people falling into the poverty trap. Malik (2011) found that landlessness and food insecurity are positively associated in Pakistan.

Being convinced of the benefits of lessening unequal distribution of land, several developing countries endeavored to introduce market-focused land redistribution reforms (Powelson, 1987). Pakistan made several efforts to pursue a similar approach of land redistribution in 1959, 1972, and 1978, but could not achieve the desired results because these reforms were neither introduced holistically nor sustained due to legal complications and political instability in the country (Mahmood, 2009). Consequently, there still exists a heavily skewed distribution of land (Table 1) in the country, which is an enormous hurdle for rural development, farm productivity, and food security. Many studies have been conducted to observe the farm productivity and poverty relationship, but none have explored land distribution and its implications for food security. Table 1 summarizes land statistics from various Agriculture Census Reports of Pakistan and presents the distribution of farms with respect to their size from 1960 to 2010.

Table 1. Farm Area Distribution Over Time by Size in Pakistan (%).

Size of Farm	Number of farms (%)						Farm area (%)					
(acres)	1960	1972	1980	1990	2000	2010	1960	1972	1980	1990	2000	2010
<5	19	28.2	34.1	47.5	57.6	64.7	3	5.2	7.1	11.3	15.5	19.2
5<12.5	44.3	39.9	39.4	33.4	28.1	24.8	23.6	25.2	27.3	27.5	27.9	28.8
12.5<25	23.8	21.1	17.3	12.2	8.8	6.8	27	26.6	24.7	21.5	19.1	17.7
25<50	9	7.7	6.5	4.7	3.9	2.6	19	18.8	17.8	15.8	16.3	12.7
50<150	3.3	2.7	2.4	1.8	1.2	1	16	15.1	14.7	13.9	9.6	10.5
>150	0.5	0.4	0.3	0.3	0.2	0.2	11.5	9.1	8.5	10.1	11.6	11.1
Total	100	100	100	100	100	100	100	100	100	100	100	100

Source: Government of Pakistan (1960, 1972, 1980, 1990, 2000 and 2010)

None of the previous studies have focused on district land distribution disparities in Pakistan. Even in other developing countries, no studies have investigated the land distribution at such small administrative divisions for an entire nation. Hence, the current study has a number of novel aspects and the major objectives of the paper are as follows: (a) explore district-level land distribution disparities in Pakistan; (b) rank the districts on the basis of land inequality and (c) quantify relationships between land distribution and food security in Pakistan

MATERIALS AND METHODS

Data sources and variables: The main purpose of this study is to explore the relationship between food security, food availability, food access, food absorption, and agricultural land distribution, and the ranking of the districts of Pakistan. In this regard, secondary data sources, namely the Agricultural Census Report of Pakistan (Government of Pakistan, 2010) and Food Insecurity in Pakistan (SDPI, 2009) have been used. Initially, several variables were used during the data mining stage, but later only few selected variables were identified and analyzed.

This study upholds the definitions of various terms as described by the Federal Bureau of Statistics, Government of Pakistan. Farms or holdings are an aggregate area of land operated by one or more households and normally used for crop production. Fragments or Parcels denote any piece of farmland surrounded by the other farmlands, thus one farm may have one or more fragments/parcels in it. In the case of owner farm holdings, the entire land is owned by the operators themselves. However, operational farm holdings may contain owner, tenant or owner cum tenant operated land. This study has used operational farm holdings in order to account for owner, tenant and owner cum tenant operated land. Land use intensity is a common term representing the extent to which the farmland is used for the cultivation of crops. Cropping intensity is the ratio of effective cropped area to the total area in a certain year. Thus, an area sown more than once will also be accounted for accordingly to calculate an effective cropped area. The Ratio of fragmented farms per cultivated area was also estimated by dividing operational farm holdings by the total cultivated areas in Pakistan. Food security, food availability, food access, and food absorption are based on the definitions stipulated by the Food and Agriculture Organization. The following research methodology was adopted:

Gini Coefficient and ranking of districts: To quantify the differences in land distribution in Pakistan, the concept of the Gini coefficient was employed, though it is commonly used to investigate income inequality. For calculating the distribution of farmland holdings by size at the district level, the number of farms in each category (<5, 5-12.5, 12.5-25, 25-50, 50-150, and >150 acres) was obtained and we divided by corresponding total cultivated area to obtain the number of fragments per cultivated area in each district. Then, the Gini Coefficients of operational farm holdings and ownership farm holdings were calculated separately by using the following formula:

$$GC = 1 + \sum_{1-0}^{k-1}[(q_{i+1} + q_i)(p_{i+1} + p_i)] \text{------------} (1)$$

Where GC stands for Gini Coefficient. i and k are the number of observations from **1** to k and, all the observations were arranged from smaller farm size to larger farm size. However, q_i is the cumulative percentage of the frequency of number of farms in each category of farm size. Similarly p_i is a cumulative percentage of the frequency of farm area in each category of farm size. Moreover, q_{i+1} and p_{i+1} are preceding observations of q_i and p_i respectively. The above formula is in line with Brown (1994). However, the value of the Gini coefficient ranges from zero to one. Any value closer to zero portrays more equal land distribution and any values closer to one indicates more unequal distribution of land in a certain district. While ranking the 122 districts of Pakistan, descending order of operational and ownership farm holdings was adopted for Gini.

The abovementioned procedure was repeated in the case of land-use intensity, cropping intensity, and the ratio of fragmented farms, and Gini coefficients were computed for each district. However, in contrast with districts' ranking of operational and ownership farm holdings, an ascending order ranking was used to measure inequality in land-use intensity, cropping intensity and the ratio of fragmented farms in all the districts based on the corresponding value of Gini coefficients.

Specification of econometric models: In this study, four models were specified. Multiple linear regressions models were used after carefully ascertaining that the data values of selected variables were normally distributed. The percentage of food insecure population (food security), food availability, food accessibility index, and food absorption has been included in the models as dependent variables. The Gini of operational farm holdings, the ratio of fragmented farms to farms cultivated and land-use intensity (%) were taken as independent variables. The Pearson correlation between dependent and independent variables was estimated. The following are the econometric models used in this study:

$FIP = \alpha + B_1 OPFH + \beta_2 FFPA + \beta_3 LUI + \epsilon$ -------- *(2)*

$FAV = \alpha + \beta_1 OPFH + \beta_2 FFPA + \beta_3 LUI + \epsilon$ -------- *(3)*

$FAC = \alpha + \beta_1 OPFH + \beta_2 FFPA + \beta_3 LUI + \epsilon$ -------- *(4)*

$FAB = \alpha + \beta_1 OPFH + \beta_2 FFPA + \beta_3 LUI + \epsilon$ -------- *(5)*

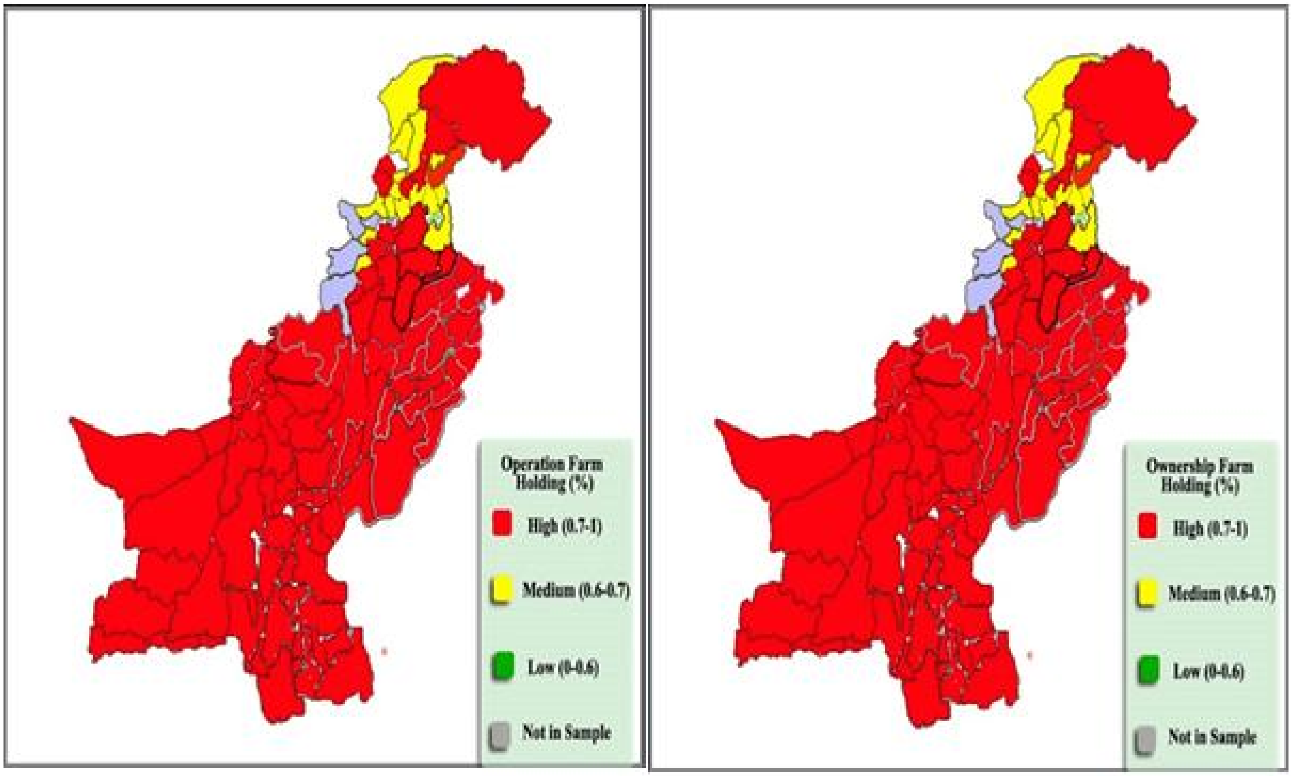
Where, FIP is food insecure population (%), FAV is food availability, FAC is food access, FAB is food absorption, OPLH is Gini of operational farmland holdings, FFPA is the ratio of fragmented farms to the cultivated area, LUI is land-use intensity (%), € is stochastic random error

For the estimation of the above models, the Ordinary Least Square method was used.

RESULTS AND DISCUSSION

District ranking of land distribution disparities: All the districts of Pakistan have been ranked on the basis of the Gini coefficient of operational and ownership farm holdings. Figure 1 illustrates the ranking of all the districts of Pakistan based on the Gini coefficients of operational farm holding. The detailed values of the Gini coefficients of operational farm holdings are provided in Appendix-I. The disparity of operational farmland holdings is least in F.R. Kohat, Khyber Agency, Haripur, Chitral, Charsadda, and Rawalpindi districts and therefore are ranked high. The districts of Faisalabad, Kharian, Gujranwala, Chakwal, Thatta, and Narowal have been ranked in the middle category which means disparity of operational farmland distribution is moderate. However, Karachi, Toba Tek Singh, Gawadar, Warsuk, and Pakpattan are ranked low, showcasing the existence of severe land distribution disparity in these districts.

Similarly, the right side of figure 1 also illustrates the ranking of districts based on the Gini coefficient of ownership farm holdings. The graphical representations of land disparity with respect to operational farmland holdings and ownership farmland holdings are identical. The detailed values of the Gini coefficients of ownership farm holdings are provided in Appendix-II. F.R. Kohat, Charsadda, Khyber Agency, and Haripur are high ranked districts, Sukkur, Killa Saifullah, Jhang, Lahore, Umerkot and Loralai are middle-ranked, and Pakpattan, Jehlum, Layyah, Jhalmagsi, Gawadar, Warsuk, and Karachi are low ranked districts.



Source: Based on Authors own calculations

Figure 1. District ranking based on Gini of operational farmland holdings and ownership landholdings.

Correlation Analysis: Using Pearson correlation, the association between land resources and food security was analyzed. Pearson correlation was calculated between the percent of food insecure population (FIP) and selected variables of land resources, i.e., operational farmland holdings (OPFH), ownership farmland holdings (OWFH), fragmented farmland per cultivated area (FFPA), cropping intensity (CRI) and land-use intensity (LUI). The Pearson correlation was also analyzed between food availability (FA), food access (FAC), and food absorption (FAB) with selected variables of land resources. Table 2 exhibits the output values of respective Pearson's correlation along with their statistical significance between food security and selected variables of land resources.

Table 2. Pearson correlation between food security and selected variables of land resources.

Food Security	OPFH	OWFH	FFPA	CRI	LUI
FIP	-.097	-.130	-.572	-.468	-.363
	(.318)	(.179)	(.000)	(.000)	(.000)
FAV	.387	.288	.257	.292	.338
	(.000)	(.003)	(.007)	(.002)	(.000)
FAC	-.109	-.005	.488	.395	.256
	(.260)	(.961)	(.000)	(.000)	(.008)
FAB	-.062	-.022	.502	.313	.251
	(.526)	(.826)	(.000)	(.001)	(.009)

p-value is provided in parenthesis;
OPFH - operational farmland holdings; OWFH - ownership farmland holdings; FFPA - fragmented farmland per cultivated area; CRI - Cropping intensity; LUI - land-use intensity
FIP - percent of food insecure population; FA - food availability; FAC - food access; FAB - food absorption

The results from the Pearson correlation show a negative correlation between food insecure population and all the selected variables of land resources i.e. operational farmland holdings disparity, ownership farmland holding disparity, farms fragmented per cultivated area, cropping intensities, and land-use intensity. The output for correlation between food insecure populations and the Gini coefficient of operational and ownership farmland holdings is negative and indicates that larger farms contribute positively to food security. Meanwhile, it can be seen that increasing land-use intensity and cropping intensity improves food security, food availability, food access and food absorption in Pakistan.

Estimation of econometric models: Table 3 presents findings from the regression model. Model-1 explains the relationship between food insecure populations (%) with the Gini of operational farmland holdings, fragmented farmland, and land-use intensity. The *F*-statistic and *p*-value are significant and indicate a good fit of the model. It is evident from the value of R^2 that at least a 25.4% variation in food insecure population is explained by the independent variables fitted in the model.

Table 3. Relationship of Gini of Land Distribution with Food Security Pillars in Pakistan.

Ind./Dep. (Variables)	FIP (%) MODEL_I		FAV MODEL_II		FAC MODEL_III		FAB MODEL_IV	
	B	*p*-value	B	*P*-value	B	*P*-value	B	*P*-value
(Constant)	94.473	0.000	-538.073	0.000	1.018	0.062	0.664	0.099
OPFH	-52.794	0.08	743.755	0.000	-0.544	0.423	-0.143	0.777
FFPA	26.937	0.000	-72.226	0.029	-0.325	0.047	-0.242	0.46
LUI	-0.191	0.007	1.172	0.000	0.003	0.09	0.002	0.097
	R2 = 0.254		R^2 = 0.332		R^2 = 0.106;		R^2 = 0.100	
MODEL FIT	F = 11.810		F = 17.197		F= 4.129		F = 3.808	
	P-Value = 0.000		P-Value = 0.000		P-Value = 0.008		P-Value = 0.012	

The output of Model-I corroborates that the rise in land distribution disparity decreases the food insecure population of Pakistan. This means that larger farms produce more and can better protect the population from the threat of food insecurity. Moreover, this model also exhibits that increased land-use intensity decreases food insecure populations or favors food security. Meanwhile, fragmented farms are positively associated with food insecurity, and it can be concluded that any increase in land fragmentation has a negative impact on food security. These results are closely related to the study executed by Mahmood *et al*. (2015), the pioneering study on the relationship between land distribution disparity and food security in the province of Punjab, Pakistan. However, no study could be traced in the literature outlinging the relationship of food security and Gini of operational farmland holding. However, if farm productivity or total factor productivity is regarded as proxy for food security, then abundant literature (Niroula and Thapa, 2005; Vollrath, 2006; Unal, 2008; Anyaegbunam *et al.*, 2012; Ali and Deininger, 2015; Sheng *et al.*, 2015) is available, indicating an inverse association between farm size and its corresponding productivity per unit area. In this context, operational farm holdings having a positive relationship with food security under brief study provides contrary evidence to these earlier studies.

Model II explains the relationship of selected variables of land resources with food availability. As shown in Table 3, the *F*-statistic and *p*-value are highly significant and indicate the good fit of the model. The R^2 is equal to 0.332, which implies that nearly one-third of the variation in the dependent variable (food availability) is explained by the independent variables (Operational farm holdings, fragmented farms, and land-use intensity). Moreover, multicollinearity was not found between the various variables of Model-II.

The findings of Model-II are very similar to those of Model-I, although, the sign of coefficients of operational farm holdings, fragmented farms, and land-use intensity is opposite in Model-I and Model-II. But their meanings collaborated and confirmed each other's results. The positive association of Gini of operation farm holdings appeared to have a very positive role in increasing food availability. The value of the coefficient denotes that unit increase in operational farm holdings translates into more than a seven hundred unit increase in food availability. This finding is highly significant for policymakers, and also confirms the conclusion of Dyer (1997) that larger farms contribute more to food availability as compared to smaller farms that consume most of their agricultural produce. Similarly, in the context of Pakistan, the ratio of fragmented farms appeared to be negatively associated with food availability.

The output of Model-III is given in Table 3. Model-III analyzes the relationship of food access with the variables of land resources, i.e., Gini of operational farm holdings, the ratio of fragmented farms and land-use intensity. Model-III can be seen as a good fit as *F* statistic and *p*-value are significant. Moreover, a 0.106 value of R^2 denotes that nearly 11% of the variation in the dependent variable (food access) is explained by the independent variables. Just like in Model-I and Model-II, multicollinearity is not present among the variables in Model-III.

As per the output of Model-III, the Gini of operational farm holdings has a negative relationship with food access, but is statistically insignificant. Empirically, the ratio of fragmented farms appeared to be negatively associated with food access, similar to findings regarding food insecure populations and food availability. As food access is related to financial aspects of food security, poverty and income can be taken as a proxy for food access. In this way, it can be inferred that land fragmentation is also an indicator of poverty among populations with less access to food. Moreover, if there is a one unit increase in land-use intensity, then there will be 0.003 unit increase in food access.

Similarly, the output of Model-IV is given in Table 3. Model-IV explains the relationship of food absorption with selected variables of land resources.i.e. Gini of operational farm holdings, the ratio of fragmented farms and land use intensity. Here, a significant *F*-statistic and *p*-value indicate a good fit of Model-IV whereas $R^2 = 0.100$ implies that the 10% variation in the dependent variable (food absorption) is explained by the independent variables. Moreover, Model-IV also passed the multi-colinearity test.

The results show that and the ratio of fragmented farms has a negative relationship with food absorption, whereas land use intensity is positively associated with food absorption. In Model-IV, the operational farm holding statistic is statistically non-significant whereas land use intensity is statistically significant at a 10% level of the confidence interval. Keeping in view the level of significance of outputs, it can be construed that food absorption for the population can be increased by less fragmented farms and increased land use intensity.

Conclusions and Recommendations: Given the above results and discussions, it can be concluded that large operational farm holdings contribute towards better food availability and result in improved food security. Based on the finding that land fragmentation has a negative relationship with food security and other aspects of food security (e.g. food availability, food access, and food absorption), it can be concluded that land pooling should be adopted as a significant intervention for food security policy in Pakistan. Moreover, land reforms should be introduced to consolidate agricultural areas by reducing land fragmentations in the country. Similarly, the consistent positive relationship between land use intensity and food security implies that farmland in Pakistan is underutilized and enhanced land use intensity will bring better food security.

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Annex I. District Level Land Distribution Disparity in Pakistan (Operational Land Holding)

Rank	District	OPFH	Rank	District	OPFH	Rank	District	OPFH
1	F.R.Kohat	0.65	10	Dera Ghazi Khan	0.74	12	Bahawalnagar	0.76
2	Khyber Agency	0.66	10	Vehari	0.74	12	Bhakhar	0.76
2	Haripur	0.66	10	Zhob	0.74	12	Tank	0.76
2	Chitral	0.66	10	Mohmand Agency	0.74	12	Sanghar	0.76
2	Charsadda	0.66	10	Jhang	0.74	12	Sukkur	0.76
2	Rawalpindi	0.66	10	Attock	0.74	12	Lasbella	0.76
3	Upper Dir	0.67	10	Sheikhpura	0.74	12	Harnai	0.76
3	Mansehra	0.67	10	Kasur	0.74	12	Quetta	0.76
3	Swat	0.67	10	Pishin	0.74	12	Lakimarwat	0.76
3	Nowshera	0.67	11	Faisalabad	0.75	12	Mandibahauddin	0.76
4	Hyderabad	0.68	11	Kharan	0.75	13	Awaran	0.77
4	Hangu	0.68	11	Gujranwala	0.75	13	Killa Abdullah	0.77
4	Abbottabad	0.68	11	Chakwal	0.75	13	Karak	0.77
4	Bannu	0.68	11	Thatta	0.75	13	Ghotki	0.77
5	Shanglapar	0.69	11	Narowal	0.75	13	Khairpur	0.77
5	F.R.D.I.Khan	0.69	11	Lahore	0.75	13	Nawabshah	0.77
5	Battagram	0.69	11	Dadu	0.75	13	Barkhan	0.77
6	Swabi	0.70	11	Sheerani	0.75	13	Nushki	0.77
6	Gujrat	0.70	11	Kohlu	0.75	13	Nausheroferoz	0.77
7	Peshawar	0.71	11	D.I.Khan	0.75	13	Mastung	0.77
7	Sialkot	0.71	11	Mianwali	0.75	13	Sargodha	0.77
7	Malakand Agency	0.71	11	F.R.Lakimarwat	0.75	13	Bolan	0.77
7	Lower Dir	0.71	11	Khushab	0.75	13	Larkana	0.77
8	Muzaffargarh	0.72	11	Loralai	0.75	13	Layyah	0.77
8	Kohat	0.72	11	Khuzdar	0.75	13	Okara	0.77
8	Mardan	0.72	12	Musa Khel	0.76	14	Derabugti	0.78
8	Nankana Sahib	0.72	12	Kalat	0.76	14	Shahdadkot	0.78
8	Bajour Agency	0.72	12	Panjgur	0.76	14	Shikarpur	0.78
8	Multan	0.72	12	Jamshoro	0.76	14	Jaccobabad	0.78
8	Balawalpur	0.72	12	Kech	0.76	14	Jafarabad	0.78
8	Jehlum	0.72	12	Tandoallahyar	0.76	14	Kashmore	0.78
9	Rahim Yar Khan	0.73	12	Matiari	0.76	14	Chagai	0.78
9	Buner	0.73	12	Sibi	0.76	15	F.R.Tank	0.80
9	F.R.Peshawar	0.73	12	TandoM.Khan	0.76	15	Karachi	0.80
9	Kohistan	0.73	12	Mirpurkhas	0.76	16	Toba Tek Singh	0.81
9	Lodhran	0.73	12	Naseerabad	0.76	17	Gawadar	0.83
9	Rajanpur	0.73	12	Umerkot	0.76	18	Washuk	0.84

9	Tor Garh	0.73	12	Hafizabad	0.76	19	Pakpattan	0.88
9	Killasaifullah	0.73	12	Jhalmagsi	0.76			
9	Badin	0.73	12	Tharparkar	0.76			
10	Khanewal	0.74	12	F.R.Bannu	0.76			
10	Sahiwal	0.74	12	Ziarat	0.76			

Source: Authors' Estimation from Provincial Agriculture Census Reports Data

Annex II. District level land distribution disparities (Ownership holdings)

Rank	District	OWFH	Rank	District	OWFH	Rank	District	OWFH
1	F.R.Kohat	0.64	11	Faisalabad	0.74	13	Kashmore At Kandhkot	0.76
2	Charsadda	0.65	11	Zhob	0.74	13	Lakimarwat	0.76
3	Khyber Agency	0.66	11	Kasur	0.74	13	Nawabshah	0.76
3	Haripur	0.66	11	Toba Tek Singh	0.74	13	Quetta	0.76
3	Chitral	0.66	11	Larkana	0.74	13	Khushab	0.76
3	Upper Dir	0.66	11	Gujranwala	0.74	13	Tandoallahyar	0.76
3	Mansehra	0.66	12	Sheikhpura	0.75	13	Awaran	0.76
4	Swat	0.67	12	Pishin	0.75	13	Harnai	0.76
4	Nowshera	0.67	12	Chakwal	0.75	13	Ziarat	0.76
5	Shanglapar	0.68	12	Narowal	0.75	13	Killa Abdullah	0.76
5	Battagram	0.68	12	Kharan	0.75	14	Lasbella	0.77
5	Hangu	0.68	12	D.I.Khan	0.75	14	Sanghar	0.77
5	Bannu	0.68	12	Ghotki	0.75	14	Barkhan	0.77
6	Abbottabad	0.69	12	Dera Ghazi Khan	0.75	14	Tharparkar	0.77
6	F.R.D.I.Khan	0.69	12	Kohlu	0.75	14	Jamshoro	0.77
6	Peshawar	0.69	12	Sheerani	0.75	14	Karak	0.77
6	Swabi	0.69	12	Sukkur	0.75	14	Tando M. Khan	0.77
7	Rawalpindi	0.70	12	Killasaifullah	0.75	14	Bolan	0.77
7	Malakand Agency	0.70	12	Jhang	0.75	14	Rahim Yar Khan	0.77
7	Gujrat	0.70	12	Lahore	0.75	14	Nushki	0.77
8	Mardan	0.71	12	Umerkot	0.75	14	Mandibahauddin	0.77
8	Sialkot	0.71	12	Loralai	0.75	14	Hafizabad	0.77
8	Muzaffargarh	0.71	13	Mianwali	0.76	15	Derabugti	0.78
9	Lower Dir	0.72	13	Shikarpur	0.76	15	Bahawalnagar	0.78
9	Kohat	0.72	13	Panjgur	0.76	15	Sargodha	0.78
9	Lodhran	0.72	13	Shahdadkot	0.76	15	Dadu	0.78
9	Bajour Agency	0.72	13	Matiari	0.76	15	Mastung	0.78
9	Nankana Sahib	0.72	13	Thatta	0.76	15	Chagai	0.78
9	Buner	0.72	13	Khuzdar	0.76	16	Hyderabad	0.79
9	Khairpur	0.72	13	Kech (Turbat)	0.76	16	Bhakhar	0.79

10	F.R.Peshawar	0.73	13	Jafarabad	0.76	16	Okara	0.79
10	Kohistan	0.73	13	Musa Khel	0.76	16	F.R.Tank	0.79
10	Balawalpur	0.73	13	Mirpurkhas	0.76	16	Multan	0.79
10	Tor Garh	0.73	13	Kalat	0.76	16	Pakpattan	0.79
10	Sahiwal	0.73	13	F.R.Lakimarwat	0.76	17	Jehlum	0.80
10	Khanewal	0.73	13	Sibi	0.76	17	Layyah	0.80
10	Rajanpur	0.73	13	Tank	0.76	18	Jhalmagsi	0.81
10	Vehari	0.73	13	F.R.Bannu	0.76	19	Gawadar	0.83
11	Mohmand Agency	0.74	13	Naseerabad	0.76	19	Washuk	0.83
11	Nausheroferoz	0.74	13	Badin	0.76	19	Karachi	0.88
11	Attock	0.74	13	Jaccobabad	0.76			

Source: Authors' Estimation from Provincial Agriculture Census Reports Data