Research Article

An Investigation of the Determinants of Farmland Prices and Implications for Land Use Policy in Central Khyber Pakhtunkhwa, Pakistan

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Abstract | This study examined the determinants of farmland prices in central Khyber Pakhtunkhwa (Pakistan), using land transaction records for 2015-16. Results from Hedonic Pricing analysis show that location, environmental and agricultural characteristics of a farmland determine its price. Residential and commercial encroachment on fertile irrigated farmlands at urban fringe is alarming. More than half of the sampled transacted farmland parcels were used for residential and commercial units' construction. Farmland potential for commercial or residential use creates a value expectation and it capitalizes into farmland price. The value, however, does not influence farmland rents. For control in loss of fertile agricultural land, the study recommends the imposition of progressive taxes on residential and commercial properties and diversion of funds for development of agricultural infrastructure. Provision of subsidized inputs could help in raising farmer's return from agriculture and changing their perception in favor of using their lands for crops and livestock production.

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Introduction

In Pakistan, economic development and urbanization in the last decades resulted residential and commercial encroachment over fertile agricultural land. As increase in population and economic development increase demand for residential and commercial units, their effects are realized in land market. Land resource has alternative uses and its supply is limited. Land potentials for alternative uses are reflected in its price; however, it is utilized for that alternative generating maximum return. The study of farmland prices and its determinants have important implications for designing effective policies to control its utilization for non-agricultural uses. It also evaluates the success of government policies for supporting agricultural production.

Pakistan is an agricultural country, and the role of agriculture in its economic development can't be denied. This sector is responsible for providing food to over 200 million populations and has a greater contribution in the country's Gross Domestic Production (GDP). The share of agriculture in GDP is around 20 percent; it is a main source of livelihood of approximately 43 percent of the total population; provides raw materials to argo-based industries and is the major contributor to the export earnings (GoP, 2015).

During the past twenty years, Pakistan's total cropped

area has been expanded by 0.74 percent (GoP, 2014). However, for KP and Sindh provinces these figures are unlike (see Table 1) where reduction of 0.32 and 0.50 million hectare, respectively, were observed since 2000 (GoP, 2014). In KP, this reduction is around 17 percent of the total agricultural land, and if this loss in agricultural land continues with the same rate, around 50 percent of the farmland will be lost in the next five decades.

Table 1: *Cropped area statistics (million hectares).*

Years	Punjab	Sindh	KP	Balochistan	Pakistan
1995-2000	15.92	3.88	2.08	0.91	22.79
2001-2005	16.24	3.25	1.97	0.88	22.35
2006-2010	16.97	3.75	1.83	1.16	23.71
2011-2015	16.73	3.38	1.73	1.13	22.96
Average	16.46	3.57	1.90	1.02	22.95
Percent change	5.07	-12.89	-16.95	23.36	0.74

Source: *GoP 2014-15.*

The loss in agricultural land due to urbanization is an emerging policy issue because of the concern that a reduced food production capacity could threaten national food security. There is an increased need to understand what factors determine agricultural land prices in land markets. In the central agricultural districts of KP, where residential development due to urbanization is competing with agriculture for land, identification of factors affecting land prices could help in designing policies for conservation of agricultural land.

In the recent past, several studies have investigated determinants of farm land prices (Khan et al. (2016); Khan (2015); Maddison (2000); Plantinga et al. (2002); Ready and Abdalla (2005); Kostov (2009); Guiling et al. (2009), are few of them); however, such studies are rare in Pakistan. To fill out this research gap, this particular study is planned to examine the determinants of farm land prices in central Khyber Pakhtunkhwa.

The specific objectives are;

1. To study agricultural/physical, location and environmental characteristics of farmland in central Khyber Pakhtunkhwa (KP).
2. To identify factors affecting farmland prices.
3. To forward recommendations for their protection from residential and commercial.

Materials and Methods

Sample Selection

For sample selection, this study followed sampling technique adopted by Khan et al. (2016) for farmland selection in district Peshawar. In central Khyber Pakhtunkhwa, Mardan district, where urban encroachment into agricultural land is alarming, was purposively selected. Based on distance from Mardan city centroid, seven villages were randomly selected (see Table 2 for details). From each selected village, farmland land parcels, having transaction record during 2015-16, were selected for data collection. Thus, in total 90 farmland parcels were selected from Mardan district.

Table 2: *Sample of farmlands selected from the study area (2015-16).*

Sampling Zones	Sampled Villages	Sampled Farmland Parcels
1-5 Km to Mardan city center	2	20
6-10 Km to Mardan city center	3	30
>10 Km away from Mardan city center	2	40
Total	7	90

Depiction of the study area

Mardan district is located in Peshawar valley of Khyber Pakhtunkhwa province. Total reported area of the district is 162100 hectares out of which 99926 hectares is the cultivated land (GoP, 2014). Administratively the district is divided into three tehsils-Mardan, Katlang and Thakhtbhai. Mardan is one of the key districts of Khyber Pakhtunkhwa which have improved infrastructure of communication and basic facilities, such as electricity, education and health.

Geographically the district can be divided into North-Eastern hilly area and South Western plain. The whole Northern-Eastern side is bounded by Buner and Malakand hills. The South-Western plain part with low hills is most fertile plain of the KP very suitable for tobacco and sugarcane production. Other crops, like wheat, rice, maize, mustard and rapeseed are other major crops cultivated in the district. Besides these, vegetables and fruits are also grown which include plum, pear, peach, orange, apricot, rare mango and apple.

Data collection

Farmland transaction/price records for the period 2015-16 were obtained from Government Revenue department, local property dealers and farmers, and

were adjusted for present value/price. Data on physical, location and environmental characteristics of selected land parcels are collected through field visits, interview with local farmers and other community members and using Google Earth (2016) images (see Figure 1, 2 and 3).

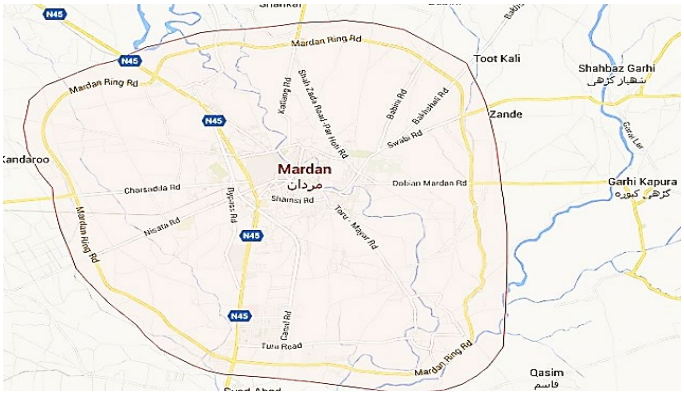

Figure 1: *Aerial image of District Mardan;*
Source: *Google Map (2016).*

Hedonic pricing model (Hpm) for agricultural land

Literature review on land pricing shows that most studies have used the net present value method (NPV) and the hedonic pricing method (HPM). HPM is a most popular method among economists for the determination of land prices and is a powerful tool for measuring the economic values of environmental goods and services (O' Donoghue et al., 2015). The main objective of this study is to utilize the hedonic pricing model to investigate determinants for agricultural land prices in Mardan district of KP.

HPM presents agricultural land price as a function of its physical, location and environmental characteristics. Mathematically the model can be written as;

$$P_j = f(Sj, Nj, Qj) \quad \text{.....(1)}$$

Where;
P is the price of j^{th} agricultural land parcel; S_j represents a set of physical characteristics; N_j is a set of location characteristics and E_j is a set of environmental characteristics of the j^{th} land parcel.

Hedonic price functions can take on a number of different functional forms, such as linear, semi-log, double-log or quadratic. Box Cox test is used to select the best fitted functional form. HPM functions can be estimated using Ordinary Least Square (OLS) or Maximum Likelihood Estimation (MLE) methods. Post estimation diagnostic tests are conducted for Normality, Multicollinearity, Hetroscadasticity, Spatial Error and Spatial Lag dependence problems in the estimated model.

Results and Discussion

Summary statistics

Results from descriptive statistical analysis on data for sampled farmland parcels are given in Table 3. The table shows that average farmland size was 3 acres and the average sale price per marla (25.29 square meters) was 95,511.11 Pakistani rupees (PKR).

Table 3: *Summary statistics for farmland characteristics in district Mardan.*

Variable	Obs	Mean	Std. Dev.
Price per marla	90.00	95511.11	81744.77
Distance to residential area (1 if less than 300 meter, otherwise 0)	90.00	0.59	0.49
Distance to road (1 if located within 50 meter to road, otherwise 0)	90.00	0.29	0.46
Distance from city centroid (meters)	90.00	7555.56	3471.14
Agri. Market (1 if located within 5000 meter to market, otherwise 0)	90.00	0.26	0.44
University (1 if located within 1000 meter to University, otherwise 0)	90.00	0.26	0.44
Fertility (1 if fertile land, otherwise 0)	90.00	0.52	0.50
Sugar mill (1 if located 1000 meter away from sugar mill, otherwise 0)	90.00	0.84	0.36

Source: *Author's calculation from data (2016).*

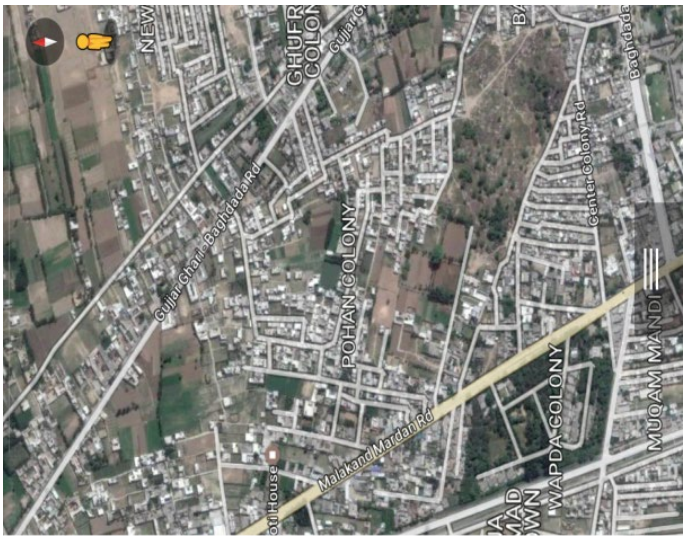

Figure 2: *Aerial image of Northern Mardan city*

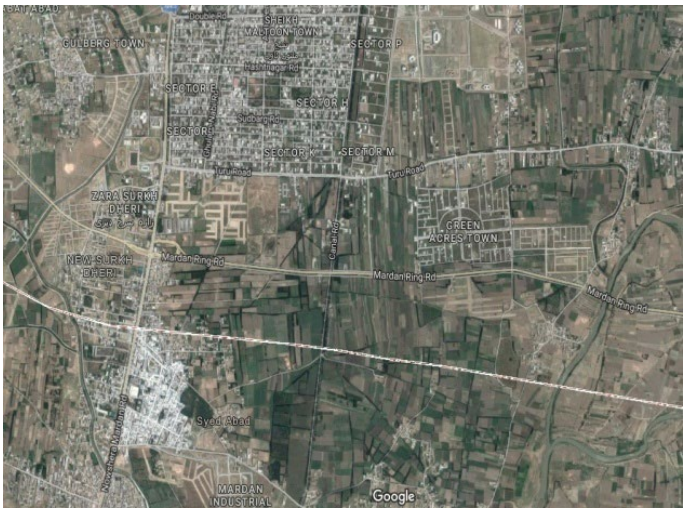

Figure 3: *Aerial image of Southern Mardan city;*
Source: *Google (2016).*

Out of the selected farmlands, 59 percent were located within 300 meters to residential area, 29 percent were within 50 meters to road, 26 percent were within 1000 meters to university and 26 percent were within 5000 meters to an agricultural market. The average farmland distance from city centroid was 7555.56 meters.

Agricultural land having good textured soil (silt-loam), flat land surface, water for irrigation and no salinity and water logging problems was categorized as good quality land (fertile land). Data collected from selected areas revealed that 55 percent of the selected farmland parcels were fertile and suitable for intensive cultivation of sugarcane, tobacco, wheat, maize, rice and vegetable crops.

In the study area, air pollution is a serious concern for local population. Mardan Sugar Mill is releasing different pollutants into air and water resources. Bad oder and ashes in fresh air can be smelled/observed within 1000 meters vicinity of the mill. The effects of these negative externalities can be indirectly reflected in property values. That's why distance from sugar mill was used as a price determining factor for farmland parcels. The table shows that 16 percent of the selected parcels were located within 1000 meters vicinity of the Mardan Sugar Mill.

Diagnostic tests

Based on results from Box-Cox test a linear function for Hedonic Pricing Model was used. The model was estimated using ordinary least square estimation method. Post estimation diagnostic tests, such as Variance-Inflating Factor (VIF), Jarque–Bera and Breusch-Pagan (BP), were conducted to check for multicollinearity, normality and heteroscedasticity problems, respectively. The Breusch-Pagan test detected the existence of heteroscedasticity problem, which was corrected by re-estimating the Model with White's Robust Standard Errors option. No post estimation tests were conducted for spatial-error and spatial-lag dependence among the land prices. The selected villages were located more than 5 kilometers away from each other and following the results of Khan et al. (2016) we ignored the spatial dependence problem in our study.

Estimated hedonic pricing model

Results for the estimated linear HPM model are given in Table 4.

Table 4: *Estimated HPM for farmland prices.*

Variables	Coef.	t-vales	P-values
Agri. Land size[1]	-5.49	-0.25	0.80
Distance to residential area[2]	21846.64	3.00	0.00
Distance to road[3]	48332.58	4.51	0.00
Distance from city centroid[4]	-3.16	-1.81	0.08
Distance from Agri. Market[5]	106863.90	5.43	0.00
Distance from University[6]	58648.17	4.39	0.00
Distance from Sugar mill[7]	109430.40	7.44	0.00
Land Fertility[8]	19876.46	3.00	0.00
Constant	-51830.45	-2.93	0.004

[1]land size in marla; [2]1 if less than 300 meter, otherwise 0; [3]1 if located within 50 meter to road, otherwise 0; [4] Distance to city centroid in meters; [5] 1 if located within 5000 meters to market, otherwise 0; [6]1 if located within 1000 meters to University, otherwise 0; [7] 1 if located within 1000 meters to sugar mill, otherwise 0; [8] 1 if fertile land, otherwise 0.

Location characteristics

The estimated coefficients for all of the location characteristics are statistically significant at 10 percent level of significance and their signs are consistent with our prior expectations. It means that location characteristics have significant effect on farmland prices. Also, the estimated results are in line with the findings of Buurman (2001); Reydon et al. (2014) and Khan et al. (2016).

Distance to Residential Area: This variable was used as a dummy proxy variable for the residential potential of a farmland parcel. Shorter the distance of a farmland parcel to housing area greater will be its residential potential; this residential potential will be reflected in its price. The coefficient value for distance

to residential area is positive and statistically significant. The coefficient value is 21846.64 which indicate that holding other characteristics constant the price per marla for a farmland located within 300 meters to residential area is high by PKR 21,846.64 than others.

Distance to Road: Distance to main road was used as a dummy proxy variable for commercial potential of a farmland-1 if a farmland is located within 50 meters to a road, otherwise 0. The coefficient value for this dummy variable is 48332.58 which indicate that the price of farmland situated within 50 meters to road is greater by PKR 48332.58 per marla as compared to others.

Field visits confirmed that 55 percent of the selected farmland parcels were converted into residential and commercial units. Farmland potential for commercial or residential use creates a value expectation and it capitalizes into farmland price. The value, however, does not influence farmland rents.

Distance to City Centroid: Distance to city centroid, a measure of urbanization pressure, has a negative significant coefficient. The coefficient value of -3.16 implies that the price for each marla of a farmland increases by PKR 3.16 as its distance to city center decreases by 1 meter.

Distance to Agricultural Market: The coefficient value of distance to agricultural market is 1,06,863.90 which specifies that keeping other features stable the price for each marla of an agricultural land situated within 5000 meters to Agri. Market is higher than other farm lands whose location is more than 5000 meters to Agri. Market by PKR 1,06,863.90.

Distance to University: Distance to a university was another dummy variable used, and its coefficient value is 58648.17 which means that the per marla price for a farmland located within 1000 meters to a university is greater than others by PKR 58648.17.

Agricultural characteristics

Physical attributes like the availability of water for irrigation and soil fertility were taken as determinants of farmland prices. The mentioned attributes were availed by some selected parcels while some others were out from these facilities. The water for irrigation and soil fertility are important factors for agricultural production and thus they significantly affect the price of a farmland (Esmaeili and Shahsavari 2011; Barnad et al., 1997, Khan et al., 2016).

Data on agricultural characteristics such as, soil texture, fertility, water for irrigation, land surface, salinity and water logging were compounded into a single dummy variable (fertile or unfertile land). The coefficient value for the fertile land is 19876.46 which indicate that the price of a fertile land is greater than unfertile land by PKR 19,876.46 per marla.

Environmental characteristics

A neat and clean environment plays a prominent role in enhancing the prices for both residential and agricultural lands. (Schaerer et al., 2008, Khan et al., 2015).

The coefficient value for the air quality, measured as distance form polluting source (Mardan Sugar Mill), is 10,9430.40 which indicate that the price per marla of a farmland located within 1 kilometer to the Mill is less than others by PKR 109430.40.

Conclusions and Recommendations

Location characteristics, such as distance to nearby residential area, main road, city centeroid, agricultural market and university have significant effects on farmland prices. Similarly, environmental characteristics (air and freshwater quality) and land fertility are also important determinants of farmland prices. Field visits confirmed that residential and commercial encroachment on fertile irrigated farmlands at urban fringes is alarming.

Based on findings from field visit and data analysis the study recommends that Government may protect and control the loss in fertile agricultural land directly through laws and indirectly through imposition of high taxes on residential and commercial property. Developmental funds may be utilized for developing new agricultural infrastructure, such as roads to link farmland with markets and industries, construction of irrigation canals and control of salinity and water logging. To change farmer's perception in favor of using agricultural lands for crops production, Government may provide them subsidizes on agricultural inputs.

Author's Contributions

Sufyan Ali provided the main theme of the study from his M.S. thesis, Syed Attaullah Shah supervised

and proof read the whole research, while rest of the authors completed the empirical portion of the study.

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