

Article

# Agricultural Land Abandonment and Farmers' Perceptions of Land Use Change in the Indus Plains of Pakistan: A Case Study of Sindh Province

Habibullah Rajpar<sup>1,\*</sup>, Anlu Zhang<sup>1,\*</sup>, Amar Razzaq<sup>2</sup> , Khalid Mehmood<sup>3</sup>,  
Maula Bux Pirzado<sup>4</sup> and Weiyan Hu<sup>1</sup>

<sup>1</sup> College of Land Management, Huazhong Agricultural University, No. 1, Shizishan Street, Hongshan District, Wuhan 430070, China

<sup>2</sup> College of Economics and Management, Huazhong Agricultural University, No. 1, Shizishan Street, Hongshan District, Wuhan 430070, China

<sup>3</sup> Adaptive Research Farm Chakwal, Directorate General Agriculture (Extension and Adaptive Research), Government of Punjab, Lahore 54000, Pakistan

<sup>4</sup> Department of Economics, Sindh Agricultural University, Tandojam Hyderabad 70060, Pakistan

\* Correspondence: habibrajper@gmail.com (H.R.); zhanglanlu@mail.hzau.edu.cn (A.Z.)

Received: 30 July 2019; Accepted: 25 August 2019; Published: 27 August 2019



**Abstract:** Agriculture is the mainstay of Pakistan's economy. However, it has been noticed that farmers are increasingly giving up agriculture in favor of non-agricultural activities. This study was conducted in the Khairpur district of Sindh province, which is part of the Indus Plains in Pakistan. The main purpose of the study was to investigate the current and future land use change (LUC) trends and to study farmers' perceptions of the causes and consequences of LUC and agricultural land abandonment (ALA) in the study area. The study used field survey data and secondary data obtained from the government sources. The results show that agricultural land in the region has decreased by about 9% in the past two decades. Survey data analysis confirms this because more than 80% of farmers believe that agricultural land in the area has declined over time. In addition, farmers believe that socioeconomic and environmental changes are the main reasons for LUC and ALA. We used a logistic regression model to determine the factors that influence farmers' decisions to sell agricultural land for other uses. The results show that the age, income, land ownership, farm inheritance by successors, social networks and lack of basic facilities in the study area are the main determinants of farmers' decisions to sell agricultural lands. In particular, farmers' integration into the social network and their belief that the farm will be inherited by heirs reduces the possibility of selling land. As for the consequences of LUC and ALA, the results indicate that farmland prices, weeds infestation, urban diffusion, and pressure on existing infrastructure have increased in the study area. In addition, the results show that the prospects of farming in the area remain grim as most farmers indicated that they were willing to abandon agricultural lands in favor of other revenue generation activities. The study suggests that policymakers should pay close attention to controlling rapid LUC and ALA to keep lands green.

**Keywords:** agriculture land abandonment; land use change; future land use; logistic regression model; social networks; Khairpur; Sindh

---

## 1. Introduction

Rural landscapes around the world are undergoing dramatic changes, manifested in agricultural decline and land abandonment, especially in mountainous regions [1,2]. Agricultural land abandonment (ALA) is a term commonly used to describe uncultivated land (land used for agricultural purposes

until recently but no longer cultivated, with a noticeable shrub cover), abandoned land (land that is not subject to any farming practices, including conservation agriculture, nor is it intended for grazing), and neglected land, posing a threat to neighboring owners [3]. According to Joint Research Centre, ALA is defined as a significant reduction in land management, leading to undesirable changes in ecosystem services [4]. Another related term is farmland abandonment, which can be defined as the cessation of agricultural activities on a given surface of land rather than by other activities such as urbanization or afforestation [5].

Farmland abandonment is a major problem in Africa due to severe climate change [6]. This problem is also seen as a major environmental threat to the European regional structure, as a substantial area has been affected by agricultural abandonment [7]. In the past few years, forest transition phenomenon (an implication of ALA) has been clearly observed in the developed regions such as the United States, the European Union, and Japan, as well as in developing regions such as India, Vietnam, China, and the Philippines [8]. In the two global surveys conducted by the China Family Financial Survey and Research Center in 262 countries, 13.5% and 15% of farmlands were found idle in 2011 and 2013, respectively [9]. ALA has also become a major problem in Pakistan due to water shortages, climate change, and agricultural income decline.

The management strategies of ALA are currently under debate [10]. Agricultural biodiversity conservation and marginal production land maintenance systems require large-scale reforms based on local features, including the succession management of large-scale marginal production land and promotion of rewilding process [11]. Market forces [12,13] and economic factors such as farm incomes [14]; non-economic factors such as place attachments [15] and social capital [16]; and other factors, including disaster events, institutional frameworks and policy-oriented incentives [17–19] have been observed to influence farmers' decisions on agricultural land abandonment (ALA) and land use changes (LUC).

Farmers are key decision-makers in choosing land use patterns and production systems in a community [20]. Farmers' perceptions of LUC and ALA have been discussed in a few studies [17]. Pröbstl-Haider et al. [20] investigated the impact of climate change on landscape change and farmers' preferences for Austria's future agricultural land use. LUC was observed in the area as farmers increased forestation to mitigate the effects of climate change [21,22]. Kuntz et al. [23] investigated farmers' perceptions of ALA in rural New York and determined that land abandonment affected the neglected rural residents and undermined their livelihoods. In a case study in northern Portugal, van der Zanden et al. [10] used a combination of statements, photograph rating exercises, and open-ended questions to determine local residents, visitors and experts' perceptions of land abandonment and their preferences of various possible post-abandonment courses. Land degradation and desertification can also lead to ALA. In Pakistan, for example, Qasim et al. [24] studied farmers' views on the causes, indicators and local strategies of dealing with the desertification in the Pishin basin in Baluchistan. Hunziker [25] assessed the perceptions of locals and tourists about spontaneous reforestation of abandoned farmland and found that land abandonment caused loss of traditional and farmland emotional value.

It is also important to understand the factors involved in land-use conversion, as these factors predict the extent of land use change, conservation plans, and agricultural policies. van Vliet et al. [26] determined that farmers act as moderators of land-use conversion phenomenon, so the actual land-use conversion may be different than expected, although the agricultural LUC factors are well recognized. In another study, Benjamin et al. [27] inferred that long-term owners, in particular, have abandoned the least popular and least valuable land. The problems of ALA and LUC have been studied in the world at length [25,27–32]; however, Pakistan lacks research on this important issue.

Agriculture is the lifeline of Pakistan's economy as it accounts for 18.9 percent of the country's gross domestic product (GDP) and absorbs 42.3 percent of the workforce. This sector plays a dual role in the country's economic development as it produces crops to meet the basic food needs of the people and, on the other hand, saves a lot of foreign exchange by reducing the import of food. It is a key

sector of the economy that supplies raw materials to the country's agricultural industry. Agriculture also plays a central role in Pakistan's socio-economic development, as other sectors of the national economy rely directly or indirectly on it [33]. However, it is a startling fact that farmers in Pakistan are increasingly giving up agriculture as a profession. It was recently disclosed in annual Pakistan Economic Survey. In the Indo-Pak history, the partition related displacement directly contributed to the transfer of large areas of land from its original owners to incoming emigrants across the border for re-allotment. It is estimated that displaced Hindus and Sikhs left about 7 million acres of agricultural land, while Muslims in eastern Punjab claimed to have abandoned a total of some 4.5 million acres. In Sindh, a large number of Hindus fled to India due to partition-induced insecurity, and an estimated 1.3 million acres were abandoned by displaced persons or "evacuees" [34]. In fact, unlike Punjab, where much of the communal abandonment took place within a few months of the partition, in Sindh, the process continued for decades, with further displacement and dispossession during the Pakistan-India wars of 1965 and 1971 [35–37]. The partition-induced land dispossession was involuntary. However, historical records confirm that the Pakistani farmers are still giving up agriculture as a profession that causes agricultural land to be abandoned.

The purpose of this study was to survey the farmers in Khairpur district of Sindh province where LUC and agriculture abandonment are emerging issues. In addition, our goal is to study farmers' perceptions of agriculture land abandonment, the factors that influence farmers' decisions to sell agricultural land, the consequences of this widespread land transition, and farmers' preferences for future land use. Understanding the social attitudes about ALA and LUC is important because it can be used to predict the extent of LUC and develop conservation plans and agricultural policies.

## 2. Materials and Methods

### 2.1. Study Area and Data

#### 2.1.1. Study Area

The study was conducted in the Khairpur district in northeastern Sindh province, surrounded by Shikarpur and Sukkur in the north, India in the east, Sanghar and Shaheed Benazirabad in the south, and Larkana and Noshero Feroz in the west. The area is located at 68°10' to 70°10' E and 26°9' to 27°42' N (Figure 1). According to the 2017 population census, Khairpur is the fifth largest district in the province after Karachi's four districts, with a population of 2.4 million [38]. Most of the agricultural land in the area is in the Indus Plain, which is irrigated by the Indus river. Khairpur is divided into eight talukas, namely Kingri, Khairpur, Kot Diji, Gambat, Sobho Dero, Thari Mirwah, Nara and Faiz Gunj. Taluka is an administrative area for taxation purposes and usually included many villages.

LUC and ALA in Sindh have drawn much attention because agriculture is the main sector of the Sindh economy, with rice, cotton, sugarcane, wheat, mango, and bananas being the most important crops. Sindh's geographical area is 140,900 square kilometers, making a significant contribution to national food security. The Indus river flows into the Arabian Sea from the highest mountains in the world. The colossal flow of water from the Indus river brings rich silt and sandy loam from the northern region into Sindh, increasing its soil fertility. As the Indus delta of Sindh no longer has freshwater flows from the Indus river, fertile farmland is turning saline due to seawater intrusion.

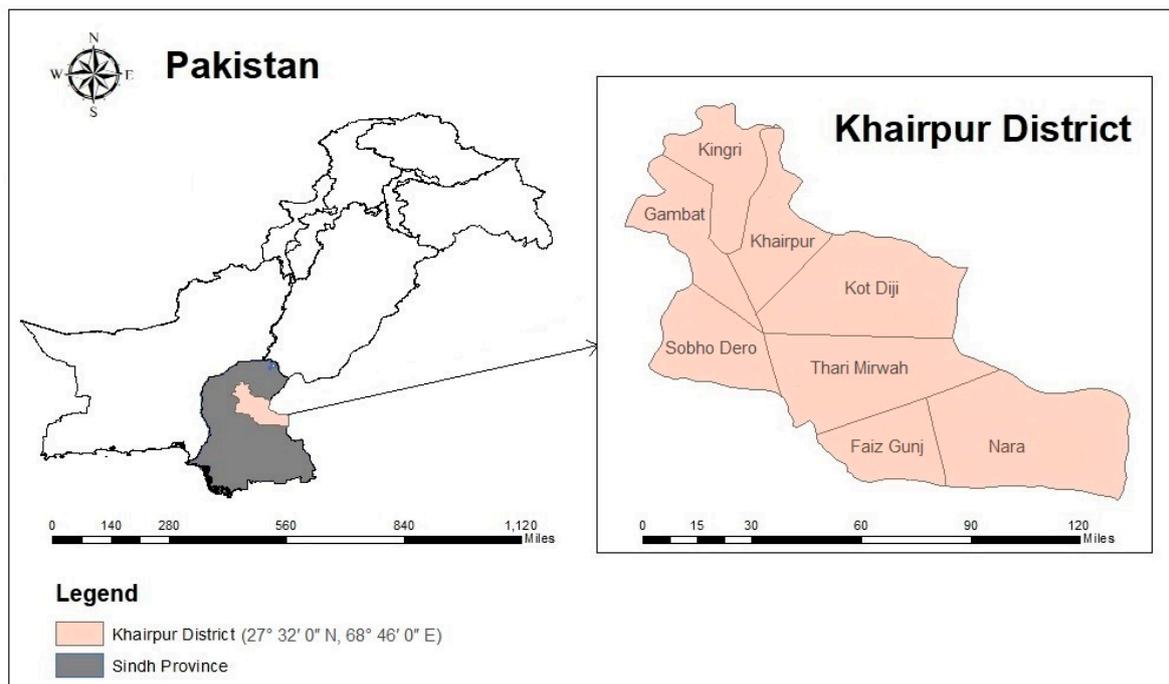


Figure 1. Location map of the study area.

### 2.1.2. Data Collection

The study uses primary and secondary data to achieve its goals. To understand land use change (LUC) in the region, we collected land use data for the period 1997–2017 from the Khairpur office of the Sindh Revenue Board [39]. These data include data on land tenure, land purchases, and land sold during the period. In addition, it includes the proportion of agricultural, barren, commercial, forest, and other lands in eight talukas per year for the selected time period. We also collected additional data from various periodicals of Pakistan Statistics Bureau and Pakistan Economic Survey.

In order to collect information about the socioeconomic characteristics of farmers, their perceptions of ALA and LUC and their consequences, their decisions to abandon agricultural lands and their intentions for future land use, we designed a comprehensive field survey. We used a multistage random sampling technique to collect primary data. In the first phase, the Khairpur region was selected as the sampling frame. In the second stage, eight strata (administrative units) of the Khairpur district were selected as the study area: (1) Khairpur; (2) Kingri; (3) Gambat; (4) Sobho Dero; (5) Kot Diji; (6) Faiz Gang; (7) Nara and (8) Thari Mirwah. In the third stage, five villages were randomly selected from each stratum (taluka). Due to different populations of each village, the choice of sample respondents was proportional to the size of the village. Proportional allocation refers to the way in which the total sample size is distributed among different strata, that is, the number of respondents in each stratum is proportional to the size of each stratum. The following formula is used to select the sample size:

$$n_i = n \cdot \frac{N_i}{N} \text{ for } i = A, B, C, D, \text{ and } E, \quad (1)$$

where:

$n_i$  = the size of the sample in  $i$ th stratum,

$n$  = total sample size to be taken,

$N_i$  = total number of households in the  $i$ th stratum (in this case, the village),

$N$  = the sum of households in all 5 strata (villages).

The letters  $A, B, C, D, E$  represent five villages. A random sample of 50 respondents was selected from these five villages. Sample respondents were selected from eight talukas using the same

procedure. Therefore, the final sample included 400 respondents from 40 villages in eight talukas of Khairpur region.

A semi-structured survey instrument was used for data collection. The questionnaire consisted of four parts, each of which aimed to achieve research goals. The first part contained questions assessing the socioeconomic and demographic characteristics of respondents, including information related to age, education, family size, employment status, income, type of farming, land tenure, and different types of land ownership (agricultural, commercial, forest, wasteland or other lands). The second part contained questions related to the farmers’ perceptions of LUC and ALA and their causes. It included open-ended questions and questions with predefined preference ratings. The preference rating was obtained with a 5-point Likert scale, in which farmers agreed on the causes of ALA and LUC, such as increased population, lack of rural infrastructure, housing needs, lack of agricultural incentives, water shortages, and land disputes. The third part contained questions about the consequence (losses and gains) of LUC and ALA. This information was also obtained on a 5-point Likert scale. The fourth part included open-ended questions to assess farmers’ perceptions of future land use.

The questionnaire was pre-tested in the study area and the necessary modifications were made prior to implementation. The survey was based on face-to-face interviews with residents of the study area related to land use and land abandonment. This approach allows researchers to be responsive to respondents’ attitude and to understand their reasoning when answering questions [40,41]. Data were collected by trained enumerators. Before starting the interview, the enumerator described the purpose of the study to the interviewee and obtained verbal consent. Participation in the survey was entirely voluntary. We ensured participants of the anonymity and confidentiality of their responses.

During the data screening process, 15 questionnaires were discarded due to insufficient information. Therefore, a total of 385 completed questionnaires were used in the analysis. Data were analyzed using SPSS Statistics v.22 (IBM Inc., Armonk, NY, United States) and MS Excel v.2010 (Microsoft Corporation, Redmond, WA, United States). Descriptive statistics such as frequency, mean, median, standard deviation, and percentage were used to assess the multivariate trends in primary and secondary data.

2.2. Econometric Model

The logit model [42,43] is used to analyze the impact of various socioeconomic factors on farmers’ ALA decision-making. Of the total 385 respondents, 42 were indifferent to ALA by selling their lands, and the remaining 343 farmers responded positively or negatively. The binary response variable is the probability that a farmer will sell his/her land for non-agricultural use, with a value of 1 (yes) or 0 (no). In general, the model can be written as:

$$L_i = \ln\left(\frac{P_i}{1 - P_i}\right) = \beta_0 + \beta_1 X_1 + \dots + \beta_i X_i. \tag{2}$$

The cumulative logistic distribution function is as follows:

$$P_i = E(Y = 1|X_i) = \frac{1}{1 + e^{-(\beta_0 + \beta_1 X_1 + \dots + \beta_i X_i)}} = \frac{e^{z_i}}{1 + e^{z_i}}, \tag{3}$$

where

- $L_i$  is the logit, which is the natural log of the odds ratio,
- $P_i$  is the probability that a farmer will sell his/her land for non-agricultural use,
- $1 - P_i$  is the probability that farmer will not sell his/her land for non-agricultural use,
- $\beta_i$  is the  $i$ th parameter of the model to be estimated,

$$z_i = \beta_0 + \beta_1 X_1 + \dots + \beta_i X_i.$$

The specific model form for the econometric analysis is given by:

$$L_i = \ln\left(\frac{P_i}{1-P_i}\right) = \beta_0 + \beta_1 \text{Age}_i + \beta_2 \text{Education}_i + \beta_3 \text{Income}_i + \beta_4 \text{Family Size}_i + \beta_5 \text{Land holding}_i + \beta_6 \text{Land ownership}_i + \beta_7 \text{Land conflicts}_i + \beta_8 \text{Farm inheritance by successor(s)}_i + \beta_9 \text{Association with social networks}_i + \beta_{10} \text{Agri Land Prices}_i + \beta_{11} \text{Commercial Land Prices}_i + \beta_{12} \text{Basic Facilities}_i + \mu_i. \quad (4)$$

Because our data is at the individual level, we used the Maximum-Likelihood (ML) method to estimate the parameters [44,45]. The independent variables used in the model include land ownership status, land conflicts, likelihood of inheriting farms by a successor(s), the embeddedness of farmers in social networks and the availability of adequate infrastructure (education, health, and employment) in the study area. These variables are discrete or binary and are defined as follows:

|                                   |  |
|-----------------------------------|--|
| Age                               | = Age of farmer in years   |
| Education                         | = Years of schooling of a farmer   |
| Income                            | = Farmer's monthly income in 000' PKR                                      |
| Family size                       | = No. of persons in a household  |
| Landholding                       | = Operational landholding size in acres                                    |
| Land ownership status             | = 1 if owner, otherwise 0  |
| Land conflicts                    | = 1 if farmer faces a land conflict, otherwise 0                           |
| Farm inheritance by successor (s) | = 1 if farmer believes that land will be inherited by someone, 0 otherwise |
| Association with social networks  | = 1 if the farmer is embedded in a social network, 0 otherwise             |
| Agri. land prices                 | = Agricultural land price per acre (000' PKR)                              |
| Commercial land prices            | = Commercial land price per in the area (000' PKR)                         |
| Basic facilities in area          | = 1 if there is sufficient infrastructure in the area, 0, otherwise.       |

### 3. Results and Discussion

#### 3.1. Socioeconomic Characteristics of Respondents

Table 1 shows the socioeconomic characteristics of respondents, indicating that the average age of farmers is 44.7 years and the number of years of schooling is 12 years. The average family has 7.36 people, including 3.4 males and 3.9 female members. About 70% of respondents are full-time farmers, while 30% of respondents work in other industries or have their own businesses. In particular, a large number of job seekers under the age of 30 are engaged in agriculture and are willing to leave the industry after obtaining a reasonable job. The average operational landholding of a farmer is 22 acres with a minimum area of half an acre and a maximum area of 241 acres. On average, two family members are farmers and two are working on other jobs. Respondents have an average annual income of 0.17 million PKR. About 72% of the land is operated by owners and 28% by tenants and land-renters.

Socioeconomic characteristics play a significant role in determining farmers' perceptions of ALA and land-use conversion. Palang et al. [46] noted that tolerating LUCs is difficult because childhood memories and cultural backgrounds greatly influence an individual's attitude towards change. For example, Kaur et al. [31] in a study conducted in Estonia showed that older rural farmers are most worried about rural decline. They recalled the early affluence and prosperity of rural life, while young people only knew the current situation and accepted it normally.

**Table 1.** Socioeconomic characteristics of the respondents in the study area ( $n = 385$ ).

| Characteristic                             | Unit        | Min.                   | Max. | Mean                        | Std. Dev. |
|--|-------------|------------------------|------|-----------------------------|-----------|
| Age of the respondent                      | Years       | 25                     | 60   | 44.70                       | 11.07     |
| Education of the respondent                | Years       | 0                      | 18   | 11.86                       | 4.01      |
| Males in the family                        | No.         | 1                      | 9    | 3.46                        | 1.73      |
| Females in the family                      | No.         | 1                      | 10   | 3.90                        | 1.95      |
| Total family members                       | No.         | 2                      | 19   | 7.36                        | 3.68      |
| Operational land holding                   | Acres       | 0.5                    | 241  | 21.90                       | 37.53     |
| Family members employed in non-farm sector | No.         | 0                      | 4    | 1.47                        | 0.74      |
| Family members working on the farm         | No.         | 1                      | 6    | 2.21                        | 1.10      |
| Annual income                              | Million PKR | 0.03                   | 4.82 | 0.17                        | 0.32      |
| Type of farmers                            | No. (%)     | Full-time<br>269 (70)  |      | Part-time<br>116 (30)       |           |
| Ownership Status                           | No. (%)     | Landowners<br>277 (72) |      | Tenants/Renters<br>108 (28) |           |

### 3.2. The Perspectives of Land Use Change and Agriculture Abandonment in the Study Area

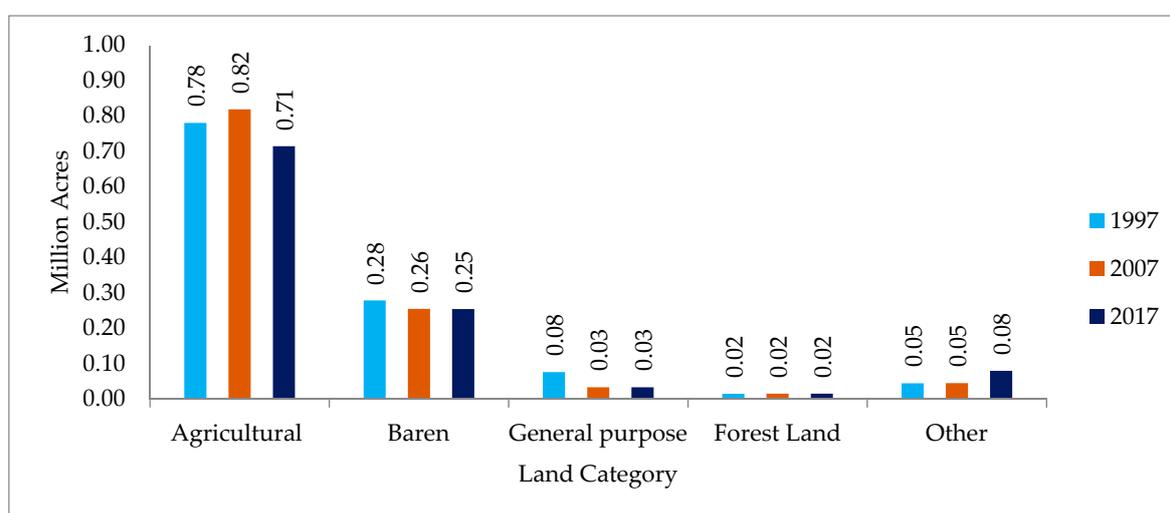
Based on the field survey data, Table 2 shows the distribution of land in the study area classified by owned land and land transfer (selling and purchasing) over the past two decades. The land owned by respondents is divided into five categories, namely agricultural, barren, commercial, forest, and other lands. Of the land owned by farmers, agricultural land accounts for 82% of the total land area. This means that the main use of land in the study area is still agriculture. However, a considerable part of the land is barren, accounting for 13% of total land owned by farmers. The proportion of commercial land owned by farmers is only 3%. During this period, some farmers also bought and sold land. Of the total land purchased by farmers over the past two decades, 80% is agricultural land bought. This means that the major investment in land is for agriculture in the study area. Only 2% of the land was purchased for commercial purposes. Another interesting finding is that 17% of farmers also purchased barren land. There may be two reasons for this. First, the barren land is usually cheaper. Second, farmers may have purchased the land for future land development for agricultural purposes. The results of the sale of land indicate that most of the land sold by the respondents is also agricultural land. This proportion accounts for 97% of the total land sold in the past two decades. These results indicate that more respondents indicated that they are selling agricultural land rather than buying agricultural land. No farmer could sell barren land, probably because the demand for this land is very low. Commercial land sold by farmers accounts for 3% of the total land sold in the study area.

**Table 2.** Taluka-wise percentage distribution of land tenure and land transfers in the Khairpur district over the past two decades (1997–2017).

| Category Taluka | Possession of Land (%) |        |            |             |       | Land Bought (%) |        |            |             |       | Land Sold (%) |        |            |             |       |
|-----------------|------------------------|--------|------------|-------------|-------|-----------------|--------|------------|-------------|-------|---------------|--------|------------|-------------|-------|
|                 | Agricultural           | Barren | Commercial | Forest Land | Other | Agricultural    | Barren | Commercial | Forest Land | Other | Agricultural  | Barren | Commercial | Forest Land | Other |
| Khairpur        | 84.7                   | 7.5    | 3.3        | 0.9         | 3.7   | 74.2            | 20.2   | 3.3        | 0.0         | 2.4   | 98.1          | 0      | 1.9        | 0           | 0     |
| Kingri          | 76.1                   | 20.1   | 1.1        | 0.9         | 1.8   | 75.7            | 21.4   | 0.8        | 2.1         | 0     | 100.0         | 0      | 0          | 0           | 0     |
| Gambat          | 91.0                   | 5.0    | 2.2        | 0.7         | 1.2   | 89.1            | 9.0    | 1.9        | 0           | 0     | 97.8          | 0      | 2.2        | 0           | 0     |
| Sobho Dero      | 91.1                   | 1.3    | 3.5        | 0.7         | 3.4   | 79.6            | 15.2   | 3.7        | 1.5         | 0     | 98.7          | 0      | 1.3        | 0           | 0     |
| Kot Diji        | 89.4                   | 3.1    | 3.1        | 0.4         | 4.0   | 87.0            | 10.3   | 2.7        | 0           | 0     | 92.5          | 0      | 7.5        | 0           | 0     |
| Faiz Gung       | 61.8                   | 32.3   | 3.0        | 3.0         | 0     | 61.2            | 35.0   | 3.9        | 0           | 0     | 100.0         | 0      | 0.0        | 0           | 0     |
| Nara            | 88.4                   | 4.1    | 3.5        | 0           | 4.1   | 82.9            | 13.3   | 2.7        | 1.2         | 0     | 95.3          | 0      | 4.7        | 0           | 0     |
| Thari Mirwah    | 69.9                   | 27.1   | 2.2        | 0.4         | 0.5   | 87.8            | 11.3   | 0.9        | 0.0         | 0     | 95.6          | 0      | 4.4        | 0           | 0     |
| Overall         | 81.5                   | 12.6   | 2.7        | 0.9         | 2.3   | 79.7            | 17.0   | 2.5        | 0.6         | 0.3   | 97.2          | 0      | 2.8        | 0           | 0     |

### 3.3. The Evidence of Land Use Change and Agriculture Abandonment in the Study Area

We used secondary data to confirm evidence of land use change (LUC) and agriculture land abandonment (ALA) in the study area. LUC data for three different time points in the Khairpur district (i.e., 1997, 2007 and 2017) were retrieved from different government sources. Figure 2 shows the increase in the agricultural area in the first decade (1997–2007). However, in the second decade (2007–2017), the agricultural area decreased from 0.82 million acres to 0.71 million acres, a reduction of about 13%. There has been no major change in barren land and forest land over the past two decades. The general-purpose land was decreased from 0.08 million acres to 0.03 million acres in the first decade and remained unchanged for the second decade. The last category of “other” land remained unchanged during the first decade and increased during the second decade. This category includes residential, commercial, industrial and watershed land. The literature largely supports the fact that LUC and ALA occur globally [1,2,6–9,23], a trend that has existed since the beginning of human history and continues to this day. It can be inferred that part of general-purpose land and barren land that was reduced in the first decade (1997–2007) is likely to become agricultural land, thus increasing agricultural land. During the second decade (2007–2017), agricultural land was reduced and converted to the ‘others’ category.



**Figure 2.** Changes in agricultural, barren, forest and other land area in the Khairpur district over the past two decades (1997–2017).

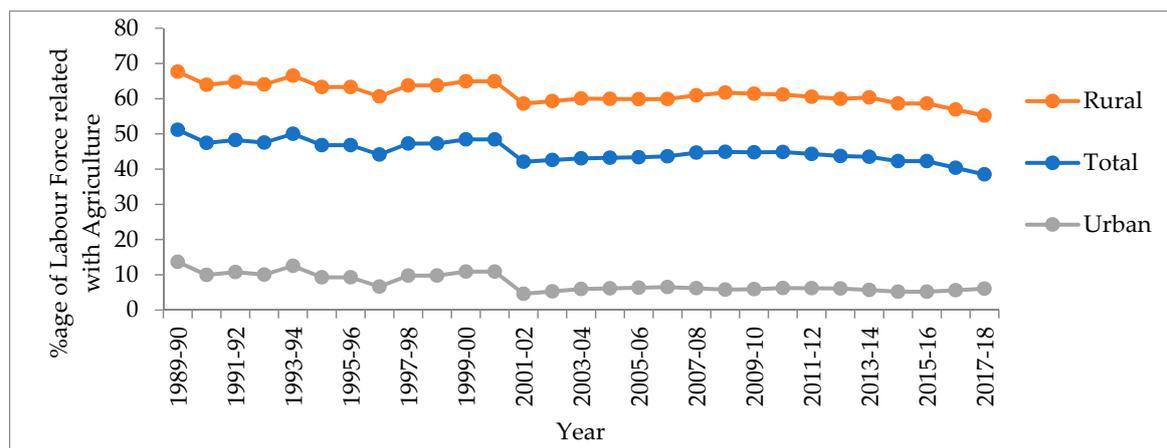
Since our main focus in this study is on the agricultural sector, the taluka wise pattern of agricultural LUC is worthy of attention, as shown in Table 3. In the past two decades, the changes in the agricultural land area of all talukas of the Khaipur district show a similar trend. In the first decade (1997–2007), the agricultural land area of all talukas showed an increasing trend, while the second decade (2007–2017) showed a significant downward trend. As shown in the table, LUC and ALA occurred in the study area. If the current trend continues, it is expected that the agricultural area will decline further in the future. The land will be diverted to other purposes, such as industrial, commercial and residential uses, which can lead to the evolution of serious problems such as food insecurity, global warming, destruction of natural habitat and extinction of wildlife [47].

In addition to ALA, farmers are gradually giving up agricultural production and related activities in Pakistan. The 2017–18 Pakistan Economic Survey shows that agriculture and its related sub-sectors now account for only 38.49% of the country’s total workforce aged 10 and over—a sharp drop from 51.15% in 1989–90. This means that employment in the sector has fallen by about 13% in the past three decades. The decline in the employment rate in the agricultural sector is worrying because agriculture is the backbone of the Pakistani economy. This decline is more prominent in urban areas. Among the urban population, the agriculture-related decline has been about 8% over the past three decades, which is also significant (Figure 3).

**Table 3.** Taluka-wise statistics of agricultural land use change in the Khairpur district over the last two decades (‘000’ Acres).

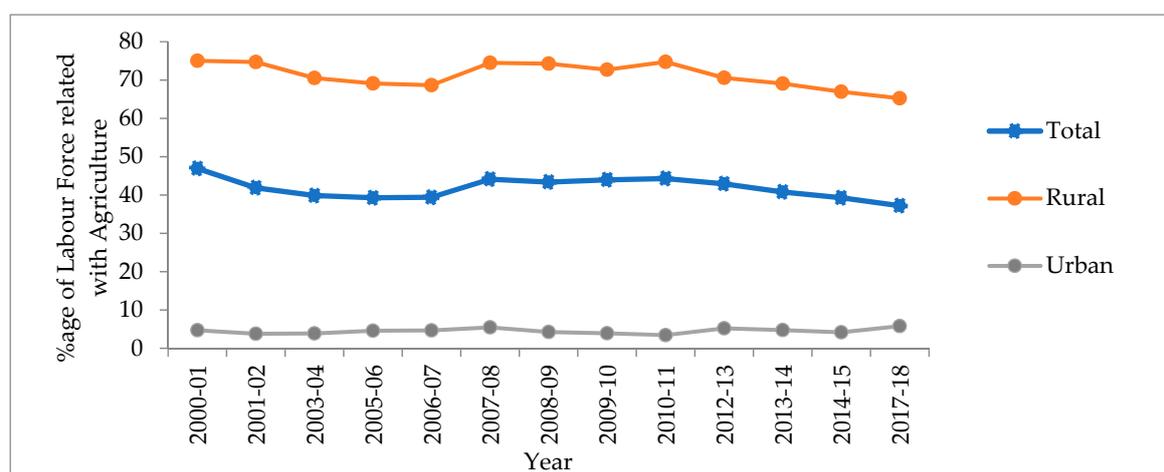
| Year | Khairpur | Kingri | Gambat | Sobho Dero | Kot Diji | Nara  | Thari Mirwah | Faiz Ganj | Total  |
|------|----------|--------|--------|------------|----------|-------|--------------|-----------|--------|
| 1997 | 82.47    | 112.94 | 96.39  | 84.78      | 94.96    | 86.43 | 111.90       | 110.51    | 780.37 |
| 2007 | 89.65    | 122.24 | 96.39  | 92.23      | 102.56   | 93.39 | 112.76       | 109.74    | 818.97 |
| 2017 | 78.26    | 101.23 | 85.23  | 81.26      | 82.56    | 93.39 | 102.76       | 89.74     | 714.42 |

Source: Sindh Revenue Board (2018) [39].



**Figure 3.** Changes in Pakistan’s rural and urban labor force employed in agriculture (aged 10 years and above) over the past two decades. Source: Federal Bureau of Statistics, 2018 [48].

Figure 4 depicts the percentage distribution of agriculture-related labor force aged 10 and over in Sindh from 2001–2018. Sindh’s data was not available until 2001. In the past two decades, the total labor force in the agriculture sector in Sindh has decreased by about 9%, which is a significant decline.



**Figure 4.** Changes in Sindh’s labor force employed in agriculture (aged 10 years and above) over the past two decades. Source: Federal Bureau of Statistics (2018) [48].

At the provincial level, the total number of agricultural laborers in Khyber Pakhtunkhwa fell the most, with 17.88% of agricultural workers leaving the sector between 1994 and 2018. During the same period, the second-largest decline in the agricultural workforce was 15.45% in Baluchistan. It is worth noting that during 1994–95, agriculture was the largest employer of Baluchistan’s labor force. In Sindh, the agricultural workforce fell by 9.42% between 1994–95 and 2017–18. At present, agriculture accounts

for 37.21% of the Sindh labor force. Punjab is the country’s largest producer of agricultural products, however, the agricultural workforce fell by only 7.2% between 1994–95 and 2018 [33]. These statistics provide strong evidence of agriculture abandonment in Pakistan.

The agriculture sector in Pakistan is underperforming [49]. Due to uncertain weather conditions, shortage of irrigation water, disease and pest attacks, poor marketing systems and lack of resources, it has gradually lost the trust of farmers and is considered to be an unreliable source of livelihood. Farmers are turning to other sources of livelihood and are giving up their farmland.

### 3.4. Farmers’ Perceptions

#### 3.4.1. Farmers’ Perceptions of Land Use Change and Agricultural Land Abandonment

Individual perceptions and perspectives on ALA and LUC are critical for quantifying LUC, conservation plans, agricultural policy development [26]. In the field survey, we asked farmers if they thought that LUC and ALA were taking place in the study area. Overall, 75% believe that agricultural land is declining over time, while 14% of respondents believe that agricultural land has not declined, and the remaining 11% of respondents are indifferent to respond. The taluka-wise percentage distribution of responses to the decline in agricultural land is shown in Figure 5. Almost all talukas have observed a uniform trend. Most farmers in each taluka responded that agricultural lands declined over time. About 7–15% of respondents in each taluka are indifferent to land abandonment and LUC occurrence in the area because they do not understand the current situation. We also noticed, in the previous section, that the agricultural area in Khairpur district was declining as farmers were selling more land. Although the current rate of decline is slow, in the near future, it may be more prominent and worrying for the community in terms of national food security, climate change, soil conservation, and natural habitats.

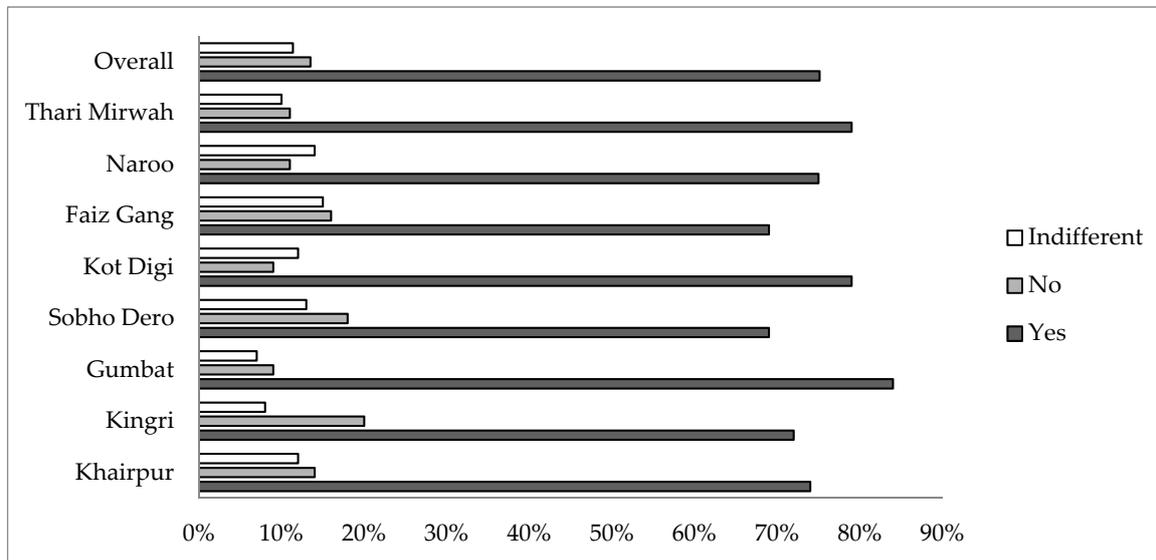
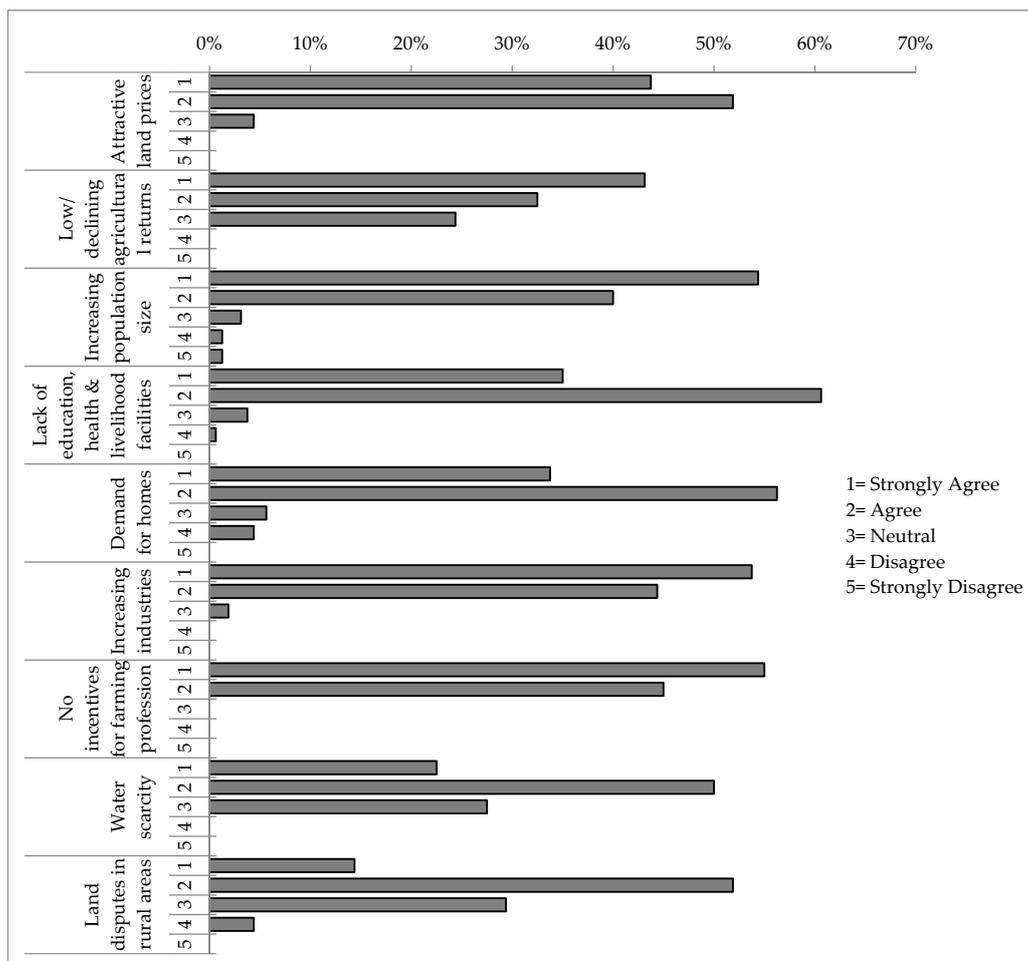


Figure 5. Farmers perceptions of declining agricultural land area in eight talukas of Khairpur district.

#### 3.4.2. Farmers’ Perceptions of the Causes of Land Use Change and Agricultural Land Abandonment

Farmers were asked about the reasons of LUC and ALA in the study area on a 5-point Likert scale, with 5 indicating strong disagreement and 1 indicating strong agreement. Figure 6 shows that 96% of respondents believe that attractive agricultural and commercial land prices are driving farmers to sell their lands. With the rise of industrialization and the gradual increase in land prices, the demand for industrial and commercial land has gradually increased. There is evidence that economic factors mainly affect farmers’ decisions on LUC and ALA [50]. Our results confirm this finding. Approximately

76% of respondents believe that LUC and ALA are occurring due to declining agricultural returns. Yan et al. [14] also pointed out that LUC in rural areas around the world is mainly driven by the decline in net agricultural income. One interviewee stated that “agriculture is a 24/7/365 day job with a small income”. Market forces explain the decision of farmers to sell the lands because the return on suburban land development often exceeds those by the farming [12,13], and farm incomes are often lower than off-farm remunerations [14]. Marginal soils or topography also affect productivity and ultimately lead to ALA. LUC and ALA are also caused by non-economic factors, such as the catastrophic events of Chernobyl, the institutional framework Eastern Europe in the 1990s and the dust bowls of the United States in the 1930s, which largely disturbed agriculture [17,18]. In our study, about 60% respondents said that population growth in rural areas, lack of better health, education and employment facilities, housing needs, water shortages, and land disputes also included LUC and ALA reasons. All respondents believe that there are no incentives in agriculture. Policy-oriented economic incentives are also sometimes used to motivate farmers to suspend field operations in certain areas. U.S. farmers, for example, were encouraged, through a policy of the Conservation Reserve Program, to let the marginal and ecologically sensitive lands go fallow, and they got successful compliance on 36.7 million acres in 2007 [19]. However, in our study, respondents recognized different drivers or causes of LUC and ALA. The most common causes identified are socio-economic and environmental changes [51,52].



**Figure 6.** Farmers’ perceptions of the causes of land use change/agriculture abandonment in Khairpur district.

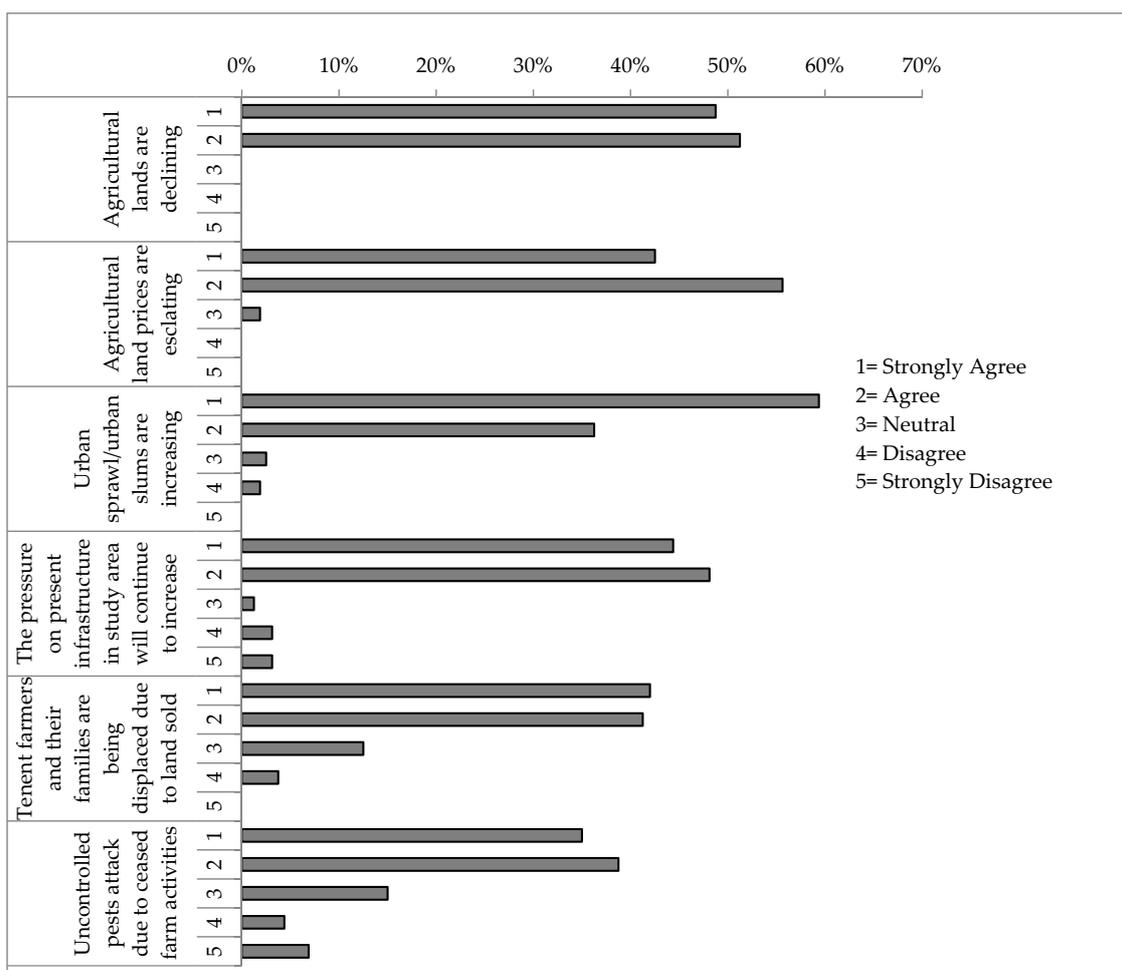
### 3.4.3. Farmers' Perceptions of the Consequences of LUC and ALA

The researchers have documented many of the advantages and disadvantages of LUC and ALA. Figure 7 shows a histogram of the farmers' perceptions of the consequences of LUC and ALA in the Khairpur district. Perceptions were recorded on a 5-point Likert. All respondents believe that agricultural land is decreasing due to land abandonment. The loss of agricultural land is mainly seen in the suburbs where population growth has led to an increase in land prices and the conversion of land into residential areas [53]. This is why the growth rate of urban areas in the world exceeds the density of the urban population [54]. About 98% of respondents believe that LUC and ALA are caused by rising agricultural land prices, as more and more land is needed for commercial and industrial use. The unplanned and faster urban sprawl in Pakistan is a bitter truth. About 95% of respondents believe that urban sprawl is triggered by LUC and land abandonment. As more and more people leave agriculture to move to non-agricultural activities, the pressure on existing infrastructure will increase. However, some farmers disagree with this statement. They believe that supply creates its own demand. When people turn to non-farm activities, the existing infrastructure will automatically adjust to digesting additional labor. About 83% of farmers believe that LUC and ALA forced tenant farmers and their families to be displaced. In Pakistan and Sindh, agricultural land is an important source of food, fiber, and shelter for a large number of tenant farmers. When the landowner abandons the agricultural land or approves the farmland for other uses, the tenant farmer is displaced along with his/her family. However, 4% of respondents disagreed with this view because they believed that tenant farmers were gradually decreasing in the study area and their dislocations were no longer a problem. Approximately 74% of respondents believe that the field pests attack caused by the cessation of farm activities is a serious problem. Birds and other animals that bring weeds seed abandoned land to make it harder for neighbors to keep the fields clean. Other wild animals also use uncultivated fields as a good habitat for growth. The farm community is worried about ALA and fears a large-scale land degradation.

Previous studies have confirmed that general attitudes towards agricultural land abandonment are negative, which is mainly linked to despair and inefficient land use. Only a few people have a positive view of ALA because they think it looks more natural when land is uncultivated [25,27,29,32,55–57]. Non-economic factors may also be related to the eco-centric perceptions of ALA [23]. Most non-farmers believe that giving up agricultural land is a good gesture for forest recovery and atmospheric CO<sub>2</sub> reduction [58,59], restoring the natural habitat of wildlife [60] and protecting cultural heritage [25].

### 3.4.4. The Impact of Socioeconomic Factors on Farmers' Decisions of Agricultural Land Abandonment

We used a logit model to analyze the impact of certain socioeconomic factors on farmers' decisions to abandon agricultural land and sell it for non-agricultural use. The likelihood that farmers decided to sell agricultural land for non-agricultural use was used as a binary response variable in the logistic regression model. The binary choice is 'yes' or 'no', that is, whether the farmer intends to sell his/her land for non-agricultural purposes. The results of logistic regression are shown in Table 4. The results indicate that age, family size, landholding size, the likelihood of one or more children inheriting farms, farmers integration into social networks, commercial land prices and adequate availability of basic infrastructure near farms decrease the probability that farmers will sell their lands for non-agricultural uses. However, higher education, annual income, land ownership, land conflicts and rising agricultural land prices increase the likelihood that farmers will sell agricultural land.



**Figure 7.** Farmers’ perceptions of the consequences of land use change/agriculture abandonment in Khairpur district.

**Table 4.** Results of logistic regression explaining factors affecting farmers’ decisions to sell agricultural land for non-agricultural use.

| Variable                                   | Logit       | Std. Err | Odds Ratio | Pr (> z ) |
|--|-------------|----------|------------|-----------|
| (Intercept)                                | 3.6025 ***  | 0.9322   | 36.6898    | 0.000     |
| Age  | −0.0446 *** | 0.0139   | 0.9563     | 0.001     |
| Education                                  | 0.0385      | 0.0323   | 1.0393     | 0.232     |
| Income (‘000’ PKR)                         | 0.0097 ***  | 0.0023   | 1.0098     | 0.000     |
| Family Size                                | −0.0595     | 0.0569   | 0.9422     | 0.295     |
| Land Holding                               | −0.0165 *** | 0.0057   | 0.9836     | 0.004     |
| Land Ownership Status                      | 0.6461 *    | 0.3659   | 1.9081     | 0.077     |
| Land Conflicts                             | 0.2673      | 0.2774   | 1.3065     | 0.335     |
| Farm inheritance by successor(s)           | −1.1197 **  | 0.5238   | 0.3264     | 0.033     |
| Association with social networks           | −2.4446 *** | 0.2864   | 0.0868     | 0.000     |
| Agri. land price per acre (‘000’ PKR)      | 0.0056      | 0.0147   | 1.0057     | 0.701     |
| Commercial land price per acre (‘000’ PKR) | −0.0011     | 0.0009   | 0.9989     | 0.201     |
| Basic Facilities in Area                   | −0.4608 *   | 0.2699   | 0.6308     | 0.088     |

Significance Codes: ‘\*\*\*’ = 0.01 ‘\*\*’ = 0.05 ‘\*’ = 0.1; Likelihood Ratio-Test: chi-square = 153.61\*\*\*.

The estimated age coefficient indicates that, for every year increase in a farmer’s age, the likelihood of farmers selling agricultural land is reduced by 0.04 units. This is the actual phenomenon observed during the field survey. Old farmers usually showed a conservative attitude toward selling agricultural land. On the contrary, young farmers were more eager to sell agricultural land and give up this

profession. However, this mechanical interpretation of the logit coefficient is not very appealing. A more meaningful interpretation can be obtained by using the antilog of slope coefficients, namely the odds ratio [43]. The odds ratio for the age coefficient is 0.96, indicating that, for a year increase in the respondent's age, the probability of farmers selling agricultural land is reduced by 0.96 or 4%. The odds ratio of education coefficient indicates that, for a year increase in the education level of the respondents, the probability of selling agricultural land increases by 4%. This may be because well-educated people usually have more jobs in the non-agricultural sector. In addition, higher enrollment rates result in potential labor leaving the agricultural sector and leading to ALA [61]. The results further indicate that income also increases the likelihood that farmers will sell their land. In particular, an increase in annual income of 1000 PKR may increase the probability of selling agricultural land by 3.9%. This result is statistically insignificant. However, there is evidence that wealthy farmers are less affected by ALA than poor farmers because ALA exacerbates poverty among low-income rural residents [61]. The results further indicate that larger family sizes reduce the likelihood of selling agricultural land, although this finding is also statistically insignificant.

The size of landholdings has a significant negative impact on the likelihood of farmers selling agricultural land. This means that small farmers are more likely to sell their agricultural lands and turn to non-agricultural sources of income earning. The small farm size impedes the efficient substitution of labor with farm-machinery, ultimately increasing production costs and reducing productivity, and forcing small farmers to turn to non-farm activities [62,63]. The results further indicate that farmers' land ownership increases the probability of selling agricultural land. This result supports the proposal of Zhang et al. [64,65], who suggested avoiding ALA by increasing the marketization of agricultural tenancy.

The odds ratio of land conflict coefficient indicates that, if farmers face land conflicts, the probability of selling agricultural lands increases by 3%. Another important factor affecting farmers' decision to sell agricultural land is whether they believe that one or more children will inherit the farm. The results show that, if farmers believe that the farm will be inherited by their heirs, the probability of selling agricultural land will be reduced by 77%. The same trend of ALA due to the lack of successors has been reported in Europe [66,67]. Farmers' social networks also seem to predict their decision to sell agricultural land. Our findings suggest that farmers who are more integrated into social networks are less likely to sell their agricultural land. Other studies have also shown that local attachments and social networks can influence the farmers' decisions to retain or sell land [68]. Finally, we see that the availability of infrastructure in the study area also affected farmers' decisions to sell agricultural land for other uses. The results show that farmers are less likely to sell their agricultural land if there is sufficient infrastructure near the farm, such as health, education and employment opportunities. The Likelihood Ratio (LR) test, the equivalent of an *F*-test in the linear regression model [43], indicates the chi-square value of 153.61. Therefore, we reject the null hypothesis that all the slope coefficients are simultaneously equal to zero.

### 3.4.5. Prospects for Future Agricultural Land

By understanding public preferences, land use management with social and ecological motives can be well balanced [65]. During the field survey, we asked farmers about future land use plans. Small farmers with a land area of fewer than five acres tend to leave agriculture and switch to other sources of income outside of agriculture. They want to sell their land because they have a hard time getting enough income from agriculture to support their large families. In addition, most of them prefer that their offspring do not continue to inherit agriculture, but live a better life. Small farmers are usually subsistence farmers and cannot carry out profit-oriented agribusiness. This is why they have low standards of living. Medium-sized farmers with 5–20 acres of land are somewhat content to continue farming, but they are also nervous about low agricultural productivity, poor market structure, scarce irrigation water and lack of basic facilities in rural areas. If the agriculture sector is incentivized by the government, large and medium-sized farmers can earn reasonable profits. Large farmers with strong

financial backgrounds face fewer problems in carrying out agriculture. However, a small number (about 4%) sold part of their lands to meet domestic needs. It is difficult for farmers in the study area to effectively manage large agricultural land. For a long time, farming has stopped on most lands of many large and medium-sized farmers. With the extensive growth of shrubs, the abandoned land becomes barren. However, landowners look forward to restoring their lands for future use in agriculture. In a survey of suburbs, 8% of farmers were found willing to commercialize most of their agricultural land for housing colonies and shopping centers. Looking ahead, farm areas will be increasingly far from urban centers, creating a huge gap between urban areas and environment-friendly components such as open-air, clean water, and green spaces.

#### 4. Conclusions

The agriculture sector is the backbone of Pakistan's economy because it largely contributes to the country's gross domestic product and employment. However, it has recently been noticed that farmers are abandoning agricultural land and switching to non-agricultural activities. This study aimed to investigate land use change (LUC) and agricultural land abandonment (ALA) in the Khairpur region of Sindh, Pakistan. In addition, we also explored farmers' perceptions of LUC, ALA, and future land use. To this end, we used primary data collected through the field survey and secondary data from various government sources. The results show that, over time, agricultural land in the area was significantly reduced, confirming the abandonment of agricultural land in the study area. Agriculture has also been abandoned by farmers as a profession, as data indicate a sharp decline of the agricultural labor force in the past two decades. Changes in land use from agricultural activities to non-agricultural activities are also on the horizon. Farmers' perceptions of LUC and ALA also confirm these findings.

The most common causes of LUC and ALA include socio-economic factors and environmental changes. As for the consequences of agricultural land abandonment, the results indicate that, due to LUC and ALA, agricultural land prices, weeds infestation, urban sprawl and pressure on existing infrastructure have increased in the study area. The results of logistic regression model show that age, income, landholding size, land ownership, farm inheritance by successors, farmers' integration into social networks and lack of basic facilities in the study area are the main determinants of farmers' decisions to sell agricultural lands for other uses. Higher-income and land ownership increase the likelihood of farmers selling land, while large landholdings, farmers' perception that farms will be inherited by the heirs, their integration into social networks, and the availability of infrastructure near the farm reduce the likelihood of farmers selling land.

The study recommends that policymakers should pay earnest attention to controlling ongoing ALA and the rapid land use conversion of agricultural lands to other uses, which have a negative impact on the environment and national food security. The research on this issue in Pakistan is still very limited, so more research should be commissioned to gain a deeper understanding of the issue. Awareness campaigns should be carried out to educate farmers about the negative impacts of ALA and LUC. In particular, measures should be taken to address the economic reasons for ALA. Most of the farmers in our study indicated that the main reason for leaving agriculture is the low rate of return in agriculture. Therefore, incentives should be provided for the new farming community in the study area, which may increase agricultural productivity. High-value crops, drought resistant and high yielding varieties should be promoted in the study area to increase agricultural productivity. It is important to ensure that quality agricultural inputs, such as certified seeds, fertilizers, and pesticides, are available at reasonable market prices. In addition, the government should intervene to restore/reclaim abandoned land of depressed farmers who have ceased farming activities due to low agricultural productivity. To this end, agricultural land development can be carried out through land leveling and watercourse lining on land that has long been abandoned. Furthermore, the marketization of land tenancy policies should be strengthened, and tenant farmers should be encouraged to cultivate agricultural land abandoned by landowners. However, ALA prevention policies do not require extensive farming in marginal and heavily eroded soils. Land abandonment should be rather promoted in these areas

through early interventions to restore ecology and forestation. Public–private partnership is also important for improving the agriculture sector. Concrete steps should be taken to control the illegal and unjustified development of housing colonies and commercial markets in inappropriate places.

**Author Contributions:** Conceptualization, H.R., A.Z. and W.H.; Data curation, H.R., A.R., K.M. and W.H.; Formal analysis, H.R. and A.R.; Investigation, H.R. and K.M.; Methodology, H.R. and K.M.; Project administration, A.Z.; Resources, A.Z. and W.H.; Supervision, A.Z. and W.H.; Validation, A.R. and M.B.P.; Writing—original draft, H.R.; Writing—review and editing, H.R., A.R., K.M. and M.B.P.

**Funding:** This research received no external funding.

**Acknowledgments:** The authors would like to acknowledge the financial support of the China Scholarship Council. This study is a part of the first author’s doctoral dissertation. There is no specific funding of the research, except for a doctoral scholarship from the China Scholarship Council under Chinese Government Scholarships—Chinese University Program. The authors also acknowledge the data collection team and the farmers in Pakistan for their time and effort.

**Conflicts of Interest:** The authors declare no conflict of interest.

## References

1. MacDonald, D.; Crabtree, J.; Wiesinger, G.; Dax, T.; Stamou, N.; Fleury, P.; Lazpita, J.G.; Gibon, A. Agricultural abandonment in mountain areas of Europe: Environmental consequences and policy response. *J. Environ. Manag.* **2000**, *59*, 47–69. [[CrossRef](#)]
2. Soliva, R.; Rønningen, K.; Bella, I.; Bezak, P.; Cooper, T.; Flø, B.E.; Marty, P.; Potter, C. Envisioning upland futures: Stakeholder responses to scenarios for Europe’s mountain landscapes. *J. Rural Stud.* **2008**, *24*, 56–71. [[CrossRef](#)]
3. Leal Filho, W.; Mandel, M.; Al-Amin, A.Q.; Feher, A.; Chiappetta Jabbour, C.J. An assessment of the causes and consequences of agricultural land abandonment in Europe. *Int. J. Sustain. Dev. World Ecol.* **2017**, *24*, 554–560. [[CrossRef](#)]
4. Keenleyside, C.; Tucker, G. *Farmland Abandonment in the EU: An Assessment of Trends and Prospects*; Institute for European Environmental Policy: London, UK, 2010.
5. Pointereau, P.; Coulon, F.; Girard, P.; Lambotte, M.; Stuczynski, T.; Sanchez Ortega, V.; Del Rio, A. *Analysis of Farmland Abandonment and the Extent and Location of Agricultural Areas that are Actually Abandoned or are in Risk to be Abandoned*; European Commission Joint Research Centre, Institute for Environment and Sustainability: Copenhagen, Denmark, 2008.
6. Tesfaye, W.; Seifu, L. Climate change perception and choice of adaptation strategies: Empirical evidence from smallholder farmers in east Ethiopia. *Int. J. Clim. Chang. Strateg. Manag.* **2016**, *8*, 253–270. [[CrossRef](#)]
7. Zakkak, S.; Radovic, A.; Nikolov, S.C.; Shumka, S.; Kakalis, L.; Kati, V. Assessing the effect of agricultural land abandonment on bird communities in southern-eastern Europe. *J. Environ. Manag.* **2015**, *164*, 171–179. [[CrossRef](#)] [[PubMed](#)]
8. Rudel, T.K.; Coomes, O.T.; Moran, E.; Achard, F.; Angelsen, A.; Xu, J.; Lambin, E. Forest transitions: Towards a global understanding of land use change. *Glob. Environ. Chang.* **2005**, *15*, 23–31. [[CrossRef](#)]
9. Gan, L.; Yin, Z.; Tan, J. *China Household Finance Survey Report 2014*; Southwestern University of Finance and Economics Press: Chengdu, China, 2015.
10. Van der Zanden, E.H.; Carvalho-Ribeiro, S.M.; Verburg, P.H. Abandonment landscapes: User attitudes, alternative futures and land management in Castro Laboreiro, Portugal. *Reg. Environ. Chang.* **2018**, *18*, 1509–1520. [[CrossRef](#)] [[PubMed](#)]
11. Merckx, T.; Pereira, H.M. Reshaping agri-environmental subsidies: From marginal farming to large-scale rewilding. *Basic Appl. Ecol.* **2015**, *16*, 95–103. [[CrossRef](#)]
12. Lubowski, R.N.; Plantinga, A.J.; Stavins, R.N. What drives land-use change in the United States? A national analysis of landowner decisions. *Land Econ.* **2008**, *84*, 529–550. [[CrossRef](#)]
13. Radeloff, V.C.; Nelson, E.; Plantinga, A.J.; Lewis, D.J.; Helters, D.; Lawler, J.; Withey, J.; Beaudry, F.; Martinuzzi, S.; Butsic, V. Economic-based projections of future land use in the conterminous United States under alternative policy scenarios. *Ecol. Appl.* **2012**, *22*, 1036–1049. [[CrossRef](#)] [[PubMed](#)]
14. Yan, J.; Yang, Z.; Li, Z.; Li, X.; Xin, L.; Sun, L. Drivers of cropland abandonment in mountainous areas: A household decision model on farming scale in Southwest China. *Land Use Policy* **2016**, *57*, 459–469. [[CrossRef](#)]

15. Brown, G.; Raymond, C. The relationship between place attachment and landscape values: Toward mapping place attachment. *Appl. Geogr.* **2007**, *27*, 89–111. [[CrossRef](#)]
16. Robison, L.J.; Myers, R.J.; Siles, M.E. Social capital and the terms of trade for farmland. *Rev. Agric. Econ.* **2002**, *24*, 44–58. [[CrossRef](#)]
17. Hostert, P.; Kuemmerle, T.; Prishchepov, A.; Sieber, A.; Lambin, E.F.; Radeloff, V.C. Rapid land use change after socio-economic disturbances: The collapse of the Soviet Union versus Chernobyl. *Environ. Res. Lett.* **2011**, *6*, 045201. [[CrossRef](#)]
18. Prishchepov, A.V.; Radeloff, V.C.; Baumann, M.; Kuemmerle, T.; Müller, D. Effects of institutional changes on land use: Agricultural land abandonment during the transition from state-command to market-driven economies in post-Soviet Eastern Europe. *Environ. Res. Lett.* **2012**, *7*, 024021. [[CrossRef](#)]
19. USDA-FSA. Conservation Reserve Program: Summary and Enrollment Statistics. 2007. Available online: [https://www.fsa.usda.gov/Assets/USDA-FSA-Public/usdafiles/Conservation/PDF/annual\\_consv\\_2007.pdf](https://www.fsa.usda.gov/Assets/USDA-FSA-Public/usdafiles/Conservation/PDF/annual_consv_2007.pdf) (accessed on 15 March 2019).
20. Pröbstl-Haider, U.; Mostegl, N.M.; Kelemen-Finan, J.; Haider, W.; Formayer, H.; Kantelhardt, J.; Moser, T.; Kapfer, M.; Trenholm, R. Farmers' preferences for future agricultural land use under the consideration of climate change. *Environ. Manag.* **2016**, *58*, 446–464. [[CrossRef](#)] [[PubMed](#)]
21. Paulrud, S.; Laitila, T. Farmers' attitudes about growing energy crops: A choice experiment approach. *Biomass Bioenergy* **2010**, *34*, 1770–1779. [[CrossRef](#)]
22. Shoyama, K.; Managi, S.; Yamagata, Y. Public preferences for biodiversity conservation and climate-change mitigation: A choice experiment using ecosystem services indicators. *Land Use Policy* **2013**, *34*, 282–293. [[CrossRef](#)]
23. Kuntz, K.; Beaudry, F.; Porter, K. Farmers' Perceptions of Agricultural Land Abandonment in Rural Western New York State. *Land* **2018**, *7*, 128. [[CrossRef](#)]
24. Qasim, S.; Khan, A.N.; Shrestha, R.P.; Ahmad, I.; Qasim, M. The analysis of Farmers, Perceptions of Land Management Technologies to Combat Land Degradation and Desertification in Balochistan, Pakistan. *J. Appl. Emerg. Sci.* **2016**, *5*, 20–25.
25. Hunziker, M. The spontaneous reforestation in abandoned agricultural lands: Perception and aesthetic assessment by locals and tourists. *Landsc. Urban Plan.* **1995**, *31*, 399–410. [[CrossRef](#)]
26. Van Vliet, J.; de Groot, H.L.; Rietveld, P.; Verburg, P.H. Manifestations and underlying drivers of agricultural land use change in Europe. *Landsc. Urban Plan.* **2015**, *133*, 24–36. [[CrossRef](#)]
27. Benjamin, K.; Bouchard, A.; Domon, G. Abandoned farmlands as components of rural landscapes: An analysis of perceptions and representations. *Landsc. Urban Plan.* **2007**, *83*, 228–244. [[CrossRef](#)]
28. Bauer, N.; Wallner, A.; Hunziker, M. The change of European landscapes: Human-nature relationships, public attitudes towards rewilding, and the implications for landscape management in Switzerland. *J. Environ. Manag.* **2009**, *90*, 2910–2920. [[CrossRef](#)] [[PubMed](#)]
29. Höchtl, F.; Lehninger, S.; Konold, W. "Wilderness": What it means when it becomes a reality—A case study from the southwestern Alps. *Landsc. Urban Plan.* **2005**, *70*, 85–95. [[CrossRef](#)]
30. Bell, S.; Montarzino, A.; Aspinall, P.; Penēze, Z.; Nikodemus, O. Rural society, social inclusion and landscape change in Central and Eastern Europe: A case study of Latvia. *Sociol. Rural* **2009**, *49*, 295–326. [[CrossRef](#)]
31. Kaur, E.; Palang, H.; Sooväli, H. Landscapes in change—Opposing attitudes in Saaremaa, Estonia. *Landsc. Urban Plan.* **2004**, *67*, 109–120. [[CrossRef](#)]
32. Peneze, Z. Transformations of the Latvian Rural landscape in the 20th and 21st Centuries. Ph.D. Thesis, University of Latvia, Latvia, Riga, 2009.
33. GOP. *Economic Survey of Pakistan 2017–18*. Ministry of Finance; Government of Pakistan: Islamabad, Pakistan, 2018.
34. Gazdar, H. *The Fourth Round and Why They Fight on: An Essay on the History of Land and Reform in Pakistan*, Collective for Social Science Research; PANOS South Asia: Karachi, Pakistan, 2009.
35. Gilmartin, D.; Ayesha, J. The State of Martial Rule: The Origins of Pakistan's Political Economy of Defence (Cambridge: Cambridge University Press, 1990). Pp. 373. *Int. J. Middle East Stud.* **1992**, *24*, 161–163. [[CrossRef](#)]
36. Maniruzzaman, T. Group interests in Pakistan politics, 1947–1958. *Pac. Aff.* **1966**, *39*, 83–98. [[CrossRef](#)]
37. Schechtman, J.B. Evacuee Property in India and Pakistan. *JSTOR* **1951**, *24*, 406–413.

38. GOP. *Population Census 2017*; Pakistan Bureau of Statistics, Government of Pakistan Islamabad: Pakistan, Islamabad, 2018.
39. Sindh Revenue Board. *District Revenue Office, Khairpur*; Sindh Board of Revenue, Ministry of Revenue: Sindh, Pakistan, 2018.
40. Calvo-Iglesias, M.S.; Crecente-Maseda, R.; Fra-Paleo, U. Exploring farmer's knowledge as a source of information on past and present cultural landscapes: A case study from NW Spain. *Landsc. Urban Plan.* **2006**, *78*, 334–343. [[CrossRef](#)]
41. Marshall, C.; Rossman, G.B. *Designing Qualitative Research*, 4th ed.; Sage publications: London, UK, 2006.
42. Griffiths, W.E.; Hill, R.C.; Judge, G.G. *Learning and Practicing Econometrics*; John Wiley and Sons. Inc.: New York, NY, USA, 1993.
43. Gujarati, D.N. *Basic Econometrics*; Tata McGraw-Hill Education: New York, NY, USA, 2009.
44. Aldrich, J.H.; Nelson, F.D.; Adler, E.S. *Linear Probability, Logit, and Probit Models*; Sage: Newcastle upon Tyne, UK, 1984.
45. DeMaris, A. *Logit Modeling: Practical Applications*; Sage: Newcastle upon Tyne, UK, 1992; Volume 86.
46. Palang, H.; Alumäe, H.; Printsman, A.; Rehema, M.; Sepp, K.; Sooväli-Sepping, H. Social landscape: Ten years of planning 'valuable landscapes' in Estonia. *Land Use Policy* **2011**, *28*, 19–25. [[CrossRef](#)]
47. Semwal, R.L.; Nautiyal, S.; Sen, K.; Rana, U.; Maikhuri, R.; Rao, K.; Saxena, K. Patterns and ecological implications of agricultural land-use changes: A case study from central Himalaya, India. *Agric. Ecosyst. Environ.* **2004**, *102*, 81–92. [[CrossRef](#)]
48. Pakistan Bureau of Statistics. *Labour Force Statistics. Pakistan Bureau of Statistics*; Government of Pakistan: Islamabad, Pakistan, 2018.
49. Hussain, M.; Ashfaq, M.; Ali, A.; Hassan, S.; Imran, M.A. An econometric analysis of bed-furrow irrigation for cultivated wheat in irrigated areas of Punjab, Pakistan. *Pak. J. Agric. Sci.* **2017**, *54*, 467–474.
50. Munroe, D.K.; van Berkel, D.B.; Verburg, P.H.; Olson, J.L. Alternative trajectories of land abandonment: Causes, consequences and research challenges. *Curr. Opin. Environ. Sustain.* **2013**, *5*, 471–476. [[CrossRef](#)]
51. Benayas, J.R.; Martins, A.; Nicolau, J.M.; Schulz, J.J. Abandonment of agricultural land: An overview of drivers and consequences. *CAB Rev. Perspect. Agric. Vet. Sci. Nutr. Nat. Res.* **2007**, *2*, 1–14. [[CrossRef](#)]
52. Cramer, V.A.; Hobbs, R.J.; Standish, R.J. What's new about old fields? Land abandonment and ecosystem assembly. *Trends Ecol. Evol.* **2008**, *23*, 104–112. [[CrossRef](#)] [[PubMed](#)]
53. Alig, R.J.; Kline, J.D.; Lichtenstein, M. Urbanization on the US landscape: Looking ahead in the 21st century. *Landsc. Urban Plan.* **2004**, *69*, 219–234. [[CrossRef](#)]
54. Seto, K.C.; Fragkias, M.; Güneralp, B.; Reilly, M.K. A meta-analysis of global urban land expansion. *PLoS ONE* **2011**, *6*, e23777. [[CrossRef](#)]
55. Bell, S.; Nikodemus, O.; Penēze, Z.; Krūze, I. Management of cultural landscapes: What does this mean in the former Soviet Union? A case study from Latvia. *Landsc. Res.* **2009**, *34*, 425–455. [[CrossRef](#)]
56. Ruskule, A.; Nikodemus, O.; Kasparinskis, R.; Bell, S.; Urtane, I. The perception of abandoned farmland by local people and experts: Landscape value and perspectives on future land use. *Landsc. Urban Plan.* **2013**, *115*, 49–61. [[CrossRef](#)]
57. Sayadi, S.; González-Roa, M.C.; Calatrava-Requena, J. Public preferences for landscape features: The case of agricultural landscape in mountainous Mediterranean areas. *Land Use Policy* **2009**, *26*, 334–344. [[CrossRef](#)]
58. Rhemtulla, J.M.; Mladenoff, D.J.; Clayton, M.K. Historical forest baselines reveal potential for continued carbon sequestration. *Proc. Natl. Acad. Sci. USA* **2009**, *106*, 6082–6087. [[CrossRef](#)] [[PubMed](#)]
59. Kuemmerle, T.; Olofsson, P.; Chaskovskyy, O.; Baumann, M.; Ostapowicz, K.; Woodcock, C.E.; Houghton, R.A.; Hostert, P.; Keeton, W.S.; Radeloff, V.C. Post-Soviet farmland abandonment, forest recovery, and carbon sequestration in western Ukraine. *Glob. Chang. Biol.* **2011**, *17*, 1335–1349. [[CrossRef](#)]
60. Brooks, E.W.; Bonter, D.N. Long-term changes in avian community structure in a successional, forested, and managed plot in a reforesting landscape. *Wilson J. Ornithol.* **2010**, *122*, 288–295. [[CrossRef](#)]
61. Khanal, N.R.; Watanabe, T. Abandonment of agricultural land and its consequences. *Mt. Res. Dev.* **2006**, *26*, 32–41. [[CrossRef](#)]
62. Lusho, S.; Papa, D. *Land Fragmentation and Consolidation in Albania, Albanian series*; Working Paper; Land Tenure Centre: Madison, WI, USA, 1998.
63. Vranken, L.; Noev, N.; Swinnen, J. Fragmentation, abandonment, and co-ownership: Transition problems of the Bulgarian land market. *Q. J. Int. Agric.* **2004**, *43*, 391–408.

64. Zhang, Y.; Li, X.; Song, W. Determinants of cropland abandonment at the parcel, household and village levels in mountain areas of China: A multi-level analysis. *Land Use Policy* **2014**, *41*, 186–192. [[CrossRef](#)]
65. Zheng, B.; Zhang, Y.; Chen, J. Preference to home landscape: Wildness or neatness? *Landsc. Urban Plan.* **2011**, *99*, 1–8. [[CrossRef](#)]
66. Schnicke, H.J. *Impacts of Socio-Economic Factors on Farm Household Dynamics-Empirical Survey Data in An Agent-Based Model Application*; Ljubljana, Slovenia, August 25–27, 2010; European Association of Agricultural Economists: Ljubljana, Slovenia, 2010.
67. Terres, J.; Nisini, L.; Anguiano, E. *Assessing the Risk of Farmland Abandonment in the EU*; Institute for Environment and Sustainability (JRC-IES): Ispra, Italy, 2013; LB-NA-25783-EN-N.
68. Huddy, A.J. *Farming Alone: Factors Influencing Farmland Conversion Along the Rural Urban Fringe*. Doctor's Dissertation, University of Connecticut, Storrs, CT, USA, 2016.



© 2019 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<http://creativecommons.org/licenses/by/4.0/>).