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A Comparative Study of Urbanization's Impact on Agricultural Land Between China, Pakistan, and Germany

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Abstract
Accelerated urbanization leads to high demand for the constructed area which causes loss of natural resources and becomes a major challenge for arable land loss. The aim of this study is to identify the urbanization's impact on agricultural land in China, Pakistan, and Germany. Time series data of arable land, urban population growth rate, and agricultural value added percentage of GDP and industrial value-added percentage of GDP were used to found empirical results. Main regression results indicate that urban population growth rate and industrial value of Pakistan impacts negatively and significantly on per capita arable land and the results of China and Germany the industrial value added of GDP impacts negatively and the urban population growth rate impacts positively and significantly with per capita arable land. The findings show that there was a more arable land loss in Pakistan while in China and Germany there was significantly less loss of arable land by industrialization. So Pakistan can learn experience from China and Germany to control arable land loss due to urbanization.
Keywords: Arable land, China and Germany, GDP, industrial value added, Pakistan, Urban Population growth rate

1. Introduction

Land is the basic resource of human society; it is naturally fixed and does not increase with the population. Increasing population and urban growth results in a need for more land. The use of land for residential, industrial, municipal, and civilization purposes tends to reduce the amount agricultural land, thereby reducing agricultural production (Naab et al., 2013). While development (commercial, industrial and residential) potential of farmland affects agricultural land values in all countries, its impact is potentially more acute in newly Industrialized Countries where development pressure is strong and planning law is often weakly enforced (Haniza Khalid., 2013). Fast economic growth, increasing populations, urban development, and industrialization exert pressure on scarce resources; this poses a serious challenge for policy makers to maintain balance in the use of natural resources, weighing the need to protect sustainable development against the need for food and livelihood security (Bardhan., 2010). Accelerated urbanization leads to aggressive competition and high demand for constructed areas and the protection of agricultural land, forests, and arable land it has become a great challenge to recognize the continuous growth of land resources (Luo et al., 2014). From 1950 to 2005, annual urban population growth in Africa, Asia, and Latin America was 3.9%, 2.9%, and 4%, respectively; the growth in Europe and North America for the same period was 1.2% and 1.9%, respectively (United Nations., 2006). In many developing countries, urban populations have grown to high concentrations in very large cities over the past 50 years. Some amount of urbanization may be required initially to decrease inter and intra regional infrastructure expenses (Henderson., 2002).

Agricultural land use in Europe has changed considerably in the last decades. Observed changes were manifested as expansion or contraction of agricultural land as well as in changes of land management intensity and agricultural land use activity. Major land use change trajectories in relation to globalization of agricultural

markets, the transition from a rural to an urban society, and the shift to post-socialism in central and Eastern Europe (Jasper et al., 2015). Conflicts over the use of scarce land and water resources between food production, expanding industries and rising urbanization are increasing. Food safety, protection of soils, biodiversity and other natural resources, and the fight against poverty, crises and food insecurity are all elements of the overall food challenge in the 21st century (Stephan Von., 2000). In Germany land system change was gradually surprising which indicates high resilience to the drastic socio-economic and institutional shifts that occurred during the last 125 years. However, the German reunification sparked a fundamental and rapid shift in former East Germany's land system, leading to altered levels of production, land use intensity and land use efficiency. Gradual and continuous land use intensification, a result of industrialization and economic optimization of land use (Niedertscheider et al., 2014). German Federal Government aims at reducing land consumption to 30 hacters per day until 2020, soil loss due to urbanization and infrastructure development remains high in Germany (Statistisches Bundesamt., 2011). The urbanization level in China has grown to 54.77%, with an annual growth rate of 1% in the period from 1978 to 2014 (National Bureau of Statistics of China, 2014). Rapid urbanization leads to land conversion, which further induces serious land use problems such as loss of arable land, an increase in landless peasants, abandonment of arable land, and the emergence of hollowing villages (Yang and Li, 2000). In China, an expanding population and growing economy have increased pressure for development and for shifts in using developed land in ways that increase economic and social returns. An increase in market the land might raise the force for changing agricultural land to non-agricultural uses and increase China's dependence on the import of foodstuff. Due to changes in land use once ended frequently continue in place for year, breakdown to fast develop sufficient land use planning and land-use market administration policies could have long-term consequences (Land Use Planning and Policy, International Conference, Beijing, China, 2004).

In Pakistan, urbanization has risen day by day, and it is now considered the most urbanized country in South Asia. The urban population has risen from 32.5% in 1998 to 40% in 2014; it will surpass 50% by 2025 if the trend of movement from villages to cities continues. The basic reason for urban growth is an increase in rural-urban migration. The main problem associated with land and city plans is land management and shift of cultivated and forested lands to non-agricultural uses, and it holds up the economic growth of urban regions and affects the use of potential human and natural resources. Pakistan is already food deficient; it cannot afford to lose more fertile agricultural land, particularly on the urban fringe (Government of Pakistan, Ministry of Climate Change, 2015). Urbanization in Pakistan is driven by migration; in past decades the Indian Muslims and Afghans fled to Pakistani cities to escape war in their native countries. Today, rural Pakistanis are entering cities to escape war, insecurity, and natural disasters, and also to seek new livelihoods and better basic services. This increase in total population also explains the country's rising urban population (Kugelman, 2013). The present research estimates the impact of urbanization on agricultural land loss in China, Pakistan and Germany. It is hope that the results of the present study will be helpful for researchers in understanding the impact of urbanization on agricultural land in these countries.

2. Methodology

The focus of this study is to compare the impact of urbanization on arable land of China, Pakistan and Germany.

2.1Theoretical Framework

In this study we analyze the loss of arable land by urbanization and industrialization. We used per capita arable land hectares as dependent variable and percentage of urban population growth rate, agricultural value added percentage of GDP and industrial value added percentage of GDP were independent variables.

2.2. Sources of data

The research was based on time series data of the per capita arable land, urban population growth rate and agricultural value added percentage of Gross domestic product and industrial value added percentage of Gross domestic product. The data were collected from World Bank organization, World Bank development indicators for the period of 1961 to 2013 (WDI 2016).

2.3. Research Question

1. What is the influence of urban population growth rate on agricultural land of China, Pakistan and Germany?
2. Which country of the three countries, China, Pakistan and Germany has more arable land loss by urbanization?

2.4. Hypothesis

This research hypothesizes that:

H_1: Urban population growth has significant effect on arable land loss of China, Germany and Pakistan.

H_2: Agricultural Value added has positive and significant relationship with arable land of China, Germany and

Pakistan.
H3: Industrial growth and Industrial value added of GDP have negatively impact on arable land of China, Germany and Pakistan.

To test hypothesis empirically, the combination of dependent and independent variables were used as (Y) per capita arable land hectares as dependent variable explained by four independent variables as urban population growth rate, agricultural value added percentage of GDP and the industrial value added percentage of GDP.

2.5. Model and variables specifications

Regression analysis (OLS) ordinary least square method was preferred to use to get the desired results of the study.
Hutcheson and Sofroniou (1999) defined the Ordinary Least-Square regression is mainly basic and powerful model to check assumptions such as linearity, constant variance and the effect of outliers using simple graphical methods
Hutcheson, G. D. (2011) explained the Ordinary least-squares (OLS) regression is a generalized linear modelling technique that may be used to model a single response variable which has been recorded on at least an interval scale. The technique may be applied to single or multiple explanatory variables and also categorical explanatory variables that have been appropriately coded. Ordinary Least-Squares regression is one of the major techniques used to analyse data and forms the basis of many other techniques such as generalised linear models. The usefulness of the technique can be greatly extended with the use of dummy variable coding to include grouped explanatory variables.
Basic model was:

Y=f(URBAN POPULATION GROWTH RATE, AGRICULTURAL VALUE ADDED, INDUSTRIAL VALUE ADDED)

According to our hypothesis dependent variable (Y) which is per capita arable land hectares and the independent variables, urban population growth rate, agricultural value added percentage of GDP and industrial value added percentage of GDP have linear relationships.
To test the hypothesis empirically model can be specified as follow

$$Y= \beta 0+ \beta 1URPOPGRATE+ \beta 2AVADPERCENT+ \beta 3INDVADPERCENT+\mu$$

Description of variables as:
Y= Per capita arable land hectares/ arable land per person
URPOPGRATE = Urban population growth rate
AVADPERCENT =Agricultural value added percentage of GDP
INDVADPERCENT = Industrial Value added percentage of GDP
μ=Error term.

2.6. Definition of variables

i. Arable land hectares per person

Arable hectares per person is our dependent variable

ii. Urban population growth rate

Urban population growth rate is believed that a significant element that effect on arable land.

iii. Agricultural value added percentage of GDP

Agricultural value added percentage of GDP, defined as the share of agricultural sector on gross domestic production, so by changes in arable land how effect of Agricultural value added percentage of GDP or by changes in Agricultural value added percentage of GDP how much arable land was changed. Here Agricultural value added percentage of GDP is considered as explanatory or independent variable.

iv. Industrial Value added percentage of GDP

Industrial Value added percentage of GDP is defined as percentage share of industrial value added on gross domestic product. Growth in industrialization and urbanization tends to reduce arable land loss, so the industrial growth has influence on arable land; here Industrial Value added percentage of GDP selected as important explanatory or independent variable.

3. Results

The aim of this study is to identify the urbanization and industrialization impact on arable land. The study was based on time series data of per capita arable land hectares, urban population growth rate, agricultural value added percentage of GDP, and industrial value added percentage of GDP from the period of 1961 to 2013. The data were collected from the World Bank Organization, World Bank Meta data indicators (WDI 2016). The empirical results of China the estimated correlation test show that there were strong positive correlation between per capita arable land hectares and agricultural value added percentage of GDP, while Industrial value added

percentage of GDP have strong negative and the urban population growth rate have weak negative correlation with per capita arable land hectares (Table 1).

Per capita arable land hectors	Urban population growth rate	Agricultural value added percent of GDP	Industrial Value added percent of GDP
1.000			
-0.116	1.000		
0.810	-0.251	1.000	
-0.808	0.288	-0.701	1.000

Table 01 Represent the result of China the correlation test of variables
Source: Results are based on Author's calculations by using Eviews 8.

Similarly the correlation test results of Pakistan show that there were positive correlation between per capita arable land hectares and agricultural value added percentage of GDP, while urban population growth rate and the industrial value added percentage of GDP have strong negative and negative correlation with per capita arable land hectares (Table 02).

Per capita arable land hectors	Urban population growth rate	Agricultural value added percent of GDP	Industrial Value added percent of GDP
1.000			
-0.971	1.000		
0.389	-0.389	1.000	
-0.629	0.488	-0.701	1.000

Table 02 Represent the results of Pakistan the correlation Test of variables
Source: Results are based on Author's calculations by using Eviews 8.

While the correlation test results of Germany show that there were positive correlation between per capita arable land hectares and urban population growth rate, while agricultural value added percentage of GDP have negative and the industrial value added percentage of GDP have strong negative correlation with per capita arable land hectares which reveals that there were not loss of arable land by urban population growth rate but the industrial sector are negatively impacts on per capita arable land in Germany (Table 03).

Per capita arable land hectors	Urban population growth rate	Agricultural value added percent of GDP	Industrial Value added percent of GDP
1.000			
0.337	1.000		
-0.697	-0.280	1.000	
-0.778	-0.255	0.959	1.000

Table 03 Represent the results of Germany the correlation Test of variables
Source: Results are based on Author's calculations by using Eviews 8.

The results of main regression equation for China indicates the coefficient value for urban population growth rate and agricultural value added percentage of GDP were 0.003 and 0.001 respectively which reveals positive relationship with per capita arable land at one percent significant level. However the coefficient value of industrial value added percentage of GDP was -0.002 which shows the negative impact on per capita arable land at one percent significant level. The value of R-Squared was 0.792 which indicates that Goodness of Fit of the linear regression model and about 79 percent of total change in per capita arable land hectares were explained by urban population growth rate, agricultural value added percentage of GDP and industrial value added percentage of GDP (Table 04).

Explanatory Variable	Coefficient	Std. Error	t-Statistic
Constant(β0)	0.166**	0.021	8.046
URPOPGRATE	0.003**	0.001	2.259
AVADPERCENT	0.001**	0.000	5.386
INDVADPERCENT	-0.002**	0.000	-5.451
R-squared	0.791	----------	----------
Adjusted R-squared	0.778	----------	----------

Note. **indicates 1% significant level
Table 04 Main result of Regression analysis of China
Source: Results are based on Author's calculations by using Eviews 8.

The equation for this model was

$$PCRLAND = \beta 0 + \beta 1\ URPOPGRATE + \beta 2\ AVADPERCENT + \beta 3\ INDVADPERCENT + \mu$$

$$PCALAND = 0.166 + 0.003 + 0.001 + (-0.002) + \mu$$

$$(8.046)\ (2.259)\ (5.386)\ (-5.389)$$

The results of main regression equation for Pakistan show the coefficient value for urban population growth

rate and industrial value added percentage of GDP were -0.030 and -0.014 respectively which indicates one percent significantly negative impact on per capita arable land. While the coefficient value of agricultural value added percentage of GDP was 0.003 which reveals the positive impact on per capita arable land at five percent significant level. The value of R-Squared was 0.978 which reveals that Goodness of Fit of the linear regression model and about 97 percent of total change in per capita arable land hectares were explained by urban population growth rate, agricultural value added percentage share of GDP and industrial value added percentage of GDP (Table 05).

Explanatory Variable	Coefficient	Std. Error	t-Statistic
Constant(β0)	1.567**	0.037	42.646
URPOPGRATE	-0.030**	0.001	-31.844
AVADPERCENT	0.003*	0.001	1.806
INDVADPERCENT	-0.014**	0.002	-8.506
R-squared	0.978	----------	--------
Adjusted R-squared	0.976	----------	---------

Note. ** and * indicates 1% and 5% significant level respectively
Table 05 Main Regression result of Pakistan
Source: Results are based on Author's calculations by using Eviews 8.

The equation for this model was

$$PCRLAND = \beta0 + \beta1\ URPOPGRATE + \beta2\ AVADPERCENT + \beta3\ INDVADPERCENT + \mu$$

$$PCALAND = 1.567 + (-0.030) + 0.003 + (-0.014) + \mu$$
$$42.646)\ \ (-31.844)\ (1.806)\ (-8.5069)$$

The results of main regression equation for Germany show the coefficient value for urban population growth rate and agricultural value added percentage of GDP were 0.002 and 0.009 respectively which indicates positive impact on per capita arable land at one percent significant level. While the coefficient value of industrial value added percentage of GDP was -0.001 which reveals negative impact on per capita arable land at one percent significant level. The value of R-Squared was 0.664 which reveals that fit was good and about 66 percent of total change in per capita arable land hectares were explained by urban population growth rate, agricultural value added percentage of GDP and industrial value added percentage of GDP (Table 06).

Explanatory Variable	Coefficient	Std. Error	t-Statistic
Constant(β0)	1.567**	0.001	163.608
URPOPGRATE	0.002**	0.001	2.021
AVADPERCENT	0.009**	0.004	2.353
INDVADPERCENT	-0.001**	0.000	-4.775
R-squared	0.664	-------	---------
Adjusted R-squared	0.644	-------	---------

Note. **indicates 1% significant level
Table 06 Main results of Regression analysis of Germany
Source: Results are based on Author's calculations by using Eviews 8.

The equation for this model was

$$PCRLAND = \beta0 + \beta1\ URPOPGRATE + \beta2\ AVADPERCENT + \beta3\ INDVADPERCENT + \mu$$

$$PCALAND = 0.156 + 0.002 + 0.009 + (-0.001) + \mu$$
$$(163.608)\ \ (2.021)\ (2.353)\ (-4.775)$$

4. Discussion

Urbanization and industrialization processes tend to impact on agricultural land is a big issue of the world especially of China and Pakistan as well as in Germany. This study evaluates the impact of urbanization on arable land in China and Pakistan and Germany. The study was based on urban population growth rate, agricultural value added percentage of GDP and industrial value added percentage of GDP. The urbanization has affected agricultural land because of the growth of construction areas and urban development. From 1995 to 2000, the rate of loss of agricultural land was 7% in the eastern areas of China, and from 2000 to 2008, this rate increased to 29.2%. Policies have been developed to save agricultural land by motivating people to migrate to small towns (Deng et al. 2015). Urbanization has been so rapid that this plan failed and large-scale land conversion of farmland to construction land occurred in most places in China (Tan et al., 2005; Liu et al., 2014). While comparing results with the study of Deng et al. 2015, our empirical results of main regression analysis show in Pakistan the coefficient value of urban population growth rate and industrial value added percentage of GDP were -0.030 and -0.014 respectively which indicates negative impact on per capita arable land at one percent significant level. While in China and Germany the industrial value added percentage of GDP were -0.002 and -0.001 respectively which reveals negative impact on per capita arable land at one percent significant level.

By comparing three countries, the results of Pakistan shows there were both urbanization and industrialization growth have negative impact on arable land, while in China and Germany the loss of arable land only by industrialization and it is significantly less loss. So Pakistan can learn from China and Germany to control arable land loss from urbanization and industrialization.

5. Conclusion

Rapid urban population growth and industrialization has results in the loss of arable land. Growing population, particularly in urban areas, requires more land, which is a fixed in supply. Our results reveals the agricultural land conversion is due to urbanization growth; and industrial growth in Pakistan, therefore urbanization is a threat to agricultural land as rapid economic growth shifts from agricultural to non-agricultural economies of Pakistan. While in China and Germany the results indicate there was significantly less loss of arable land by industrialization. Therefore it is concluded that in Pakistan the arable land reduces by urbanization and industrialization growth. However in China and Germany arable land only affected by industrial growth and the loss of arable land significantly less. Our results suggest that the government of Pakistan should learn from China and Germany about land protection and management policies to protect arable land loss.

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