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DRIVING FACTORS OF AGRICULTURAL LAND CONVERSION AT RURAL-URBAN INTERFACE IN PUNJAB, PAKISTAN

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ABSTRACT

A study was conducted during 2017-18 to assess the socio-economic and physical drivers shaping the farmer's decision of agricultural land conversion (ALC) in two contrasting cities i.e. Faisalabad (a highly urbanized city) and Sahiwal (at initial stage of urbanization) of Punjab. For this purpose a mixed method approach was applied. Required information was obtained from 416 farming households in 6 communities at rural-urban interface of both cities. Further, six focus group discussions were arranged with the farmers who had sold their agricultural land to urban developers. The results showed that the most significant infrastructure on agriculture land was housing development i.e. 94.0% in Faisalabad and 99.0% in Sahiwal followed by roads/ motorways construction (30.8% & 8.7%), respectively. The results of binary logistic regression revealed that the agricultural land conversion is mostly driven by physical and economic factors in both cities. In Faisalabad, five socio economic variables namely; age, income from agriculture, cost of inputs, commodities prices and land value/price; whereas two physical/proximate variables i.e. distance to road and access to irrigation water were statistically significant in shaping the farmer's decision. On the other hand, in Sahiwal four socio-economic variables education, family structure, income from agriculture, and size of landholdings) and two physical/ proximate variables i.e. access to water and agricultural land conversion in surroundings were found significant. The findings of focus group discussions also supported that majority of the respondents (76.0%) did not want to continue cultivation on their agri. land while they were interested in selling their agricultural land or converting it to different urban uses. The profit motive/high land price was the most powerful pull driver (96.0%) and less profitable agriculture was the most compelling push factor (92.7%) shaping the land use change decision of farmers. An effective land use policy and workable measures are required to preserve the agricultural land and improve the farmer's livelihoods at rural-urban interface.

KEYWORDS: Urban expansion; Agricultural land conversion; drivers, socio - economic; physical; rural-urban interface; Punjab; Pakistan.

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INTRODUCTION

Agricultural land conversion (ALC) is a process characterized by the transforming the agricultural land to other uses, particularly, to urban uses (Azadi *et al.* 2011). This is a worldwide phenomenon that is seen as inevitable during periods of economic development and population growth (Barrico and Castro, 2016). However, uncontrolled land conversion has great impacts on environment in general and agricultural land in particular. The problem is serious in those countries where economy is mainly agrarian and urban population growth rates are high which suggest that the problem is serious but its nature is regional rather than the global one (Seto and Ramankutty, 2016).

Generally, agricultural land conversion process is driven by complex social, economic, environmental, and political factors and exhibit a place and time specific relationship. Therefore, the phenomenon of agricultural land conversion varied in terms of intensity, trends and drivers in different countries (Ho and Lin, 2004; Lichtenberg and Ding, 2008). Firman (1997), identified two main types of drivers contributing to agricultural land conversion i.e. internal and external. The internal drivers include the location and land potential, ownership patterns, size of landholding, household size and family income. The external factors include population growth, socio-economic conditions, urbanization, and government policies. At local level, mostly internal drivers like age, gender, size of household, employment, education, values, attitudes, personal traits of family members, ownership status, farm size, cost of production, product price and land management

practices influencing the household land use decision (Briassoulis, 2000; Nzunda et al., 2013). Some other studies (Burgi *et al.,* 2004; Quasem, 2011; Sharami *et al.,* 2 014; Ustaoglu and Williams, 2017; Tran *et al.,* 2018) identified demographic factors, socio-economic forces, technological developments, urbanization, new demands of land for nature conservation, and land-use policies along with biophysical factors as key drivers of land-use change. Various studies revealed that fluctuating economic situations and technological advancements have been intervened by institutional factors and is responsible for the many major stubborn land use changes along the rural-urban interface (Lawanson et al., 2012; Irwin and Geogeghan, 2001; Farajollahi et al., 2017). The analysis of socio economic drivers of land use changes is supported by location and accessibility factors and explains their relationship with natural drivers (Mottet *et al.,* 2006)**.** Physical and proximity factors exerting a significant influence the urban landscape changes. Among these factors the most important have been the effects of road networks, distance to railway and distance to city center (Tan et al., 2014; Karami et al., 2017; Azadi et al. 2011). According to Ng'ayu (2015) the buying and selling of agricultural land in the market creates multiple land uses likes housing, roads, industries, schools and so on. However, this buying and selling is heavily influenced by different physical factors such as soil type, location, availability of water, climate, transportation system etc. These factors are also associated in determining the land value and land uses as the buyer and seller both desire the highest valuable use of land.

Pakistan has a landscape with great variety of regional characteristics with agriculture as the most dominating land use which covers almost half i.e. 47% of total land area (FAO, 2018). In Pakistan, land use patterns have developed over centuries and have been influenced by physical and environmental factors such as soil, water availability, landform, climate, as well as human factors like size and growth of population, economic demands, customs and cultural practices. The intensive social changes transformed the demography of Pakistan which led to emergence of mega cities. This urban growth have exerted extraordinary environmental consequences predominantly the encroachment of prime agricultural land, solid waste disposal, land degradation, and enhanced environmental pollution (Govt. of Pakistan, 2009). Although land use changes have not been addressed vigilantly by researchers in Pakistan, but recently this issue has drawn the attention of researchers. Punjab province of Pakistan has a strong agrarian background with a rich climatic variations, fertile agricultural land is considered the backbone of Pakistan's agricultural economy. Over the past several years, the demographic changes coupled with economic development in the province have brought considerable land use changes (Zaman, 2012; Nazir, 2015). Recently, the rapid urban expansion is converting the fertile agricultural land of major cities of Punjab into urban infrastructure (Bhalli *et al.* 2012; Zaman, 2012; Mohsin *et al.* 2017; and Younes *et al.* 2017).

A few socio-economic studies related to land use changes are available in the context of Pakistan, focusing the underlying factors behind land use changes. These studies found various factors like topographical constraints, transportation infrastructure and biophysical characteristics (Kedir *et al.* 2016), influence of land mafia (Bhalli, 2012) and income, occupation and indoor housing facilities (Mohsin *et al.* 2017) for agricultural land conversion in the urban peripheries. However, the rate of agricultural land conversion varies from region to region (Seto and Ramankutty, 2016; Azadi *et al.,* 2011; Ho and Lin, 2004; Lichtenberg and Ding, 2008), which indicates that this phenomena is driven by complex driving forces operating at local level, therefore, it is important to explore the main drivers of ALC in the regional context. As thus far discussed, many studies have focused on agricultural land conversion and its drivers in different regions. But, the phenomenon of ALC has not been systematically explored as a comparative study between diverse regions at local level. Hence, the main objective of this study is to draw a picture on the main drivers of ALC in two contrasting cities i.e. a city at highly urbanized stage and a city at initial stage of urban expansion in Punjab province of Pakistan. The findings of the research will be helpful in understanding the driving factors behind the rapid conversion of agricultural land.

The objectives of the study were (i) to analyze the land use changes at rural-urban interface due to various anthropogenic activities and (ii) identify the socio-economic drivers shaping the farmer's decision of agricultural land conversion into urban infrastructures in the study area.

MATERIALS AND METHODS

This study was conducted during the year 2017-18. A mixed method approach was employed and both qualitative and quantitative methods were used to capture the information regarding determinants of farmer's decision of changing the land use from agriculture to other uses . For study purpose, two contrasting cities of Punjab province i.e. Faisalabad, a highly urbanized city and Sahiwal, a city at initial stage

of urbanization (Fig. 1) were selected purposively to investigate the push and pull dynamics of agricultural land conversion at the rural-urban interface.

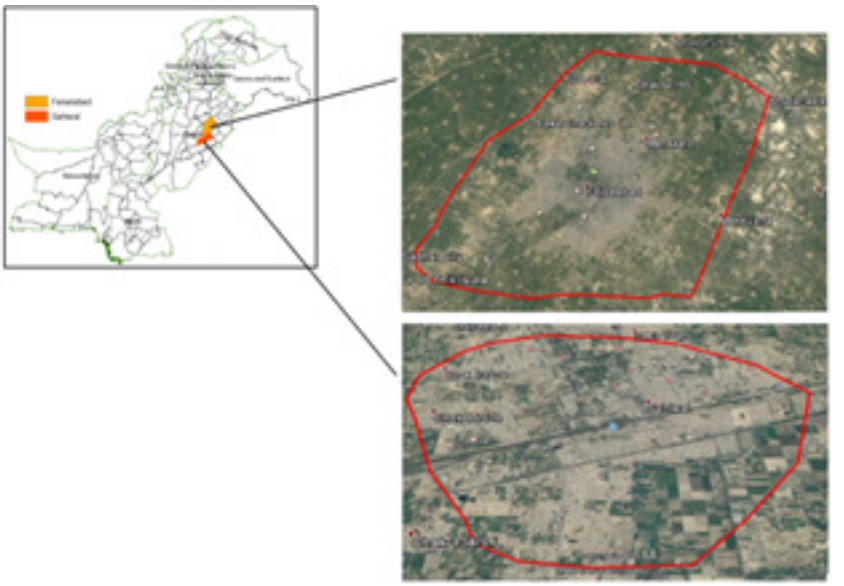

Fig 1. Map of study area, Faisalabad (above) and Sahiwal (below)

At first stage, a total of six peri-urban communities/ villages were selected purposively at a distance of 18 km and 12 km from city centers of Faisalabad and Sahiwal, respectively. The total number of farming household in the selected communities was 2,082 and a sample of 416 farming households (20 % of total farming HH) from the villages at rural-urban interface was selected proportionately.

The survey was made during the months of November 2017 - January 2018 via a well-designed interview schedule containing close ended and open ended questions. The interview schedule captured the information about personal characteristics and livelihood capitals/assets (human, physical, financial, natural and social) of the respondents, changing patterns of agricultural land utilization in the community and the socio-economic and physical factors driving the farmer's decision of agricultural land conversion.

Besides survey, focus group discussions (FGD's) were also conducted in selected communities at rural-urban interface, comprising purposively selected farmers who have sold their agricultural land to different urban developers.The aim of the focus group discussion was to get information about the push and pull dynamics of agricultural land conversion. A total of six focus group discussions were arranged, 8-12 farmers participated in each meeting and the time for each discussion was 45 minutes.

The data collected through survey were transformed by using statistical package for social sciences, (SPSS, version 22). In order to describe the information about independent variables, descriptive analysis was carried out whereas to test the relationship/association between predictor and response variables, binary logistic regression model was applied. The qualitative data obtained from focus group discussions are stated in narrative form.

RESULTS AND DISCUSSION

Socio-economic charactetstics of respondents:

Land use changes are not operating in isolation but exhibit a place- and time-specific interaction. These changes initially occur at the individual level where land managers/owner decides about the desirability of a land use change towards another land-utilization type. Such individual decisions aggregately lead towards large land-use changes at higher spatial levels (Brissoulus, 2008). Farmers are very important in land use change decisions as farmer's decisions differ significantly between types of farmers, their background characteristics and attitudes (Vliet et al., 2015).

The data (Table 1) show no significant difference with respect to demographic characteristics i.e. age, education, family size and family type, of the respondents in both locations. In Faisalabad and Sahiwal, majority of the respondents 28.1 % and 27.2% respectively was in old age (> 55 years) and most of them (38.9 % & 28.2 % respectively) have education level up to Matric. Medium-sized families consisting

of 6-8 members were common (39.4 % 7 55.4 % respectively), and similarly, nuclear families were dominant (62.4 % and 85.1 % respectively). However, the economic background of the respondents showed variations in both locations. In Faisalabad, most of the respondents (30.3 %) owned 6-10 acres of land while in Sahiwal, majority of the respondents (34.9 %) possessed 1-2 acres of land. Similarly, in Faisalabad, the monthly household income of most respondents (38.9 %) was > Rs. 60,000/- while in Sahiwal, majority of respondents (37.9 %) earned up to Rs. 20,000-40,000/- per month

Table 1. Demographic and social characteristics of respondents.

Background characteristics	Percentage		Aggregated percentage
	Faisalabad (N= 221)	Sahiwal (N=195)	
Age			
20-25 years	10.4	13.8	12.0
26-35 years	23.1	20.5	21.9
36-45 years	19.5	20.0	19.7
46-55 years	19.0	18.5	18.8
>55 years	28.1	27.2	27.6
Education			
Illiterate	24.9	26.7	25.7
Primary	20.4	21.0	20.7
Matric	38.9	28.2	33.9
Inter & above	15.8	24.1	20.7
Family size			
2-5 members	27.1	21.5	24.5
6- 8 members	39.4	55.4	46.9
9-12 members	24.0	21.0	22.6
>12	9.5	2.1	6.0
Family Type			
Nuclear	62.4	85.1	73.1
Joint	31.7	14.9	23.8
Extended	5.9	0.0	3.1
Size of the farm			
>1 acre	8.1	2.6	5.5
1-2 acres	19.0	34.9	26.4
3-5 acres	29.9	24.1	27.2
6-10 acres	30.3	11.3	21.4
<10 acres	12.7	27.2	19.5
Income from all sources			
< 20,000	11.3	10.3	10.8
20,000- 40,000	30.8	37.9	34.1
40,000-60,000	19.0	15.9	17.5
>60,000	38.9	35.9	37.5

Urban Uses of agricultural land

Fig 2 demonstrates the purposes for which agricultural land is being used in selected communities and it is evident that the most significant infrastructure on agriculture land was housing development i.e. 94.0 % in Faisalabad and 99.0 % in Sahiwal. Roads/ motorways construction is the second most important land use type and it is more obvious in Faisalabad (30.8 %) while in Sahiwal, only 8.7% agricultural land was used for this purposes. Among other urban uses, the industrial expansion is more prominent in Sahiwal (19.5 %) as compared to Faisalabad (15.8 %) while the agricultural land was converted to commercial uses (24.4 %) in Faisalabad and (2.6 %) in Sahiwal.. The establishment of civic services is very rare i.e. only 8.1 % respondents in Faisalabad and 4.1 % respondents in Sahiwal told that any educational institute, hospital or park was established at their agricultural lands. Various previous studies also found that a key challenge to the urbanization process is the rapid conversion of large amount of prime agricultural land to urban uses mainly residential construction (Owusu and Agyei, 2007; Naab, 2013), and roads construction (Jiang *et al.,* 2012; Osman *et al.,* 2016) mostly in the urban periphery thereby causing rural land prices to escalate.

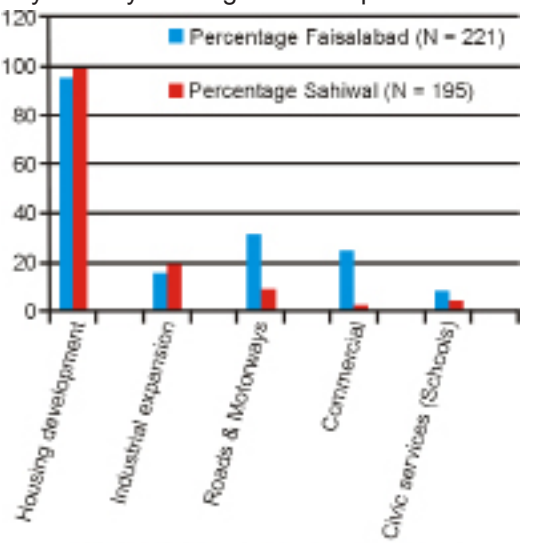

Fig. 2. Urban uses of agricultural land

Drivers of agricultural land conversion (ALC):
The farmers or the land managers mostly respond to many internal and external factors and their land use decisions are subjective to their personal characteristics as well as by the local and wider socio-economic, environmental, political, and institutional settings surrounded the land unit (Setiawan and Purwanto, 1997; Briassoulis, 2008). Binary logistic regression was employed to determine three types of driving factors i.e. socio-demographic, economic and physical/proximate factors, shaping the farmer's decision of converting their agricultural land to other uses particularly to the urban infrastructure in both cities. The estimations of relative risk in binary logistic models were calculated by odds-ratios (OR). The findings of logistic regression model (Table 2) indicated that in Faisalabad, out of 15 variables, five socio economic variables namely; (age, income from agriculture, cost of inputs, commodities prices and land value/price); whereas two physical/ proximate variables (distance to road and access to irrigation water) were statistically significant in shaping the farmer's decision. On the other hand, in Sahiwal four socio-economic variables (education, family structure, income from agriculture, and size of landholdings) and two physical/proximate variables (access to water and agricultural land conversion in surroundings) were found significant. Only significant results are explained below. For better understanding, odd ratios were converted into percentages using the formula (%=OR-1*100).

Table 2. Results of Binary logistic regression

Variables	Faisalabad		Sahiwal	
	B	OR	B	OR
Age	-.304(0.161)*	.738	.110(0.208)	1.116
Education	-.377 (0.217)	.686	.647(0.245)**	1.910
Family structure	.507 (0.414)	1.661	2.354(1.223)*	1.529
Family size	-.516 (0.302)	.597	.503(0.496)	1.654
Size of landholdings	.081 (0.188)	1.084	-.766(0.309)*	2.152
Income from agri.	-.529 (0.164)**	1.697	-1.363(0.279)**	.256
Family Expenditures	-.203 (0.178)	.816	-.008(0.222)	.992
Cost of inputs	-1.359(0.481)**	.257	-1.227(0.740)	.293
Commodities price	-1.467 (0.592)*	.231	-.894(0.552)	.409
Land value	1.516(0.362)**	4.554	.645(0.456)	1.906
Distance to road	2.383 (1.071)*	1.832	-.124(0.379)	.884
Distance to market	-.698 (0.530)	.498	.170(0.658)	1.185
Waste disposal	.770(0.311)	2.159	-.777(0.401)	.460
Access to irrigation water	.920(0.477)*	2.509	1.733(0.745)*	5.657
Urban land in surroundings	-.539(0.478)	.584	2.916(0.754)**	.054
Constant	-1.494(3.525)	.224	4.599(5.241)	99.367
MPS	77.7 %		87.9 %	
H-L model(df=15)	79.342 (p-value=.000)		74.429 (p-value=.000)	
-2 Log likelihood	170.823		106.100	
Significance test results	0.350		0.431	
Cox & Snell R^2 Nagelkerke R^2	0.471		0.578	

**Significant at P<0.01; * Significant at P<0.05, MPS=Model Prediction Success, Figures in parenthesis are standard errors.

Socio-demographic factors: Among the socio-demographic factors, in Faisalabad, only age of the household head was found significant ($p<0.05$) with a negative sign indicating an inverse relationship between age and the land conversion decision of farmer. Odd ratio for the variable 0.738 explained that each one year increase in the age will likely to decrease the willingness of farmers to convert/sell the agricultural land by 26.2 %. Ustaoglu and Williams (2017) also found significant association between the age of the farmer and their land conversion decision. Whereas, in Sahiwal, education of household head ($p<0.01$) and family structure ($p<0.05$) were significantly associated with agricultural land conversion decision of farmers. Odd ratio1.910 tells that addition of one school year will contribute 91.0 % more chances for converting the agricultural land to other uses. Education was also found positively associated by Nzunda *et al.,* (2013); Briassoulis (2000); and Tran et al., (2018), and family structure was found significant by Quasem (2011); and Briassoulis (2000) with farmer's land use change decision.

Economic factors: Monthly income from agriculture had highly significant (<0.01) but negative effect on farmer's land use change decision in both cities. The findings of the binary logistic regression show that a decrease of Rs. 1000/- per month in income from agriculture, will increase the probability of agricultural land conversion by 69.7 and 74.4% respectively. The relationship of size of landholding and agricultural land use conversion decisions is cited by many other studies (Ustaoglu and Williams, 2017; Quasem, 2011; Nzunda *et al.* 2013; Samat *et al.* 2014 and Briassoulis, 2000) as significantly associated. During the focus group discussion, the low profitability of agriculture

was also found as the most compelling push factor of selling their agricultural lands or converts it into urban use. One of the participants in Faisalabad said:

"To sustain our living, I will start some side-business along with farming, because only farming is in-sufficient for a better living. There is more profit and less efforts and labour in business than in agriculture".

In Sahiwal, the size of landholdings had a positive and significant ($p<0.05$) effect on farmer's land use change decision. The qualitative data also supported it as a participant of Focus group discussion in Sahiwal said that:

"The landholding size of the farmers is becoming short and fragmented, that ultimately lowering the agricultural productivity. Farmers are not getting sufficient agricultural output to sustain their livelihoods, hence; they are compelled to sale their land or converting it into housing colonies".

The findings show that in Faisalabad, the cost of agricultural inputs was significant ($p<0.01$) but negatively associated with farmer's land use decision. Odd ratio (0.257) explained that an increase of Rs. 1000/- in cost of inputs will increase 74.3 % the probability of changing agricultural land use, whereas in Sahiwal, a negative but non-significant relationship was found with cost of input. Further, the price of agricultural commodities had a negative but significant ($p<0.05$) effect on farmer's land use change decision in Faisalabad but non-significant in Sahiwal. The odd ratio (0.231) shows that a one unit decrease in price of agricultural commodities will increase the farmer's land conversion decision by 76.9 %. The results are supported by the findings of (Azadi et al., 2011; Nzunda et al., 2013; Sharami et al., 2014) which found that the low prices of agricultural commodities leads to escalate the farmer's decision of agricultural land conversion.

In focus group discussion, most of the participants blamed the policies of government for getting less farm gate prices of their agricultural commodities. They argued that the agricultural policies are not farmer-friendly and contributing towards the massive agricultural land conversion into residential and other infrastructures at the fringes. In Sahiwal, a progressive farmer said:

"Government is not facilitating farmers and the farm gate prices are also very low especially of the sugarcane. These factors contribute to the miseries of farmers and he has no other option except to leave the framing occupation and start some other income generating activities after selling his agricultural land".

Land value is found highly significant ($p<0.01$) in Faisalabad and the odd ratio (4.554) indicates that one unit increase in land value increase the willingness of farmer by 95.4 %. In focus group discussions, high land prices of agricultural land was also found as the major pull factor for the rising trend of land conversion into uses other than farming. One of the participants of focus group discussion in Nyamona village (Faisalabad) said:

"The investors are offering us big amounts against our agricultural lands. So, why not we should get more profit and get rid of hectic agricultural practices which are not giving us money to fulfill our basic needs".

The land price was also found associated with farmer's decision by Farajollahi et al., (2017), and some previous studies (Azadi et al. 2011; Burgi, 2004) showed that mostly political and socio-economic factors serve as the basis for the land owner's decision regarding change in land use; however, the monetary rationality was found as the key driver in most of the cases. The land owners perceived it beneficial for them to opt for other operations that have greater returns on their acreage in future as compared to agriculture (Irwin and Geogeghan, 2001).

Physical/proximate factors: The analysis of socio economic drivers of land use changes is supported by location and accessibility factors and explains their relationship with natural drivers (Mottet et al., 2006). The agricultural land conversion is heavily influenced by different physical factors such as soil type, location, availability of water, climate, transportation system, etc. These factors are also associated in determining the land value and land uses as the buyer and seller both desire the highest valuable use of land (Azadi et al. 2011; Ng'ayu, 2015). Among the physical factors, distance to road ($p<0.05$) was found significant in Faisalabad for determining the agricultural land conversion decision. Odd ratio (1.832) implies that every 1 km decrease in distance to main road increases the ratio of agricultural land conversion by 83.2 %. The distance to roads is found positively associated by Karami *et al.* (2017). Urban land in the surroundings was found highly significant ($p<0.01$) in Sahiwal and the odd ratio (0.54) implies that presence of urban land in the surroundings increases the willingness of farmers by 46.0%. Various studies reported that most of the urban development occurred on the agricultural lands that are surrounded by more urban areas (Flores and Irwin, 2004; Muller *et al.,* 2010; Osman *et al.,* 2016).

Access to irrigation water was also associated ($p<0.05$) with land conversion decision in both Faisalabad and Sahiwal. The odd ratios (2.509 and 5.657) shows that access to irrigation water increases the willingness of farmers for converting agricultural land by 97.4 % and 94.3 % respectively. According to Ng'ayu (2015) the buying and selling of agricultural land at rural-urban interface is heavily influenced by availability of water.

CONCLUSION

It is concluded that changing landscape at the fringes by the urban encroachment is occupying fertile agricultural lands and diminishing peri-urban agricultural activities. This agricultural land conversion is mostly driven by physical and economic factors in both cities. Low profitability of agriculture was found as the most compelling push factor while the high land prices of agricultural land the developers offer, was found as the major pull factor for the rising trend of land conversion into uses other than farming. Effective land use and urban policies are lacking in Pakistan, due to which prime agricultural land is being encroached by urban developers. Although it is not possible to stop the urban expansion, but proper management and planning may lead to a desirable and sustainable way for establishing city areas while preserving peri-urban agriculture.

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