Spatio-Temporal Transformation in Agricultural Land-Use Pattern in Karachi Using Geo-Spatial Techniques: A Case Study along West Bank of Malir River

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Abstract: The study attempts to investigate spatio-temporal transformation along the west bank of Malir River in Karachi between 2005 and 2013, using geo-spatial techniques. The major objective of this study is to find out the changes occurring in the pattern of land use along Malir River in various administrative units of Karachi division. The study indicates changes in agricultural land during the period covered by the study. These changes which are all related to agricultural land are mainly explained by transformation occurring in terms of various land-use.

Due to the unavailability of statistical data at grass root level, primary data have been collected from imageries to obtain different land-use categories. The results show that considerable changes have been witnessed in the entire study area. This kind of research is very useful for all agricultural areas around major cities of the Asia and Africa in terms of land-use change detection.

Keywords: Agricultural land, land-use, spatial-temporal, transformation.

INTRODUCTION

Agriculture is the major economic activity of Pakistan. It is the main source of income of Pakistan's rural population. Approximately 21 percent of country's GDP comes from agricultural sector [1]. Agriculture which is practiced within the vicinity of urban areas to fulfil the demand of urbanities is called urban agriculture [2]. It is the type of agriculture in which farmers living in urban and peri-urban areas are engaged in cultivating vegetables and fruits for city dwellers. Since population is increasing rapidly, resulting in food crises worldwide. It is estimated that urban population of world will double in next 30 years [3]. As urbanization increases, need for food supplies from the urban fringes to the city population must be increase. This will certainly result in an increased agricultural activity within city limits [4]. Nowadays it is general practice that suitable lands adjacent to urban areas are brought under cultivation to fulfil the food demand around major cities.

Karachi, the metropolitan city of Pakistan having 13.5 million populations is included in rapidly growing cities of the world [5]. In physiographical settings, hills surround Karachi from west, north and northeast while Malir river (the major river in the area) runs from north to south-west [6]. In Karachi the agriculture is practiced in its fringes and some urban areas along the Malir River, concentrated in two major areas: Gadap and Malir valley.

The importance of urban agriculture is also revealed by the historic evidence such as peripheries of Mena, Egypt, Lebanon Tunisia and Sub-Saharan Africa [7-9]. Among the different issues to major cities; urban agriculture is one of the important contributors to overcome variety of issues like poverty, employment and survival. UNDP survey acknowledges over 40 different farming systems in urban agriculture ranging from medical herbs to many others [10]. Farmers sometimes are reluctant to adapt new agricultural trends as their concern is about cost-effectiveness in short period of time [11].

OBJECTIVES

The study is based on following objectives:

- To demarcate the urban agricultural zones along the west bank of Malir River.
- To identify the spatio-temporal changes in Agricultural land-use in urban areas.

Present study focuses on seven union councils: Alfalah Society, Awami Colony, Bilal Colony, Ghazi Brohi, Moinabad, Pak-Saadat Colony and Sharafi Goth

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which are urban administrative units of lower hierarchy of Karachi (Figure **1**). Table **1** reveals the land-use categories of selected study areas along the West Bank of Malir River. During year 2005 and 2013 considerable increase has been recorded in some urban settlements as shown in Table **1**.

METHODOLOGY

Digital cartographic techniques have been employed to prepare land-use maps of the study areas. Two satellite images are used to identify the differences of land-use between 2005 and 2013. Digital format of base map of the study areas have been developed. The baseline data has been geo-coded and land-use map for the study area has been developed. ArcGIS is used to digitize, manipulate and analyze the study areas land-use pattern. In present study various categories of land-use have been focused.

Satellite imageries have been utilized in order to generate baseline data at primary levels between 2005 and 2013. This study broadly based on the images collected from Google Earth Pro of 2.44 m (multispectral) 2013 and SPOT TM of 2.5 m resolution are used to map spatial variations in land-use pattern. Supervised classification method is employed on SPOT TM image for the year 2005 in present study. Ground truthing have been conducted for year 2013 of all area of interest.

RESULTS AND DISCUSSIONS

Present study is based on spatio-temporal changes in agricultural areas in Karachi division. The results of this study show that there is a reduction in cropland has been noticed in Alfalah Society, Ghazi Brohi, Moinabad and Pak-Saadat Colony. Among the major change the reduction in crop land has been seen

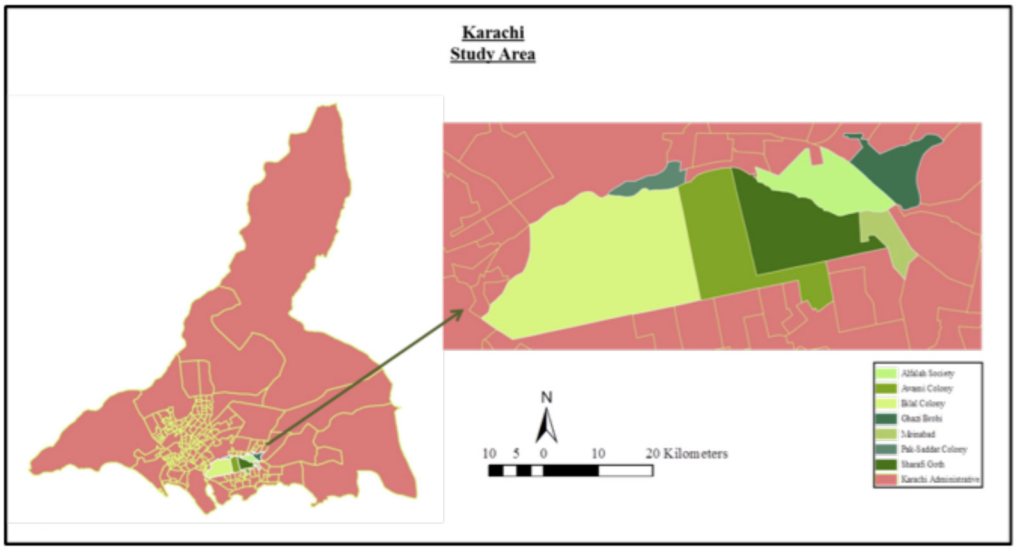

Figure 1:

Table 1: Urban Settlement of Study Area

S. No.	Study Area	Urban Settlement		Rate of Change (increase)
		2005	2013	
1	Alfalah Society	65.5	73.4	7.9
2	Awami Colony	46.2	56.9	10.7
3	Bilal Colony	56.6	60.2	3.6
4	Ghazi Brohi	53.5	53.5	0
5	Moinabad	62.4	67.6	5.2
6	Pak Saadat Colony	45.6	47	1.4
7	Sharafi Goth	26.5	27	0.5

Source: Calculated by author.

Table 2: Land-Use Pattern of Study Area 2005-2013

S. No.	Study Area	Crop Land (%)		Fallow Land (%)		Ploughed Land (%)		Orchard (%)		Cultivable Waste (%)	
		2005	2013	2005	2013	2005	2013	2005	2013	2005	2013
1	Alfalah Society	10.23	5.28	6.48	6.78	3.46	4.39	4.71	45.42	0	4.06
2	Awami Colony	13.98	14.66	21.24	22.21	17.57	8.47	7.69	0	16.27	59.51
3	Bilal Colony	15.49	16.36	41.99	37.85	21.99	25.6	0	2.6	33.21	48.49
4	Ghazi Brohi	11.63	8.47	14.92	15.61	15.83	8.61	1.19	23.88	2.77	2.92
5	Moinabad	4.26	4.73	0	1.49	7.23	9.67	0	0	3.41	4.54
6	Pak Saadat Colony	3.7	3.24	1.42	1.49	3.74	1.74	0	0	0	0
7	Sharafi Goth	40.71	47.26	13.94	14.57	37.37	34.29	86.4	28.1	1.1	23.73

Source: calculated by author.

because of increase in the urban built up area in Alfalah Society 4.95% followed by Ghazi Brohi 3.16%.

The agricultural land-use pattern has also recorded some changes over the time for example the increase of crop land in Sharafi Goth, Bilal Colony and Awami Colony has also been revealed from the study. In Sharafi Goth crop land increases from 40.71% to 47.26% (6.55% increase), this is because of orchard farms were converted into crop land. Another remarkable change has been noticed in orchard farms of Ghazi Brohi that is 22.7% increase (Table **2**). It is noticed that this increase has been caused by the reduction in cultivated land that is crop and ploughed land. Cultivable waste generally has increased in all areas. However an increase in the orchards in Alfalah society, open land has been utilized for fruit plantation.

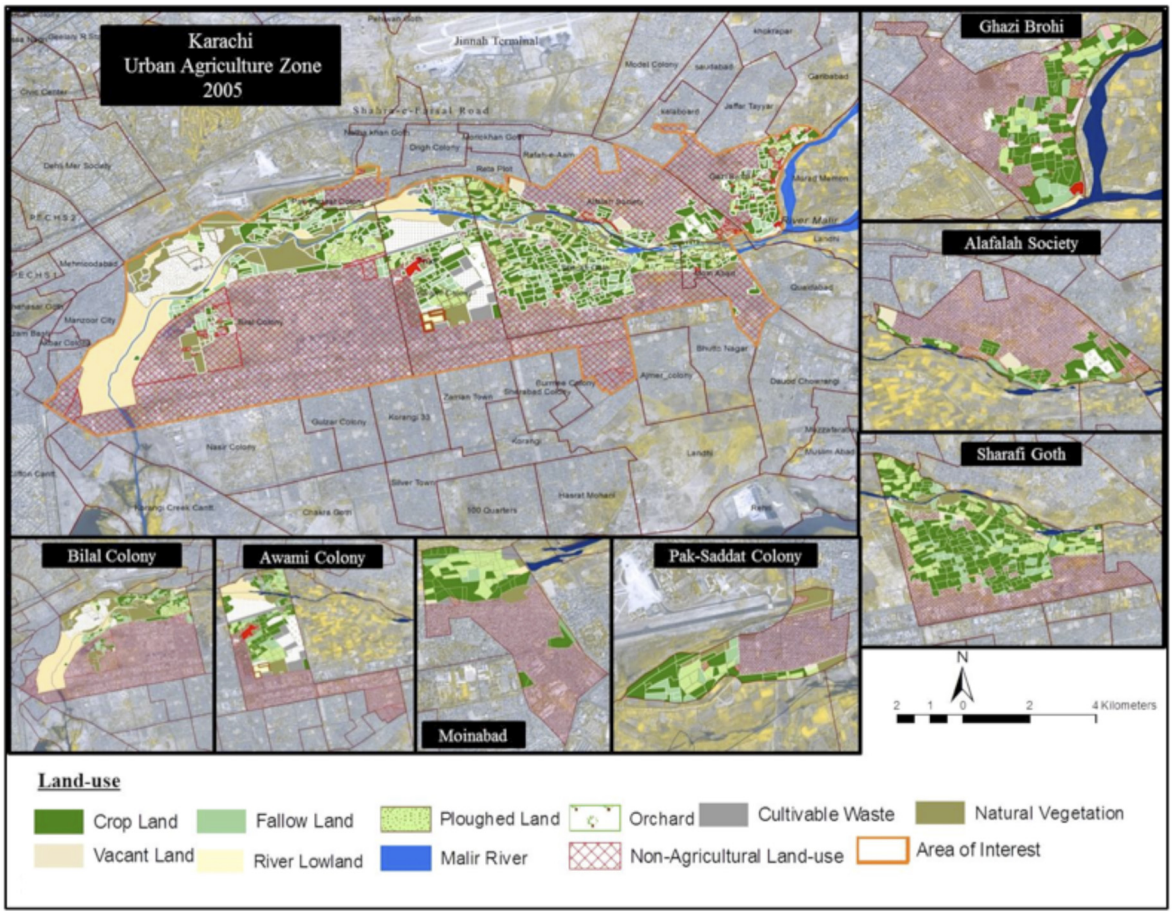

Figure 2:

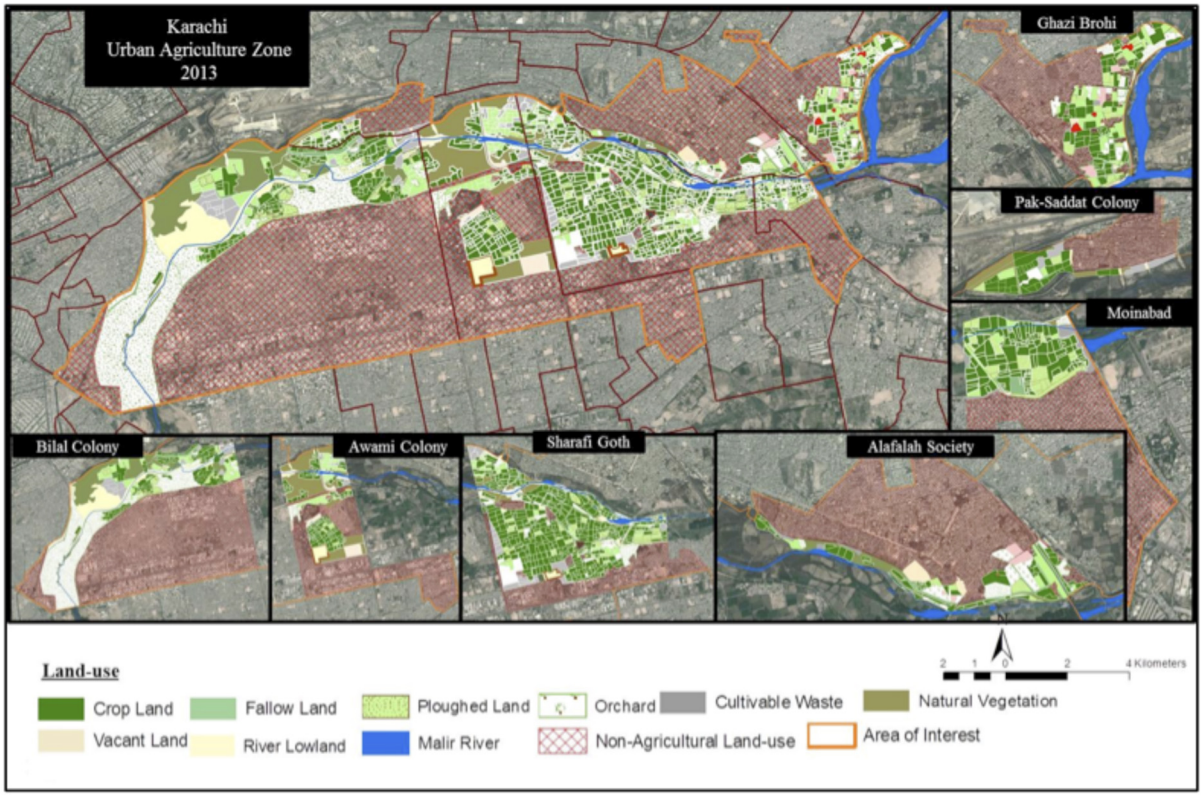

Figure 3:

Agricultural land-use patterns are very dynamic feature of cultural landscape. The occurrence of change is a multi-faceted phenomenon which can be attributed to multiple factor. Several issues have come to the forefront on the nature of transformation and the intensity of the change in the agricultural land-use of the entire area. Patterns of agricultural land-use change in Ghazi Brohi, Sharafi Goth, Moinabad, Pak-Saadat Colony, Alfalah Society, Awami Coloy and Bilal Colony have undergone changes during the period between 2005 and 2013 (Figures **2** and **3**). Some areas have seen increase in orchards e.g. Alfalah Society and Ghazi Brohi which can be attributed to the use of water conservation technology. Such methods are known as drip irrigation (use of droplets of water to control the excessive flow) and sprinkler method (where sprinkler wheel is used which sprinkles the droplets of water all around its circumference). The most striking change has been observed in Sharafi Goth where cultivable waste has increased to several folds.

The current change in agricultural land-use in the urban areas of the west bank of Malir River is driven by ecological and economic factors. However the orchards production must be under taken on free hold land since it is a permanent land-use.

CONCLUSION

The study reveals that there is a change in the agricultural land-use pattern in the study area covering the time frame of the study from 2005 to 2013. The exceptional increases in Alfalah Society and Ghazi Brohi are very positive in terms of its economic benefits whereas the substantial land in Sharafi Goth has been converted into cultivable waste.

The results of the study suggest that there is dire need to improve the water availability in the entire area. The sprinkler and drip irrigation methods need heavy capital investment that a common farmer is unable to afford, such heavy expenditure are possible through public sector only. The findings also show that attention must be paid to improve other related infrastructure. Poor transportation network, lack of agricultural related facilities and incentives and provision of electricity hamper the development of agriculture in this region. Poor standards of literacy, lack of governance and investment also adversely affect the development of agriculture in this region. The general application of the study on policy and planning calls for a proper line of action and formal policy which narrates the objective to the pursued in agricultural land-use in this area.

This need is provoked by the study as it has shown that many of the changes are unplanned and without proper policy. It is high time that policy makers in developing countries like Pakistan should focus on the determinant of development in rural areas and urban and peri-urban agricultural areas around the major cities such as Karachi. No doubt that there is a critical linkage between more investments and agricultural growth in this region. The area around Karachi could be developed as a hub of agricultural products specially vegetables and fruits not only for the needs of such a large urban center like Karachi but also the products can be exported to the adjacent markets like India, Iran, Oman, UAE, and other parts of the middle east.

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