

Research Article

Fahad Ahmed Shaikh, Kamran Malik, Mir Aftab Hussain Talpur, and Kashif Ali Abro*

Role of distinct buffers for maintaining urban-fringes and controlling urbanization: A case study through ANOVA and SPSS

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Abstract: Urbanization is giving rise to the number of challenges due to its matchless soaring proportion in scenario of management and public welfare. Difference types of buffers are utilized globally depending upon the area of action and purpose to protect development sites from external harms and to avoid factors resulting inequalities from outer boundaries, for instance population growth and development. Effects of urbanization on urban fringes and the land use changes have been conducted for their inter-relation purposiveness to maintain fringes approaching buffer. In this context, this paper studies the different types of buffers to identify their necessity and implications for exploring the appropriate buffer as a conservation approach. In order to deal with the urban boundaries of Hyderabad (delineation of urban fringes), the conversion of agriculture land into residential area due to urbanization have been analyzed. Sample questionnaire survey and analysis were conducted using ANOVA with the help of SPSS 20.0, Arc GIS 10.1 based maps. Resultantly, our findings open new dimension in understanding the buffers implementations on the basis of ANOVA testing observation. To conclude this analysis, it is observed that riparian tree buffer is strongly suggested in comparison with other employed types of buffers for designing land use plans.

Keywords: Distinct buffers, urban fringes, conservation, urbanization, agriculture-residential land

Kamran Malik: Department of Mathematics, Government College University, Hyderabad, Pakistan

1 Introduction

Urbanization at an unparalleled proportion is going on in whole world. The world's population living in urban areas was about 33% in 1950, but the share of the urban population by 2014 has amplified to 54%, expected to be reached at 66% up-till 2050 [1]. Global land is currently intensifying at double with the growth rate and predictably it would surpass 1.1 million square kilometers in 2050. The urban population, which is considered by demographic swing due to urbanization by rural urban shifts and land transformations, for the global development in 21st century holds both opportunities and the challenges. However, the continued urbanization poses numerous encounters to urban administration and communal well-being [2]. The need for land use planning, conversion from agriculture to residential land, and the restoration of stream buffers through forests in urban and agricultural settings have certainly spread to many other states, including watershed buffers. The need for environmental monitoring is highlighted. Areas adjacent to protected areas, where the use of land is prohibited to protect partially protected areas, while providing valuable benefits to neighboring rural communities. Anyone cannot inflict the conservation by fences and guns. But buffer zones in purpose are to safeguard the biodiversity that must be aligned with reimbursement for local inhabitants. The concept of protection generally applies to broader planning considerations. Innovative planning focuses on the protection potential of promoting 'adaptive reuse', in search of a middle ground between the development industry and the public response to large-scale rehabilitation. Furthermore, "The purpose of civil protection is to maintain the identity of urban areas, while security considers the entire protected areas and is concerned with managing change." [3]. Martino [4] reviewed an article in 2001, pointing out that buffer zones, and their effective use, are one of the agendas of conservationists and wildlife organizers and the top priority. Buffer zones provide a way for locals to take real advantage of the existence of a protected area carefully.

^{*}Corresponding Author: Kashif Ali Abro: Institute of Ground Water Studies, Faculty of Natural and Agricultural Sciences, University of the Free State, Bloemfontein, South Africa; Department of Basic Sciences and Related Studies, Mehran University of Engineering and Technology, Jamshoro, Pakistan; Email: kashif.abro@faculty.muet.edu.pk

Fahad Ahmed Shaikh, Mir Aftab Hussain Talpur: Department of City and Regional Planning, Mehran University of Engineering and Technology, Jamshoro, Pakistan

Urban rural fringes swell due to urbanization or the movement of urbanites for two reasons for instance, for farming or residential purposes to enjoy the rural life. This results in the expansion of land whereas different landscape patterns occur and intrude the ecological processes biological, social or physical but there is no specific theory of change or expansion of land according to Thuo [5]. However, inner peripheries are a source of regional delineation and rural economy also the change of patterns supported by the concepts of travel demand. In order to create a better understanding among buffers and ecological processes, we reviewed literature for development processes as a threat for ecosystem backing up by the change of landscape patterns and urbanization. In exaggeration, literature reviewed for the article is correlated to the fields of land policy, environmental approaches and agricultural policies discussing the worldwide approaches to implement buffers for protection of environment, agriculture and land use change due to development. Numerous environmental impacts, such as encroachments on natural areas and agricultural areas, have led to an increase in land area [6]. Sullivan et al. [7] in Midwestern USA studied about urban expansion and conversion of farming land. Buffers were studied as an alternative for resolving land conversion conflicts by examining three types of stakeholders by conducting 5-point Likert scale-based and photo questionnaires survey and using SPSS for analysis of variance by 3x3 factorization, findings revealed the variance among the opinions of all the three groups of stakeholders for different types and extension of buffers. Sullivan et.al. further suggested that buffers in agricultural landscape expected to provide more benefits than in environmental aspects. The inner peripheries are natural more associated with regional solidarity; they are also rural economic efficiency, and therefore linked to rural development [8]. Landscape style not only shows the result of the interaction between them, different natural, biological, and social processes environment in different dimensional scales, but also important for distribution and collection in various natural and environmental factors landscaping, thus limiting different types of ecological processes [9]. If we want to change the landscape in important ways, we have to change the ideas of those who have created and maintained what they have seen [10]. Some of the environmental impacts relate to specific local patterns of urban development, such as leapfrogging which increases travel demand and energy consumption [11]. Among the master plan elements, the main roads planned in the Shenzhen Master Plan 1996-2010 and the urban development patterns of the built-up zones planned in the Shenzhen 2010-2020 master plan had a strong impact contributed less than other factors, such as distance from the sea [12].

Moglen [13] claims for the trends of land conversions due to urbanization and its effects on stream buffers and land conversions. Moglen continued his research in several urban, suburban, and rural counties of Maryland by using the digitized GIS based data and its analysis, data collected from the Planning Office for land use. In addition, high-altitude aerial photography and satellite imagery are used to collect data. The 24 classifications of land use have been further reclassified as urban, agricultural and forestry. Data on the location of the river is obtained from the US Department of the Environment, According to Olokeogun and Kumar [14] about Indian Himalayan city Dehradun for the influence of the urbanization, the threat to the riparian ecosystem, new residential buildings, infrastructure (such as roads), farming activities and commercial activities (industrial setting) were some of the factors that threatened the sectarian landscape. A series of indicators was derived from remote sensing data. Analyzing and manipulating the Land State 8 and Sentinel 2 datasets using the Google Earth Engine, the data was collected and analyzed by observing changes in the landscape pattern of the riparian zone. ArcGIS 10.1. The area was identified using high resolution images, existing base maps, and surveys. These results show significant changes in ground cover within the riparian zone with human encroachment at various levels over the next twenty years (2000 to 2019).

2 Land development procedures

The process of development is not practical. By associating development requests with the Comprehensive Plan and Development Management Ordinance implemented during their approval, the project examines whether the quality of policy input helps in compromising the amount of tree cover and the level of aggression at the communal

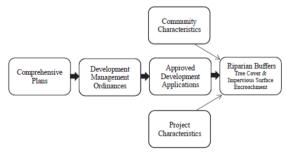


Fig. 1. Land development process and riparian buffer implementation.

Figure 1: Process of land development and implementation of riparian buffer

level [15]. The process of land development and riparian buffer implementation over there as shown Figure 1 was also graphed out. Another study was conducted [12] on patterns of growth affected by urban projects in China. The method adopted measures urban growth by comparing pixel and patch-based methods. The three methods resulted in different amounts of urban development and local characteristics. The relationship between urban growth patterns and urban planning is also explored through the multidisciplinary logistics regression model in Shenzhen. The findings discuss that among the master plan elements, the main roads planned in the Shenzhen Master Plan 1996-2010 master plan and the urban development patterns of the plant built-up zone in the Shenzhen 2010-2020 master plan are stronger Impressions are gained in a fluid, global, diffused way. Other factors, such as the distance to the sea and suggests that driving factors may change or need to be considered carefully when we examine municipal precautions.

2.1 Use of buffers

To clarify the concept of different buffers [21–24], literature is comprehensively reviewed for illumination of the major factor of study. The term buffer zone was widely used in the 1970s with the Main and Biosphere (MAB) program and Biosphere Reserves (BR). UNESCO's Human and Biosphere Program introduced the concept of BR in 1976 and by the mid-2000s it had 368 reserves in 91 countries [16]. The first 57 BRs nominated in 1976 were selected primarily for their role in security. Few buffers are classified in Table 1.

Conservation buffer

Conservation buffers are slivers of shrubbery placed in the landscape to affect environmental processes and provide us with an array of services and the goods. Many names of this particular buffers include windbreaks, greenways, filter strips and wildlife corridor depending upon the purpose. Conservation buffer methods can incorporate grassland components into agricultural landscaping, thus increasing the proportion of landscaping in natural societies while minimizing the impact on crop production systems. Any type of protection buffers is up to the landlords who make important land use decisions that affect both the production of commodities from their land and the flow of environmental or environmental services, so landlord filter strips and other Willing to create types of protection buffers. Achieving the goal of the National Security Buffer Initiative, we have: [17-20].

Riparian buffer

The riparian buffer, also known as the Stream buffers, is a natural plant that emerges from the riverbank through the riparian zone as shown in Figure 2. The botanical zone acts as a buffer for polluting pollutants, controlling erosion, and providing living and nutrients in the river. The relatively unstable riparian zone supports a strong stream system. Slender riparian zone occurs when fields, parking lots, rocks, bare soil, buildings, roads, or lawns are in close proximity to the river. Residential development, urban cen-

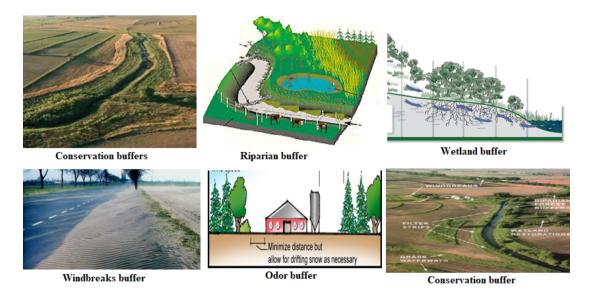


Figure 2: Different types of buffers

ters, golf courses and the Rhineland-Palatinate zone are common causes of anthropogenic degradation [14].

Wetland buffer

Wetland buffer is a blow area between a river, stream or wetland and any level of development. It maintains natural vegetation cover along the waterway, which is an integral part of the aquatic ecosystem as shown in Figure 2. Wetland buffer is a simple land management system operated by municipalities to protect property and conserve natural resources. In addition to protecting natural resource areas, buffers are the least expensive way for municipalities to protect homes and roads from flood damage, manage flood water and protect water quality.

Windbreaks buffer

Windbreaks (also called hedges, thresholds, shelter belts, plant barriers, or wind barriers) are defined as the growth of a fence, wall, line, or tree that prevents wind from coming in with its own force as shown in Figure 2. Windbreaks are unsafe barriers that reduce wind speed in areas sheltered to the left of the barrier (and to some extent on the windward) by attracting air:

Odor buffers

Odor buffers ensure that residential and other sensitive ground uses are not located near sewage treatment plants or sewage pump stations, where people may have an unpleasant odor. To help odor buffers: Minimize the effects of odors on surrounding areas, which can lead to land use disputes. Protect community investment in wastewater treatment plants and wastewater pumping stations. Provide assurance for planning and future investments. Wastewater treatment plans such as agriculture, industry, recreational areas, or plan for the use of harmonious and productive land around urban forests. Reducing operational costs to the community as shown in Figure 2. Planning to upgrade infrastructure at existing plants. Planning the location of new plants. State provides input into state and local government planning processes such as planning strategies and schemes, infrastructure planning, subdivision, and development. All the types of buffers in general are shown in Figure 2 for a clear understanding of their use and purpose and differentiation among them.

Buffer Zones Suceeded in Integrating Conversation



Figure 3: Data chart for failure and success of buffer integration

The data shows the highest rate of failure in implementing buffer zones by using bar graph, an analysis of the reviewed question "Have buffer zones succeeded in integrating conservation and Development?" Martino [4] appraised in this study for showing results of global implications of buffers for retaining land.

3 Data analysis

The quantitative data collected for the study are samples of direct observations, discussions and questionnaires divided into three population categories. The questionnaires were designed to identify and address the plight of residents in some rural areas of Pakistan. The first questionnaire was designed to fill in the area residents and farmers study area. A question mark was also created for the scholars to ask questions so that they have an opinion on the formation of the buffer. All questions were close ended questions. The Likert scale in the questionnaire represents 5 in which 5 represents strongly agree, 4 represents moderate agreement, 3 represents agree, 2 represents disagree, and 1 represents strongly disagree. Arc GIS was used to generate buffers at urban fringes of Hyderabad to allocate the areas for encroachment controlling approach. Secondary data is based on well-reviewed literature and articles from the Internet that covers the theme of buffers, their types and uses, their effects on global scoping and the gradual increase in urbanization, and urban boundaries from agriculture to residential areas. A sample of 80 questionnaires was compiled to provide feedback from farmers. Sample from the overall population conducted was 50 scholars and professionals by distributing the survey to officers and students of the City and Regional Planning Department of Jamshoro and the Institute of Environmental Engineering and Management. 70 responses from the citizens were drawn based on random sampling and people living near rural boundaries. Statistical technique namely ANNOVA

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Table 1: Analogy for the implication need among different buffer types to imply for conservation and maintaining of urban fringes and Agricultural-Residential Land

Sr.	Questions	Group	Sum of	df	Mean	F
no			Squares		Square	
1.	At what level would be your suggestions for the Grass	Between	0.481	2	0.241	0.148
	Waterways Buffers (broad and shallow grass designed	Within	262.756	161	1.632	
	to prevent soil erosion) at rural-urban fringes?	Total	263.238	163		
2.	At what level would be your suggestions for the Riparian	Between	1.177	2	0.588	0.496
	Grass Buffers (combination of trees, shrubs, grasses along	Within	190.793	161	1.185	
	stream or river) at rural-urban fringes?	Total	191.970	163		
3.	At what level would be your suggestions for the Wetlands	Between	3.634	2	1.817	1.761
	Buffers (vegetation cover maintenance with stream, river	Within	166.140	161	1.032	
	or wetland) at rural-urban fringes?	Total	169.774	163		
4.	At what level would be your suggestions for the Odor	Between	0.547	2	0.274	0.322
	Buffers (stench reductors spreads due to livestock	Within	136.843	161	0.850	
	or waste) at rural-urban fringes?	Total	137.390	163		
5.	At what level would be your suggestions for the Wind	Between	0.301	2	0.150	0.218
	Breaks Buffers (row or rows of trees and shrubs planted	Within	110.919	161	0.689	
	as shelterbelts) at rural-urban fringes?	Total	111.220	163		
6.	At what level would be your suggestions for the Riparian	Between	0.475	2	0.237	0.122
	Tree (to maintain the cooling of water and providing	Within	313.885	161	1.950	
	canopy) Buffers at rural-urban fringes?	Total	314.360	163		

Table 2: Analysis of the indications for which kind of buffer at urban-rural fringes

Sr. no	Questions	Group	Sum of Squares	df	Mean Square	F
1.	No basic buffers have to be there	Between	0.141	2	0.070	0.390
		Within	29.054	161	0.180	
		Total	29.195	163		
2.	Basic buffers have to be there	Between	0.244	2	0.122	0.488
		Within	40.262	161	0.250	
		Total	40.506	163		
3.	Broad buffers have to be there	Between	0.043	2	0.22	0.124
		Within	166.140	161	1.032	
		Total	169.774	163		

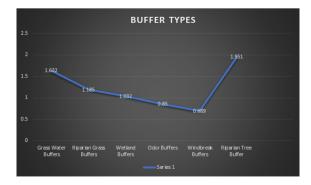


Figure 4: Mean approval ratings according to the buffer types

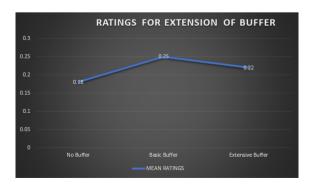


Figure 5: Mean approval rating on extension of buffer

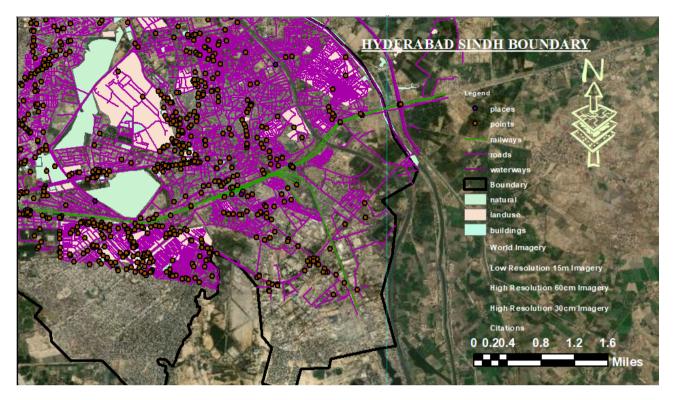


Figure 6: Digitized boundary of Hyderabad inclusive of urban sprawl at rural-urban fringes dissolving agricultural land developed at Arc GIS

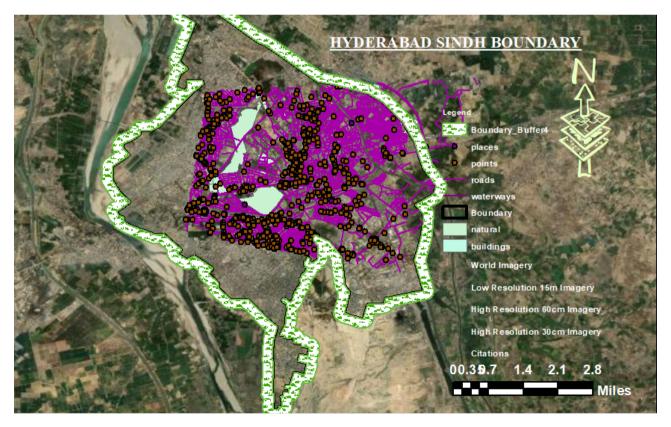


Figure 7: Snipped from Arc GIS after generating conservation grassland buffers of 300 meters at the boundaries

is applied to analyze data sets collected from three different population samples, including residents, farmers, and scholars. Such mathematical and statistical studies can be seen in recent attempts for multi-dimensions [25–30]. As already the respondents were divided into three categories, namely farmers, residents and educators, a total of 200 questionnaires were sampled out of which 80 were for farmers, 70 for dwellers and 50 for scholars. The 68, 50 and 46 questionnaires were filled in, with a response rate of 85%, 71.43% and 92% respectively, with an overall response rate of 82%. The three-way ANNOVA test was used to analyze these questions as shown in Table 1, where the 'three variables' were placed in two groups, a selection of buffer types and a group of respondents on the basis of following tests with their formula:

sum of squares =
$$\sum_{i=1}^{n} (y_i - \bar{y})^2,$$
 (1)

Mean squares =
$$\frac{1}{n} \sum_{i=1}^{n} (y_i - \bar{y_i})^2$$
. (2)

Here, n = number of data points, y_i is observed value and \bar{y}_i is predicted value.

Furthermore, the questions of type 2 as shown in Table 2 for analyzing the kind of buffers were conducted in the survey. Such analysis is depicted in Figures 4 and 5.

Figures 6 and 7 are GIS based maps of boundaries of study area and proposed buffer at 300 meters' distance is also generated as a suggestion.

4 Results and discussion

The no buffer condition earned the lowest approval rating (mean = 0.18). Approval of the basic buffer (mean = 0.25)was higher than that of the no buffer condition, while approval of extensive buffers was higher still (mean = 0.22). The chart plotted describes the average clearance rating for the various buffers that is of six categories compared to the basic buffer, no buffer, and the broad buffers. Analysis of recurring trials of deviation (ANOVA) on a scale like 5 points (1 = strictly 5 = disagree). For each and every buffer i.e., riparian tree buffer has the highest score with an average of 1.950, and grass water buffers, riparian grass buffers, wetland buffers, odor buffers and windbreak buffers 1.632, 1.185, 1.032, come down with a mean of 0.850. 0.689, respectively. The findings revealed new evidence about the conservation buffers and their adoption in urban-rural boundaries for maintaining urban fringes and to protect the rural land transformation into urban, suggested substitutes

about land use and raise new questions about buffers, urban sprawl. Land use plans can also be designed in this magnitude. Analysis of buffer zones distinguishes between biological and social benefits. The biological, or environmental, benefits are the result of territorial expansion into a protected area that keeps human impact farther away. Some of these benefits are:

- Function as to protect encroachment being physical barricade.
- Natural Habitat would be enlarged, and side effects would be reduced.
- Environmental services would be enhanced.
- Protections from storm harms.

This research has been done to identify buffers as an approach as the world is increasingly facing urbanization that erodes urban land as a result of rural land conversion. This process not only swells urban areas but also pollutes the ecosystem and damages agriculture. Therefore, this study examined the extent to which the three rural stakeholder groups adopted different agricultural buffers in rural-urban areas and revealed considerable support for the use of buffers. Through this study, conducted for the necessity, uses and implication of buffers in urban-rural areas, the stakeholders' perception for adoption of buffers was considered and found favorable response for buffers.

5 Conclusion

This research is intended to design buffers for one of the major cities of Pakistan namely Hyderabad. As an economic hub, the city is facing the major challenges of land conversion and encroachments. Fine agricultural lands in the periphery are haphazardly converted at an enormous rate into developed land. Consequently, irregular development trends, land-use imbalances and scattered city growth put decision-makers under pressure over the years. Therefore, this research was aimed to develop buffers, as precious agricultural land can be preserved to give a planned direction to the city of Hyderabad. The major findings of this research are enumerated as:

- The riparian tree buffer has scored the highest number as compared to the rest of the buffers through statistical observations via ANOVA.
- As suggested by statistical analysis, the riparian tree buffer is found suitable for the city of Hyderabad to control the city development.

 A planned direction is achieved to contribute the city growth and to control the conversion of agricultural lands.

6 Future recommendations

The suitability of buffers ahead of this area should be examined in future studies. Not only urban land swelling would be normalized with this approach, but inflation would also be reduced because of retaining agricultural land transformation into residential land. There is interest that the use of buffers will bring about positive changes in the rural landscape, demoting more urban sprawl on existing agricultural land. But buffers that improve visual quality and improve rural-urban boundaries can attract a growing number of urban dwellers. Efforts to reduce the conflicts should not compromise on measures aimed at limiting growth and development.

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