Statistical and Spatial Database on Land Use Functions: A Case Study on the Mega-City of Karachi

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1. Introduction

Urban land use and infrastructure development are mutually interdependent. Most of the times in developing countries, as result of rapid urban growth, little space is reserved for public space, green space and amenities. This lack of recreational space is another cause of deteriorating urban quality of life and increasing social instability in developing countries (Barrow, 1995).

It was once estimated that about 25 percent of the urban population in Pakistan lives in slums and squatters, "*Katchi Abadies*" (GOP, 1988). Associated to low quality housing, increasing poverty, disruption of community cohesion and other declining urban living conditions are the main public health threats. Karachi, a diversified functional cosmopolitan city, is no exception to these universal facts where fragmented, inconsistent and ill coordinated infrastructure development had been gradually taking place (Khoro and Mooraj, 1997).

In 1870 the urbanized area of the Karachi district was 5 mile^2 (Pithawalla *et al.,* 1946). The 1972 census report gives the figure of 112 mile^2. The 1974 Master Plan (KDA, 1972) metropolitan Karachi as 135 mile^2 and the Karachi Development Plan (KDA, 1991) gives a figure of 1,360 mile^2 for Karachi division. Hasan, *et al.* (1999) has speculated the rate of urban land conversion at about 6,780 acres per year.

2. Objective of the Study

This paper presents the findings of the development of a statistical and spatial database on land use functions for the mega-polis of Karachi. The methodological framework for this investigation was based on the capabilities provided by today's virtual cartography and Geographic Information Systems (GIS). The categories of land use outlined by the former Karachi Development Authority have been scrutinized on the basis of the socio-economic functional classifications.

Fig.1 Location of Study Area—Karachi Metropolis

3. Material and Methods

It is known that urban land use studies (*e.g.* Schreiber and Kias, 1983) are designed to provide basic data on land characteristics and the various activities that occupy land in the urban area. These data are used in analyzing the current patterns of urban land use to ascertain the character and quality of environment. Land use surveys furnish information on the use, misuse and non-use of urban land. In planning and zoning studies, it is essential to know the amount of land use for different purposes.

The available records from the Master Plan and Environmental control department of the Karachi Development Authority were studied and considered as the basis of land use information regarding the metropolis. These documents included Land use analysis (MP-RP/37) March 1972, KDA; The Karachi Development Plan 1974; and The Karachi Development Plan 2000, prepared in 1991.

Land use map 2000 (KDA, 1991) was the most recent among the above-mentioned publications hence it was adapted as the baseline information source for land use appraisal of this study. Although, it rendered projected figures for year 2000, however, the ground realities in 2004 have almost over run these projections.

4. The Cartographic Process

Land use map 2000 (KDA, 1991) was scanned from the published document into a digital form and thereafter geo-referenced. The map was spatially geo-referenced to a Universal Transverse Mercator (UTM) projection using first order polynomial and re-sampled with *Nearest Neighbor* algorithm. The ground control points (GCPs) were selected from an ortho-rectified Landsat TM 1998 imagery. In this process, model master data set was projected on the most appropriate projection for this region of the world:

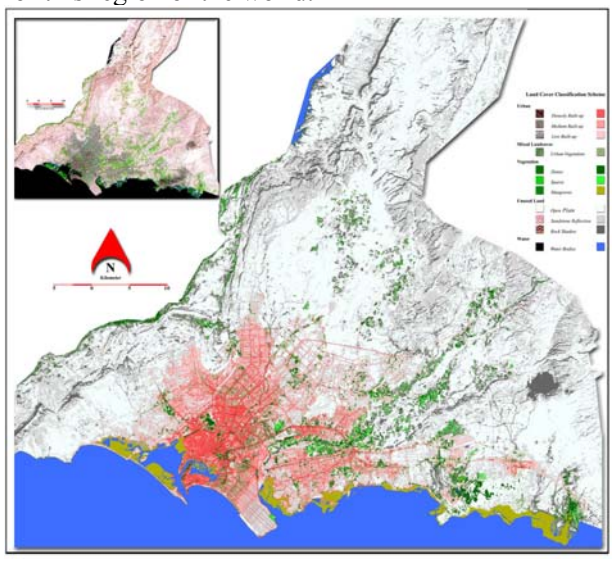

Fig.2 Land Cover Satellite Image of Karachi City

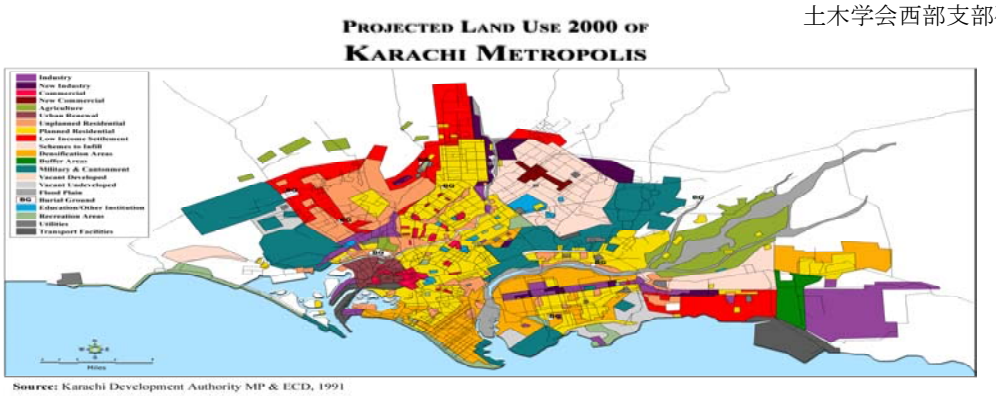

Fig. 3 Geographically Mapped Categorized Information of Karachi City

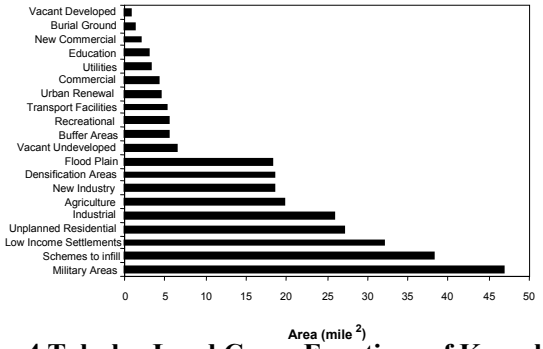

Fig. 4 Tabular Land Cover Functions of Karachi

Projection:	Universal Transverse Mercator
Zone:	42
Unit:	meter
Ellipsoid:	Everest (Pakistan)
GCP Source:	Landsat TM 1998 image

This map was then digitized and finally converted into ESRI Grid format for further interpretation with the help of ArcView Spatial Analyst. At this stage the map was ready in the form from which *data extraction* could be performed.

It was found that the land use zoning maps developed by the Karachi Development Authority (KDA) were more towards aggregation/approximation and understanding on a macro scale. A spatial inquiry, searching the micro patterns and the changes thereof, within the metropolitan city, needs an intensive and extensive information gathering effort requiring human and financial resources.

5. Results and Discussion

Karachi is a cosmopolitan city and having diversified urban functions. This has been manifested in the resultant categorized information illustrated in Figure 3 and 4**.** These tabular and geographically mapped outcomes can well be considered as value-added products of this study that will benefit the planners and administrators of the city.

These are the formulation of a statistical and geo-referenced database on land use and functions for the metropolitan city of Karachi. If some of these land use classes outlined by the KDA are grouped together broadly on the basis of their functions, interesting figures are derived, which are tabulated as under:

- It would be very unfair with the metropolis if we examine it purely according to conventional functional classification theories (*e.g.* Harris, 1943). In fact it has emerged as a “diversified city” with multi-faceted activities.
- Unprecedented huge migration is partially responsible for the mixed and chaotic land use across the metropolis. Refugee migrations of this kind are the cause of the high rate of increase in urbanization.
- Over crowded and poor quality housing may aid the transmission of diseases and pollution (Barrow, 1995).

6. Conclusion

This information set has provided a unique perspective for looking at the land use scenario of Karachi and the associated socio-economic conditions. The latent causes are rooted in the socio-economic fabric of the population. The weak governance and frail institutional controls further aggravate inequitable situation. The effects obviously are the continually changing urban land use functions peculiar to cities of developing countries especially of South Asia.

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