Assessment the Quality of Life in Karachi City through the Integration of Space and Spatial Technologies

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Abstract: This study is an attempt to map and measure the quality of life in the urban area of Karachi, Pakistan, by using Landsat-7 sensor, Enhanced Thematic Mapper (ETM+) combined with Census data through the state-of-the-art Geographic Information System (GIS). For this purpose, the physical environment of the city is determined by the variables of Normalized Difference Vegetation Index (NDVI), surface temperature and land cover/use. These are extracted from the satellite image data through various techniques of remote sensing. On the other hand, the socioeconomic variables were obtained from the 2000 Karachi District Census Reports, to represent the living environment of the city. Finally, the integration of the physical variables with the socioeconomic variables was conducted in a GIS framework using an aggregated Z Sum score approach, in order to derive the quality of life scores for the city of Karachi on the basis of Administrative-Spatial Units called Union Councils (UCs). The results effectively demonstrated the efficiency of the Index raster techniques to evaluate and map the quality of life over the study area. In addition, the GIS techniques also isolated the contributing variables that may be responsible for the spatial variability in the quality of life.

Keywords: Quality of Life, GIS, Socioeconomic variables.

INTRODUCTION

Quality of life (QOL) is a very important term for the judgment of social indicators in many societies and cultures. It is also one of the important areas of geographical research in many developed and developing countries. Generally speaking, QOL is the well-being of people and the quality of the environment in which they live. More specifically, Quality of life is a collective attribute that adheres to group of people, not to individuals [1]. “The quality of life of a person is what he/she perceives it to be” [2]. Grayson and Young (1994), reported that "there appears to be a consensus that in outlining the quality of life there are two basic sets of elements and processes operating: those that relate to an internal psychological dynamics producing a sense of satisfaction or gratification with life and those external conditions which trigger the internal mechanism" [3].

The “quality of life for an individual is focused to the objective and external realities and his (her) subjective and internal perception of these factors and himself too.” As noted already the concept of quality of life is complex and it could be used in the field of urban planning when an appropriate and reliable framework is devised for measuring it. There are two sets of indicators for the measuring quality of life which most of the researchers are agreed with them. The first set is Objective Indicators which refers to the objective and visible aspects of the urban life and are defined by different elements. For example the number of hospitals in a city, the unemployment rate, the number of crimes and the area of urban green spaces [4].

The second set is Subjective Indicators which tries to measure and quantify the citizens’ satisfaction from the urban welfare. For instance satisfaction of people from health care accessibility, access to job, satisfaction of urban security or access to green spaces.

Studies of subjective urban QOL have revealed found that subjective evaluations of many aspects of the urban environment can contribute to satisfaction in urban domains and overall life satisfaction [5-8].

One of the biggest global issues that crumbling the humanity is unplanned urbanization. The tremendous impact of urban population has led to haphazard urban growth, worsening of living conditions and the environment. Karachi has been one of the world’s largest fastest growing cities. Rapid urbanization and population growth have placed enormous stress on the quality of life. Urban Karachi has grown nearly 25 times since independence (1947) and is still growing. This paper will provide basic information that may be useful for the community and decision-makers to enable them to assess and forecast the probable consequences of future similar growth. Evaluating the Quality of life of a population on a continuing basis is important because it helps planners and government agencies engaged in the delivery of human services to the awareness of problem areas. The ultimate goal is to identify the

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aspects that improve the quality of life; factors that have no effects whatsoever, and those that adversely affect it. Probably this is in a way a first pragmatic study in Pakistan focusing Karachi taking its guideline from work of similar native case studies conducted in the developed countries.

The study of the quality of life (QOL) in the cities of both developing and developed countries is gaining interest from a variety of disciplines such as planning, geography, sociology, economics, psychology, political science, behavioural medicine, marketing and management. It is also becoming an important tool for policy evaluation, rating of places, urban planning and management. From the perspective of urban planners, cities are the center of economics, politics, commerce and other activities, so it is necessary to analyze the conditions that contribute to the quality of urban life. Various scientists around the globe have examined the various forms literature on QOL.

During the course of this study we conducted a questionnaire survey on both approaches objective and subjective QOL. In this study objective QOL was measured with a new aspect by using 37 typical indicators from the domain of environment, economic, demographic, safety, utilities, housing condition and housing facilities and use remote sensing and GIS for QOL indexing. More specifically, we sought to achieve the following objectives:

Objectives

- To obtain socioeconomic variables based on questionnaires survey and census data.
- To acquire basic Landuse Infrastructure parameters from high resolution satellite data.
- To assess quality of life with the help of bio-physical, environmental and socio-economic

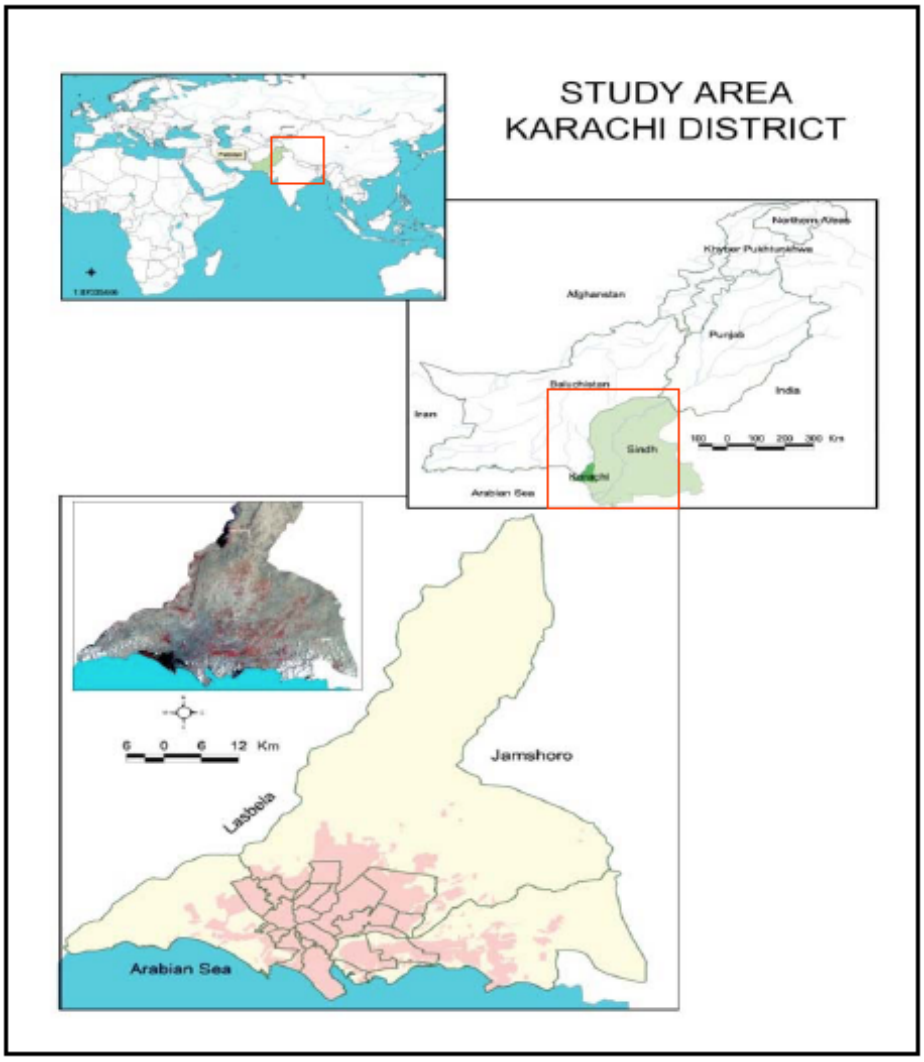


Figure 1: Study Area.

variables through GIS integration and aggregation.

- To analyze UC based maps for quality of life and its spatial variation in Karachi.
- To propose an agglomerated quality of life index for the third world cities like Karachi.

Study Area

Karachi is the capital city of the province of Sindh and the largest city of Pakistan, one of the world's largest cities in terms of population. It has the pride to be the first airport and the third seaport of the undivided India within a short span of 100 years, having been founded by Sir Charles Napier in 1843 [9]. It is situated 129 km due west of present Indus mouth. The area extends between the latitude 24º-45'North and 25º-38'North and longitude 66º-40' and 67ºEast -34' East (Figure **1**). It is bounded in the northeast and southeast by districts of Jamshoro and Thatta respectively and in the south and southwest by the Arabian Sea and in the North West by the Lasbela district of Balochistan province. It is located on the northern coast of North Arabian Sea, which gives its climate a moderate touch.

Methodology

The is a multifaceted study, based on a highly diversified approach of GIS including but not limited to Remote Sensing, Overlay analysis, questionnaire, statistic techniques, census studies (secondary data) and the meaningful source of data aggregation through Geo-informatics. Figure **2a** depicts the conceptual frameworks for this paper which would explore the objectives to reach to the desired targets.

Collection of Primary Data (Questionnaire Survey)

The data is based on one percent sample of the total number of households in each union council. The sample was drawn following a multi-stage stratified random sampling technique. The first stage of stratification was the Town. The Town is a larger administrative unit of Karachi. Eighteen Towns were selected for the field survey. In the second stage, within each town the sample was assigned to the Union – Councils in proportion to their population. During the initial stages of this research several indicators were identified which measured citizens' perceptions of various aspects of living and working in cities. It was decided that the best method for gathering this data would be through surveys of residents. In this study household questionnaire survey was conducted in which questions asked about respondent's personal information, education, income, housing structure and facilities, and environmental QOL in which they live.

Collection of Secondary and Statistical Data

Collection of secondary and statistical data from District Census Reports of Karachi, 1998 Government of Pakistan. Government of Pakistan, 1998, District Census Reports of Karachi District East, May 2000, Karachi District South, February 2000, Karachi District Central, May 2000 Karachi District West and April 2000 Population Census Organization: Statistic Division Islamabad and KDA Master Plan 1974-1985 and 2000.

Acquisition of High Spatial Resolution Satellite Imagery

Satellite imageries have the potential to provide very recent and updated information with speed and accuracy which is essentially needed to determine the existing resources of the quality of life in the study area. In this study, following imageries were acquired to study the existing land use and land cover Classification. Landsat TM 30 m, SPOT 2.5 m, and QuickBird 0.6 m were acquired from the Department of Geography and Google-Earth.

Indicator Development

A variety of indicators which have been extracted from census data, satellite data and questionnaires can be used to measure quality of life. In this study Remote Sensing and GIS will be used as a fundamental tool to evaluate the total area of each category of land use union council's wise and data integration using Z-sum. In our study the indicators, as selected have been shown in Figure **2b**.

QOL Index

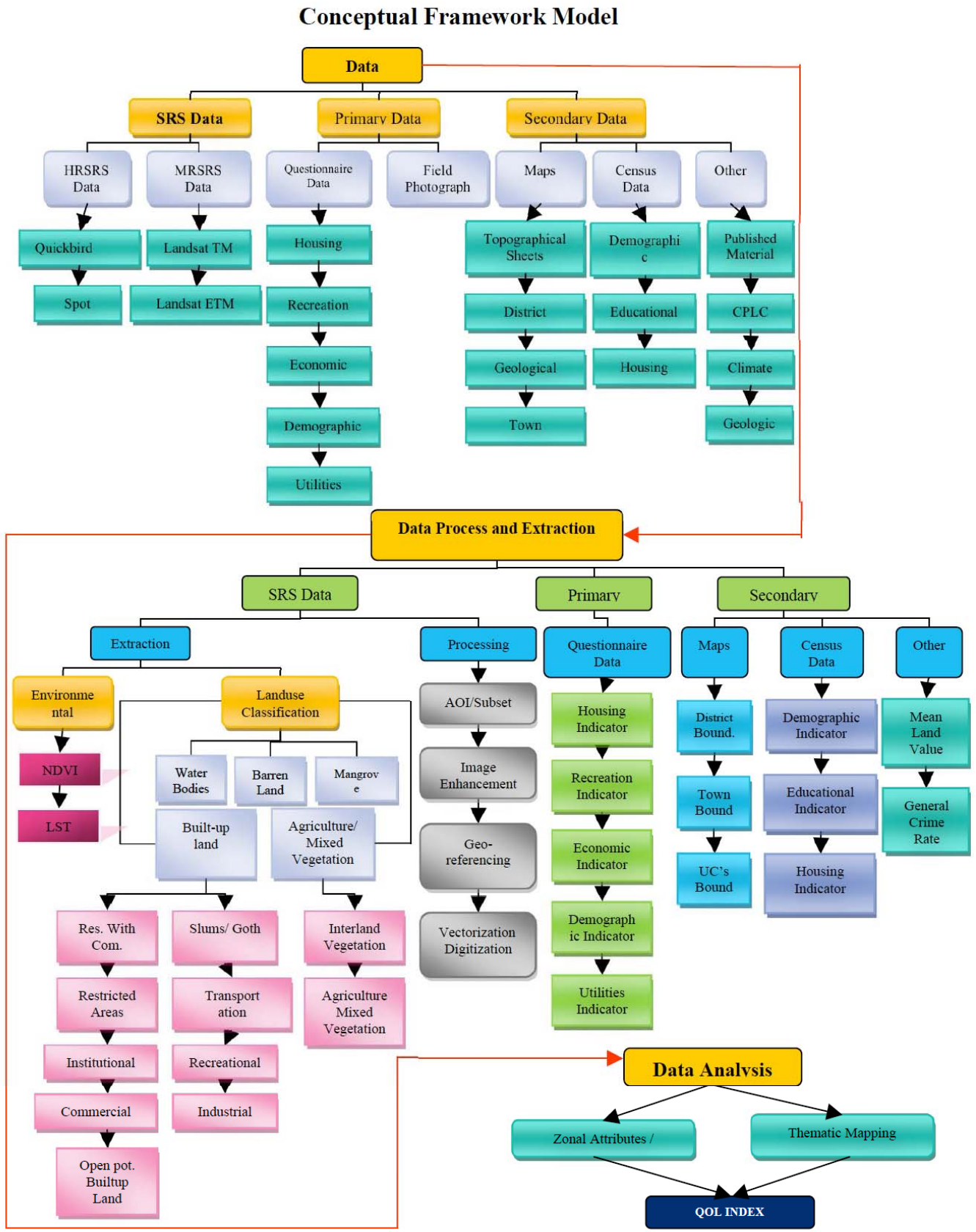
The Methodology used in the present study for calculating Quality of Life index is the simple numerical procedure of summation across indicators of standardized scores in each indicator. This technique is referred to as the Z-sum

$$(Z\text{-}Sum)j = xi - Xij / Si$$

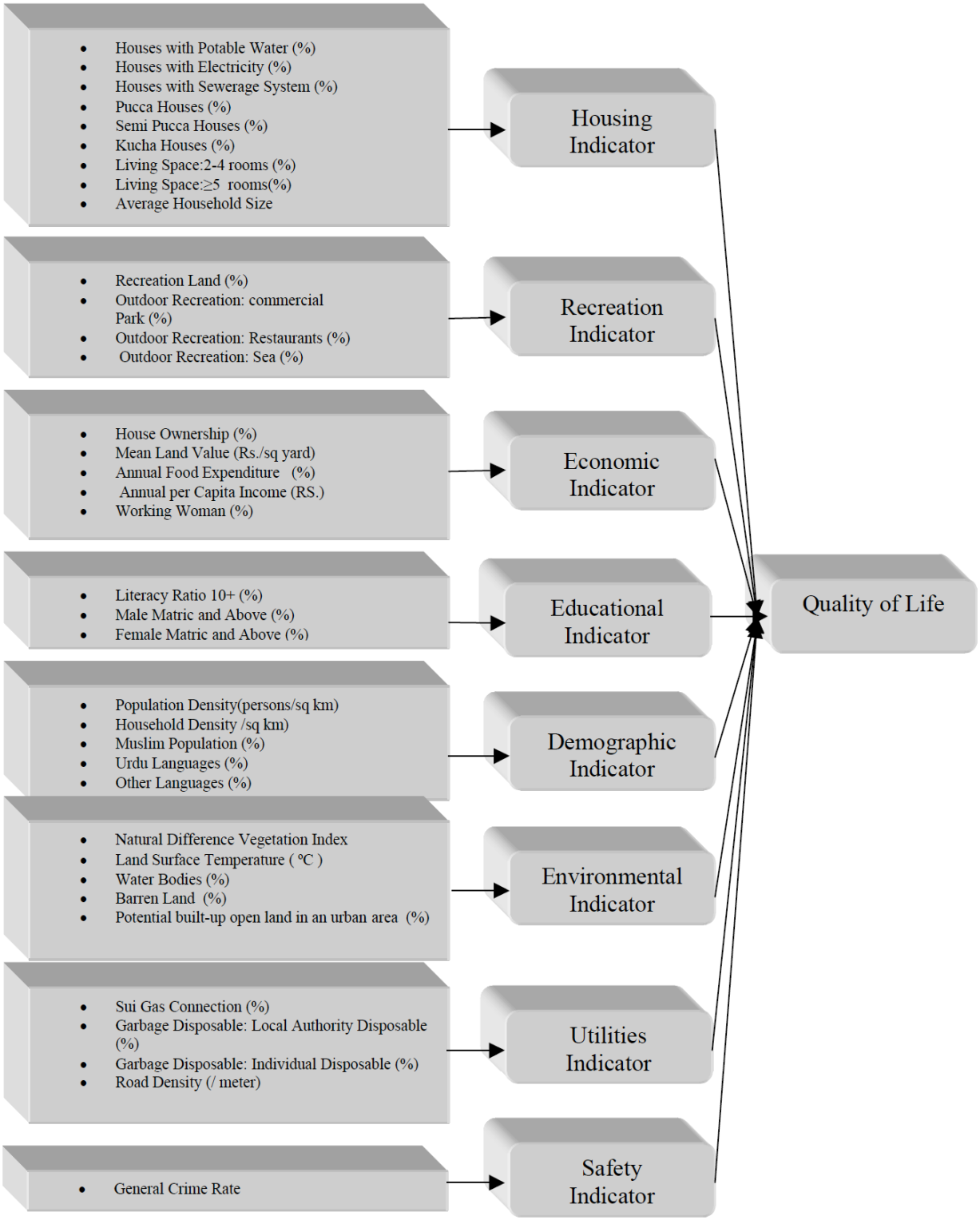
Where

n = number of indicators

xi = mean value of ith indicator


Conceptual Framework Model
Data
SRS Data
Primary Data
Secondary Data
HRSRS Data
MRSRS Data
Questionnaire Data
Field Photograph
Maps
Census Data
Other
Quickbird
Landsat TM
Housing
Topographical Sheets
Demographic
Published Material
Spot
Landsat ETM
Recreation
District
Educational
CPLC
Economic
Geological
Housing
Climate
Demographic
Town
Geologic
Utilities
Data Process and Extraction
SRS Data
Primary
Secondary
Extraction
Processing
Questionnaire Data
Maps
Census Data
Other
Environmental
Landuse Classification
AOI/Subset
Housing Indicator
District Bound.
Demographic Indicator
Mean Land Value
NDVI
Water Bodies
Barren Land
Mangrove
Image Enhancement
Recreation Indicator
Town Bound
Educational Indicator
General Crime Rate
LST
Built-up land
Agriculture/ Mixed Vegetation
Geo-referencing
Economic Indicator
UC's Bound
Housing Indicator
Res. With Com.
Slums/ Goth
Interland Vegetation
Vectorization Digitization
Demographic Indicator
Restricted Areas
Transportation
Agriculture Mixed Vegetation
Utilities Indicator
Institutional
Recreational
Commercial
Industrial
Data Analysis
Zonal Attributes /
Thematic Mapping
Open pot. Builtup Land
QOL INDEX

a



b

Figure 2: a. Conceptual Framework Model.
b. Casual Model of QOL for Karachi, Source: Authors.

Si = standard deviation of ith indicators

Xij = Average value of ith indicator in jth zone

The higher the Z-Sum for a particular zone the more developed it is in relation to other zones. After constructing indices of quality of life indicators, all the towns and Union Council were ranked on the bases of

such indices. The development ranks on the basis of these indices are shown in results and discussion.

RESULTS AND DISCUSSION

Quality of Life is a very important indicator to gauge the standard of life around the globe. National and International agencies are continuously doing research to evaluate QOL. The QOL in a country will determine the economic norms of a country, especially in welfare developed states. Unfortunately, in developing countries such as Pakistan, it is not being practiced on a regular basis and some QOL studies are not on the appropriate spatial scale. There has been a large increase in amount of time, efforts and resources that have been concentrated on quality of life studies. Many developing countries in the world have conducted QOL indicator projects, and many of these projects are in the early stages of identifying indicators, collecting data, reporting results and making recommendations for using information that indicators provide [10]. Hence, this study is being set forth to evaluate QOL anomalies on a regional scale, such as Karachi, on the smallest spatial scale as Union Council. The various dimensions of urban quality of life have been studied at two levels from local to regional. Furthermore, the magnitude of environmental, social and economic scored higher respectively through Factor and Component analysis. Such outputs show the importance of the provision of primary needs and services in the developing countries which are the main concerns of urban decision-makers and expert [11].

Assessment the Quality of Life

Assessment of quality of life in Karachi has been determined on the basis of the quality of life with various environmental, social, economic indicators. A selection of these indicators and the results of statistical analysis and remote sensing and GIS analysis are discussed below:

The decision as to which variable to include is obviously difficult and no clear guidelines exist for social studies [12]. Finally there is the question of a number of variables. The effect of including a large number of variables that measures similar characteristics and highly correlated is merely to increase the importance of the factor through which they are represented, without necessarily changing the overall factor structure. But it is necessary to maintain some balance between variable [13].

After the careful consideration of the above mentioned facts, 36 variables were short listed to conduct this analysis. In addition to this, many new variables have been tested first time in this study to judge their role in the assessment of quality of life. The subsequent pages indicate the sources of data and the methodology for the collection of the 37 variables used in the study for the statistical and remote sensing and GIS analysis.

Housing/Habitat Indicators

Houses with Potable Water (%)

The provision of potable water is a municipal facility and criteria for urbanization. Water is one of the most essential requirements not only for the sustenance of life but also for the maintenance of health and hygiene of the human and physical environment. However the increasing significance of filtered water as an indicator of development is indisputable. The data were gathered from the District Census Reports of the recent census of 1998.The Figure **3a** shows the highest values of houses with potable water in New Karachi, Jamshed, North Nazimabad and S.I.T.E Town because these areas are well planned, high percentage of *pacca* houses and well connected.

Houses with Electricity (%)

Along with the availability of water, electricity is also a basic necessity. Although power shut downs are a chronic problem nevertheless it is part of municipal facilities. Similarly, with constantly increasing and improving pace of living styles and standards, electrification is gaining significance. Thus, the greater the level of electrification of houses the more developed one area may be considered and vice-versa. Electricity is a source of light, heat, cooling and all manifestation of energy; it enhances our quality of life, making life very convenient and luxurious. The Figure **3b** shows the highest values of houses with electricity in New Karachi, Jamshed, North Nazimabad, Gulberg, sadder and S.I.T.E Town because these areas are urban localities, high percentage of *Pacca* houses and well connected. Lowest values are found in rural areas of Karachi

Houses with Sewerage System (%)

In this variable only number of those houses with flush latrine facility are considered because flush latrine in Karachi, in general, is an indicator of proper sewerage system. Therefore, number of houses having flush facility whether separately or jointly is taken as

per cent from the total number of houses. The data were gathered from the District Census Reports. The Figure **3c** shows the highest values of houses with sewerage system in some Union Council of New Karachi, Jamshed and Malir. Liaquatabad Town because in these areas are high percentage of *pacca* houses. Lowest values are found in rural areas of Karachi.

Pacca Houses, Semi *Pacca* Houses and *Kacha* Houses (%)

The physical quality of houses has been categorized on the basis of material used in the constriction of roofs and walls, based on the types of building material used, three types of houses "*KACHA*" and "*SEMI PACCA*" "*PACCA*" can be identified. "*PACCA*" houses being on identification well—to—do living standard the spatial measurement of which displace the disparity in levels of housing condition. As defined in the district census report, a house having its outer walls with baked bricks or blocks or stone cement bounded was considered as *Pacca*. As most of *Kacha* houses having mud walls. The data were gathered from the District Census Reports. Figure 5.11 and 5.12 shows *pacca* and *kacha* houses in the study area. The Figure **3d** shows the highest values of *Pacca* houses in central part of city because all areas are urban. Lowest values are found in rural areas of Karachi. The Figure **3e** showing the highest values of semi *pacca* houses in surrounding areas of city center because all areas are rural. Lowest values are found in urban areas of Karachi. The Figure **3f** is showing the highest values of *kacha* houses in surrounding areas of city center because all areas are rural. Lowest values are found in urban areas of Karachi.

Living Space: 2-4 Rooms and ≥ 5 Rooms per House

The living space has been calculated by household questionnaire survey. The Figure 5.15 shows the highest values of 2-4 rooms per house in new Karachi, Gulshan-e-Iqbal, Landhi and Korangi, because in all areas plot size are small and mean land value is not

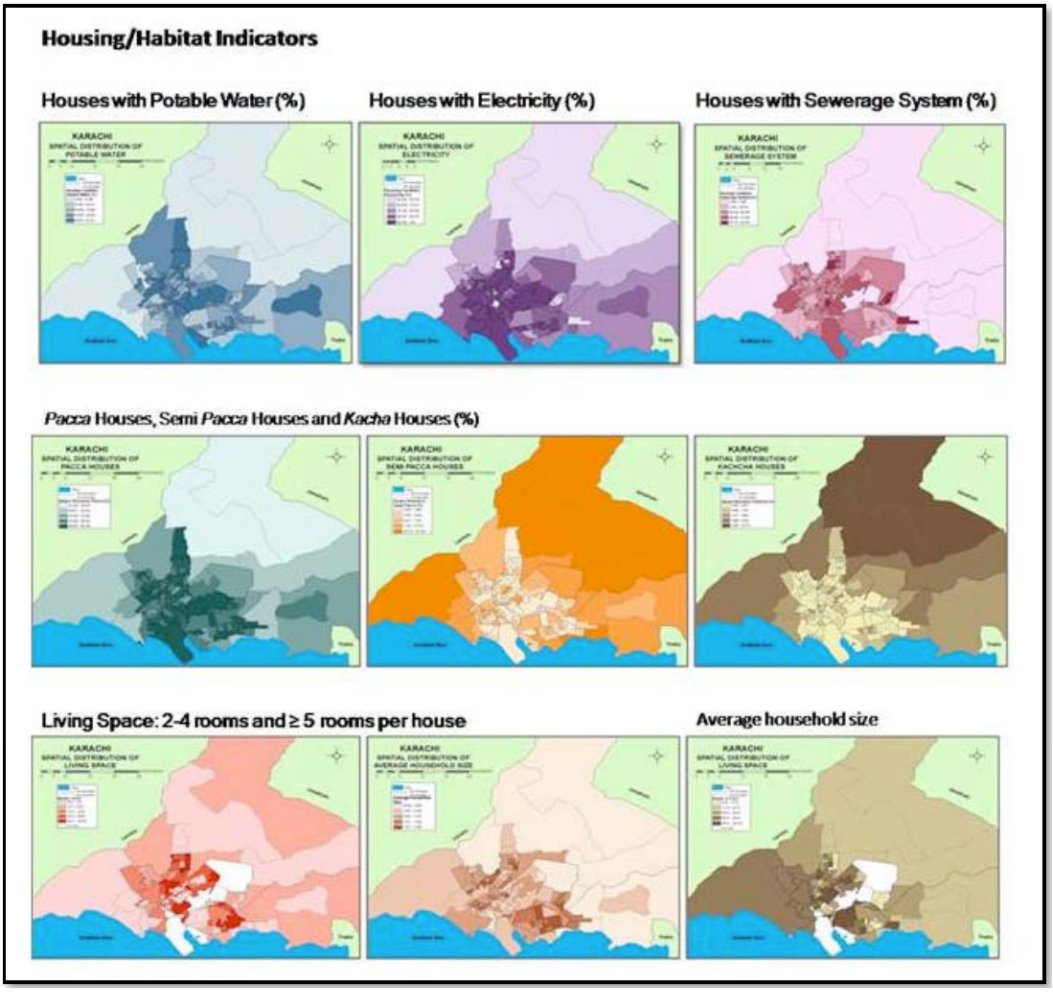


Figure 3: Housing Indicators.

much more high. Lowest values are found in rural areas of Karachi. The Figure **3g** shows the highest values of ≥5 rooms per houses in mostly Gulshan-e-Iqbal, Jamshed, North Nazimabad and Gulberg where mean land value is high. Lowest values are found in rural areas of Karachi where mean land is not so much high.

Average Household Size

The indicator on average household size is an important indicator as it is the proportion of population to the total number of houses. In other words it gives us an idea of the degree of congestion in the houses or the household density. The data were gathered from the District Census Reports. The Figure **3h** shows the highest values of average household size in some Union Council of New Karachi, Orangi, Landhi, Korangi and Baldia Town because all areas are lower income areas and literacy ratio is low, education level much more high and population density maximum. Lowest values are found in rural areas of Karachi because in these areas population density is minimum and poor medical facilities which cause death rate high as compareto urban areas.

Recreation Indicator

Recreational Land (%)

Open space is a contributor to the general health and well-being of a community. Measuring public open space highlights the availability of parks and reserves for the city's population and can indicate how urban sprawl is encroaching on parks and reserves by showing whether the ratio is being maintained as the population increases. The Figure **4a** shows the highest values of recreational land in North Nazimabad, Gulberg, Gulshan-e-Iqbal, Jamshed, Saddar Town because in this town high numbers of parks and playground. City Government has made number of model parks in Karachi. Lowest values are found in rural areas of Karachi. This is a very positive indicator of quality of life.

Outdoor Recreation: Commercial Park, Restaurants and Sea Side

The outdoor recreation has been calculated from the household questionnaire survey. The Figure **4b** shows the highest values of outdoor recreation: Sea Side Saddar, Kaimari, Landhi and Korangi Town because these towns are near to sea or coast line of Arabian sea. Lowest values are found in rural areas of Karachi because in these areas no concept of outdoor recreation. The Figure **4c** shows the highest values of outdoor recreation: Restaurants some Union Council of North Nazimabad, Korangi, Gulshan-e-Iqbal and Baldia Town because in these townspeople prefer to go to restaurants. Lowest values are found in rural areas of Karachi because in these areas no concept of outdoor recreation. The Figure **4d** shows the highest values of

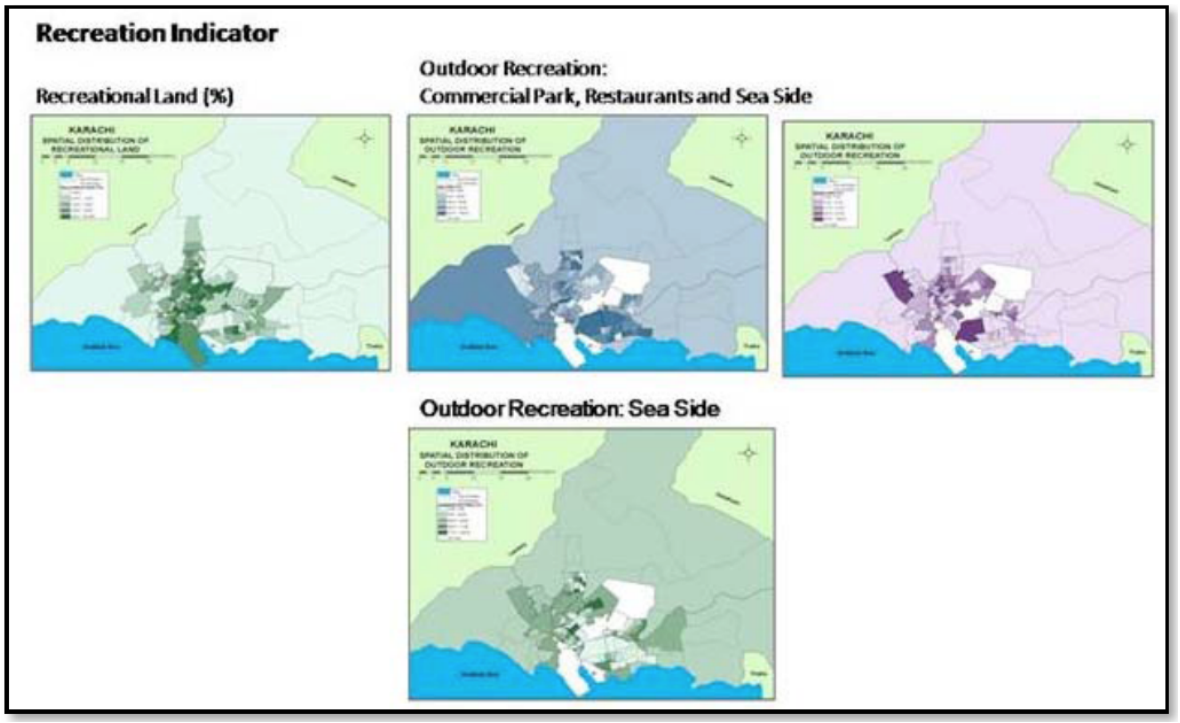


Figure 4: Recreation Indicators.

outdoor recreation: Commercial Parks Gulshan-e-Iqbal Town because in this town many commercial parks like Aladin park, safari Park and Aziz Bhti park. Lowest values are found in rural areas of Karachi because in these areas there is no concept of outdoor recreation.

Economical Indicators

Home Ownership (%)

Housing is the largest component of many households expenditure and is key factor for determining the ability to meet basic needs. When housing costs are too high relative to income, people have less residual income to spend on other essential household costs such as food and power. The ownership of houses not may only enhance economic standards but also lends an aura of the social status of its owner. Levels of home ownership are used as a guide to population stability, community participation, the relative wealth of the community and changes in lifestyles and household patterns. Home ownership has been assessed using the proportion of private dwellings that were owned with and without mortgages. The home ownership has been calculated from the household questionnaire survey. The Figure **5a** shows the highest values of house ownership in surrounding areas of the city center because all areas are rural where most people have their own houses. Lowest values are found in urban areas of Karachi and high value found in New Karachi, North Nazimabad, Gulberg and Korangi because these areas planned.

Mean Land Value

The data of mean land value have been collected from Dr. Ihshanullah published Ph. D thesis [14]. The Figure **5b** shows the highest values of mean land value in some areas Saddar, Jamshed, because these towns are part of the old city, commercial with residential and major hospital and colleges are found here and also Gulshan-e Iqbal town as it is a because newly planned area. Faisal cantonment also shows the highest values because high income areas. Lowest values are found in rural areas of Karachi.

Annual Food/Grocery Expenditure (%)

Food is a basic item of household expenditure. Affordable food is important for nutrition and general health, and is particularly important for children. Food prices are affected by seasonal factors and by changes in the broader national economy as well as the international environment. Those on lower incomes are particularly vulnerable to changes in price. They have limited ability to adjust to increases in the price of food, as it tends to make up a significant proportion of household expenditure. The annual food expenditure has been calculated from the household questionnaire survey. The Figure **5c** shows the highest values of annual food expenditure in Landhi, Baldia and Orangi because all areas are low income areas. Lowest values are found in rural areas of Karachi.

Annual per Capita Income (Rs.)

The per capita Income, though it is a highly objective indicator, used widely by economists and difficult to evaluate. However, taken in conjunction with other indicators it proves to be a helpful indicator of Q.O.L. Income is the single most important modifiable determinant related to health and quality of life in general. Income levels indicate the ability of citizens to meet their needs and directly correlates with their conditions of health, education, social, housing, leisure and general lifestyle. Unfortunately, the data on Union Council regarding income per capita is not available in any published material. Again a positive correlation is established like other factors. As the increase in of income will most of the time improve the quality of life of the people. The per capita income as a measure of developed on a measure of basis one defense of 'income' is that it is an objective, value free indicator. It is a direct income measure which can be qualified, although the technical problems related with the use of per- capita income as a measure of developed are numbers ranging from the problems of pricing of products in an inflating market, problems of comparing regions, states, countries, etc., that have different part. The Figure **5d** shows the highest values of annual per capita income in some union of Shah Faisal, Malir, New Karachi and Landhi town. Second highest values in Saddar, Jamshed, North Nazimabad, Gulberg and Gulshan-e-Iqball because all areas are planned. Lowest values are found in rural areas of Karachi.

Working Women (%)

The indicator on percentage of working women to total women has been taken as an indicator of quality of life because with reference to third world countries in rural areas is an indicator of gender suppression while in urban areas females are largely engaged as domestic workers but nevertheless in urban areas where education of females is better the indicator of working women sheds light on its positive aspect of social development as they contributes to economic viability along with social upliftment. The working woman has been calculated from the household

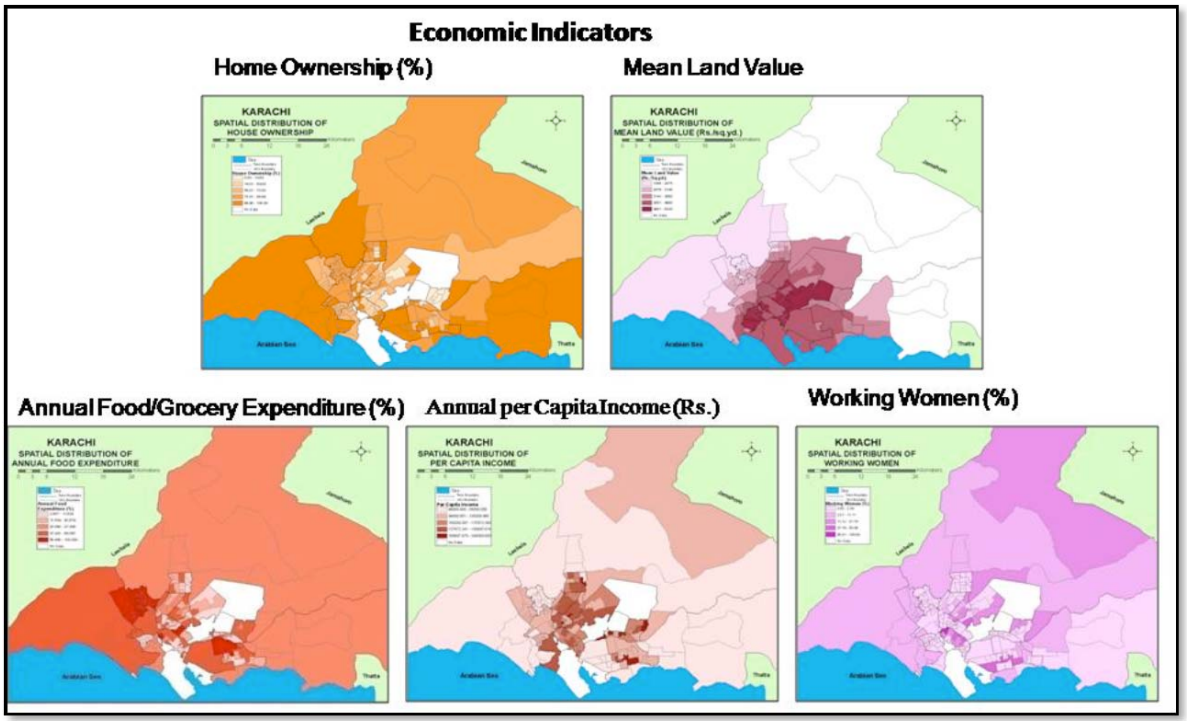


Figure 5: Economic Indicators.

questionnaire survey. The Figure **5e** shows the highest values of working woman are found in Jamshed, Gulberg, Korangi and Landhi, Gulshan-e-Iqbal town because in all areas educational level is high and in some industrial areas number of working women is quite significant.

Educational Indicators

Literacy Ratio (10+) and Male, Female Matriculates and above (%)

Male, Female matriculates and above (%) calculated Male, Female matriculates and above the total male and female population. The indicators on literacy, male and female education have been selected as indicators to highlight the significance of education.

The indicator an educational attainment specifically is based on a calculation of female matriculates and above. These are areas with; comparatively high standards of living and hence high educational achievements. Education of females has suffered a lot in third world countries as there is a large proportion of dropouts even at school level, so very few women achieve higher education. According to the 1998 Census literacy is defined as the ability of a person who can read a newspaper and write a simple letter in any language “The literacy is measured in terms of literacy ratio and computed as percentage of literate persons among; the population aged; 10 years and above the literacy ratio has very positive correlation with quality of life.

Literacy is one of the most important indicators of social development because it is the lowest rung on the ladder of educational achievement. Any social upliflment is highly dependent on this achievement. As regards the indicator on female matriculates and above. The Census is divided into a number of categories e.g. Below Primary, Primary, Middle Matric, Intermediate, B.A/B.Sc. and equivalent, M.A/M.Sc. and equivalent, Diploma Certificate etc. Therefore in view of the observed conditions the indicator in females matricules has been taken because in third world countries which are traditional and back word countries not only economically but socially as well and females are the last to benefit from development.

The largest number of shops outs is also females there; the basic education, a first educational degree is an achievement for females. The social significance of education lies in its impact on alleviating the population squeeze as well as is changing the structure of “stimuli to labour”.

Computed from the population (10 years and above) as a percent of literate persons. Taken directly from various district census reports. However, it indicates that as we increase the level of education and

awareness we certainly lower down the various human conditions.

The Figure **6a** shows the highest values of literacy in North Nazimabad, Gulberg, Jamshed town because in all area educational level is high in both male and female. Lowest values are found in rural areas of Karachi. The Figure **6b** shows that the highest values of male matric and above in some Union Council of North Nazimabad, Gulberg, Jamshed and Gulshan-e-Iqbal town and Fasial Cantonment because in all area literacy ratio is high. Lowest values are found in rural areas of Karachi.

The Figure **6c** shows the highest values of female matric and above in some Union Council of North Nazimabad, Gulberg, Jamshed and Gulshan-e-Iqbal town because in all literacy ratio is high. Lowest values are found in Baldia, Orangi because these areas are low income areas and mostly slums are in this town and also lowest values in rural areas of Karachi.

Demographic Indicators

The demographic factors are very critical for the evaluation of quality of life. Therefore, these factors are pivotal in this analysis.

Population Density (persons per Km^2)

Density of population is the number of people per unit area, per square kilometer. Population density as an indicator has basic values in that it is an indication of the pressure of people on land or the degree of congestion and hence over utilization. Density of Population gives an indication of overall crowding.

The Figure **7a** shows the highest values of population density in city center and Malir, Shah Faisal, Landhi and Korangi town because all areas are urban where household density is also high. Lowest values are found in urban rural of Karachi.

Household Density (per Km^2)

The study of Housing Congestion is important because varying degrees of congestion are a reflection of manifestations of poverty. It is also a reflection of the effect of economy on social conditions, e.g. congestion may be due to the inability to pay high rates. The phenomenon of social crowding is related to the perception of the environment by an individual or a group or a section of society and is largely the subjective feeling and assessment of the environment by the concerned persons. Since social crowding is difficult to quantify physical crowding in the form of population density and household density has been taken as a surrogate in order to highlight its social significance. Excessive crowding has been found to have a deteriorating impact not only on conditions of health and education but to a large extent on distortion of social and psychological values, especially of children [15]. It is a proportion of houses to area i.e. houses/Km^2 high density indicates congestion e.g. small plots and high rise apartments. Low density indicates large plot sizes and a better quality of life. Crowded households are considered a primary factor not only or the lower academic achievement, incidence of diseases, but also to juvenile delinquency [16]. Crowding is usually associated with low incomes and associated negative impact e.g. pressure on services and amenities and on the social and physical resources [17]. The Figure **7b** shows the highest values of hold density in many Union Councils of Saddar, Jamshed and Liaqtabad Town because these towns are old and here population density is maximized. Lowest values

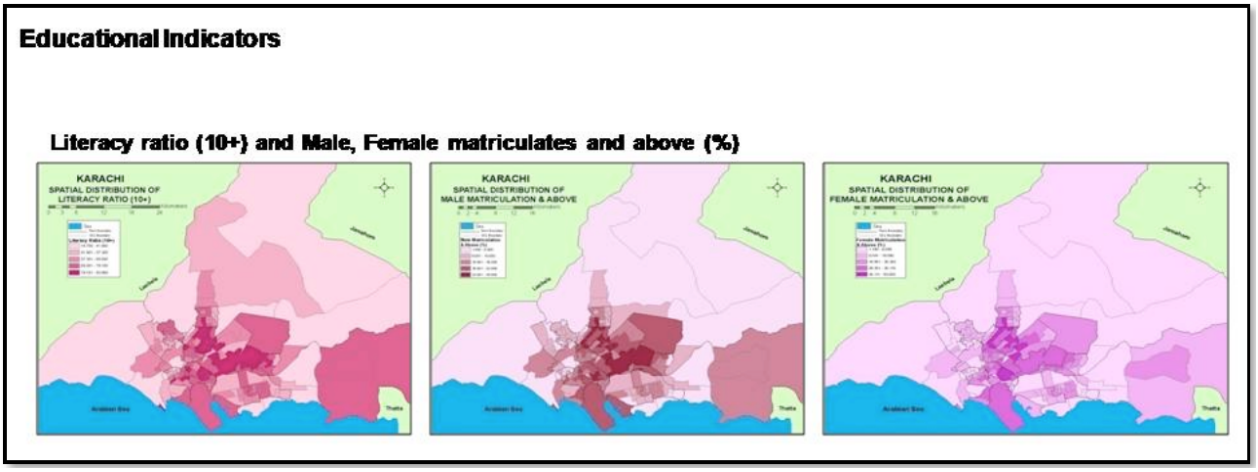


Figure 6: Educational Indicators.

are found in rural areas of Karachi where population density is also minimized.

Muslim Population (%)

The percentage of Muslims as per total population of the Union Council has an edge over non-Muslims in QOL. The data were gathered from the District Census Reports. Non Muslims like Christians and Hindus live in those areas where basic facilities of life are not properly provided especially in slums and rural areas of Karachi. Most Christians are involved in low level income professions like sweepers and cleaners. The population of non Muslims is also low as compared to Muslims in study area that's why the Muslim population positively correlated with QOL. The Figure **7c** shows the highest values of Muslim population in most of the towns of Karachi. Lowest values are found in some Union Councils of rural areas of Karachi.

Urdu Language and other Languages

The ethnicity has been calculated from the household questionnaire survey. Mostly people who spoken Sindhi, Blochi, live in rural areas of Karachi where basic facilities are not adequate. The Figure **7d** shows the highest values of Urdu language in the city center. Lowest values are found in rural areas of Karachi.

The Figure **7e** shows the highest values of other languages in rural areas where the maximum population of Sindhi and Balochi live. Lowest values are found in urban areas of Karachi where maximum population is Urdu speaking peoples.

Safety Indicator

General Crimes Rate

General crime rate indicator calculated is based on data obtained from CPLC. The Figure **8** shows the highest values of general crime rate in rural areas of some Union Council of North Nazimbad, Gulshan-e_Iqbal and Jamshed town and also in Clifton and Faisal cantonment. Lowest values are found in rural areas of Karachi.

Environmental Indicators

Physical environmental indicators are often the basis of good quality of life. Remote sensing is the technology which could provide these data sets very effective. The following indicators extracted from remote sensing.

Normalized Difference Vegetation Index (NDVI)

Earlier studies show that green vegetation and urban land use within given districts are important indicators of quality of life, with high green vegetation and low percentage of urban land use being of higher quality of life. Vegetation can be measured using vegetation indices such as NDVI (normalized difference vegetation index). The NDVI shows that the highest values of vegetation were observed in agricultural and natural vegetation areas, while the lowest values were

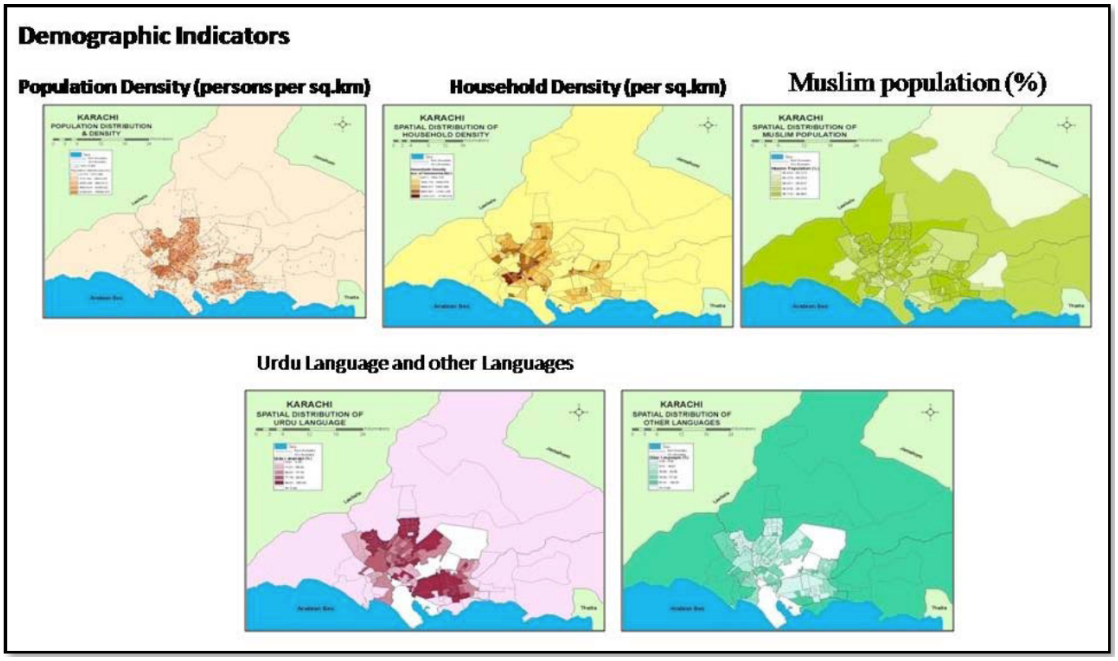


Figure 7: Demographic Indicators.

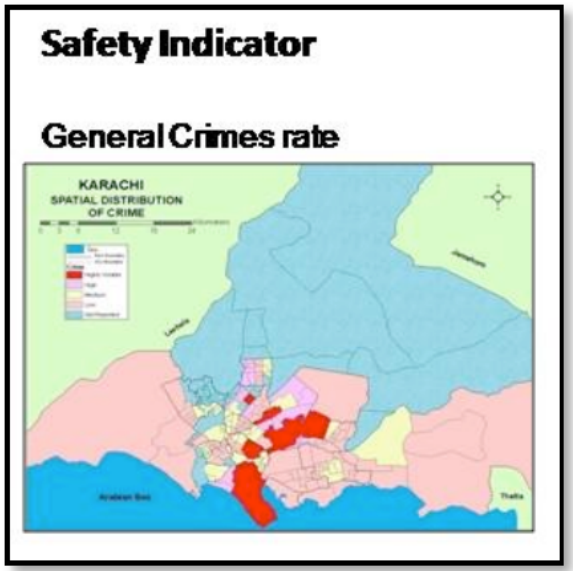


Figure 8: Safety Indicators.

found in the urban and water areas. Lo and Faber (1997), Afsar, (2001) and Li and Weng (2007) have also used NDVI as an environmental indicator [18-20].

In this study year March 2003 NDVI is calculated from satellite images Landsat TM. The value ranges from - 1 to + 1 as greenness (and biomass) increases. The vegetation index is a positive indicator of environmental quality.

The Figure **9a** indicates highest values of NDVI in some Union Council of Landhi, S.I.T.E because in these areas farming activity is high and similarly high in North Nazimabad and Gulberg and Gulshan-e-Iqbal because these areas have a number of model parks. Second highest values are found in rural farming areas of Karachi. This is an important environmental indicator for quality of life.

Land Surface Temperature (LST)

Temperature image derived from TM band 6 indicates that high surface temperatures were found in the urban areas, while low temperatures in vegetated areas and water bodies. These remote sensing variables were then aggregated at the Union Council level, and their mean values for each Union Council calculated in ARCGIS VERSION 9.3 SOFTWARE. In this study year March 2003 Land surface temperature is calculated from satellite images Landsat TM. Lo and Faber (1997) and Li and Weng (2007) have also measured surface temperature as an environmental indicator [18, 19]. This is particularly important for consideration in the case of Karachi where summer temperatures reach over 31°C.

The Figure **9b** shows the highest values of LST in some Union Council of S.I.T.E, because in these areas industrial activity is high and also high in North Nazimabad, Baldia, Orangi and Gulberg and Gulshan-e-Iqbal. Most Highest values are found in rural areas of Karachi. Lowest values are found in coastal areas because of the sea breeze effect. This indicator is also a very important environmental indicator for quality of life.

Water Bodies (%)

This indicator extracted from SPOT XS 2.5 m resolution satellite image**.** The Figure **9c** shows highest values of water bodies in surrounding areas of Malir, Lyari River and rural areas. Whereas, lowest values are found in the urban areas of Karachi.

Barren Land (%)

This indicator extracted from SPOT XS 2.5 m resolution satellite image. The Figure **9d** shows that the highest values of Barren Land totally relate to rural areas of Karachi. Lowest values are found in mostly the urban areas of Karachi.

Potential Built-Up Open Land in an Urban Environment (%)

This indicator is extracted from SPOT XS 2.5 m resolution satellite image. The Figure **9e** shows that the highest values of potential built-up open land are found in Gulshan-e-Iqbal, Baldia, Gadap and Bin Qaism. Lowest values are found in mostly rural areas of Karachi.

Utilities Indicators

Sui Gas Connection (%)

The sui gas connection has been calculated from the household questionnaire survey. The Figure **10a** shows the highest values of sui gas connections in all urban areas Lowest values are found in the rural areas of Karachi.

Garbage Disposable: Local Authority Disposable and Individual Disposable

The garbage disposable connection has been calculated from the household questionnaire survey. The Figure **10b** shows that the highest values of Local Authority Disposable in North Nazimabad, New Karachi, Gulberg and Jamshed Town. Therefore in these town qualities of life is best. Lowest values are found in Landhi, Korangi towns. The Figure **10c** shows the highest values of Individual Disposable in mostly

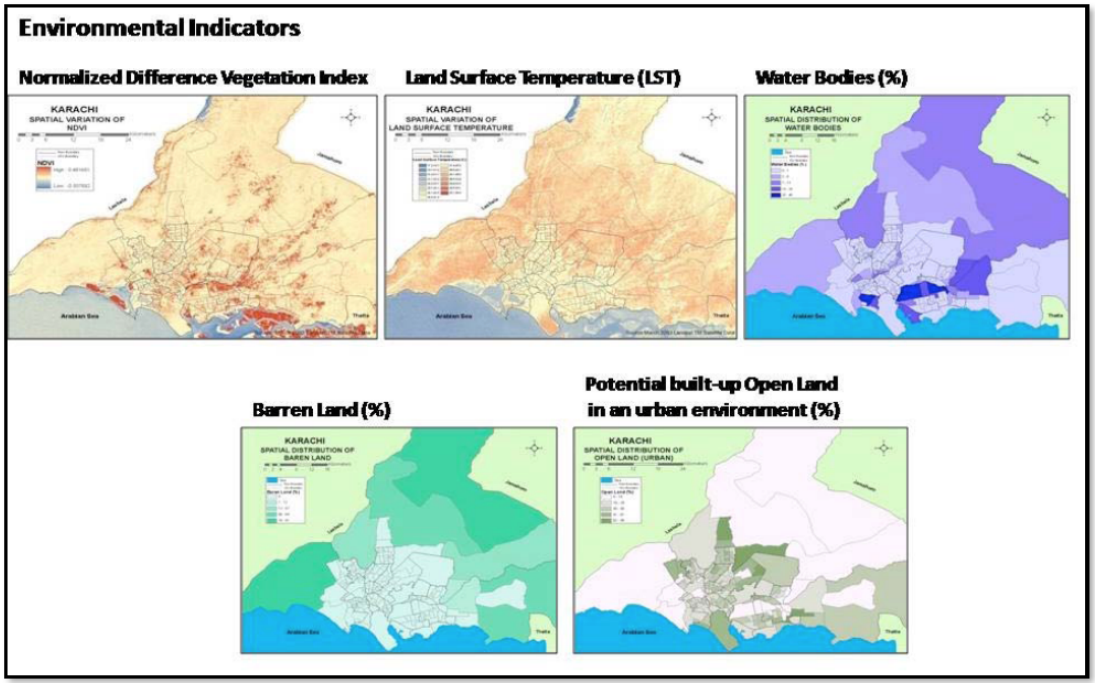


Figure 9: Environmental Indicators.

rural areas of Karachi. Lowest values are found in Landhi, Korangi town.

Road Density (per meters)

Road density is length of road in meter per area in square meters. This indicator calculated from satellite data and map data. The Figure **10d** shows highest values of Road Density in many towns because in all areas a population density and the household density both are high. Lowest values are found in the rural areas of Karachi.

Quality of Life Indicator

The Z-Sum is a method of summation across indicators of standardized score in each indicator.

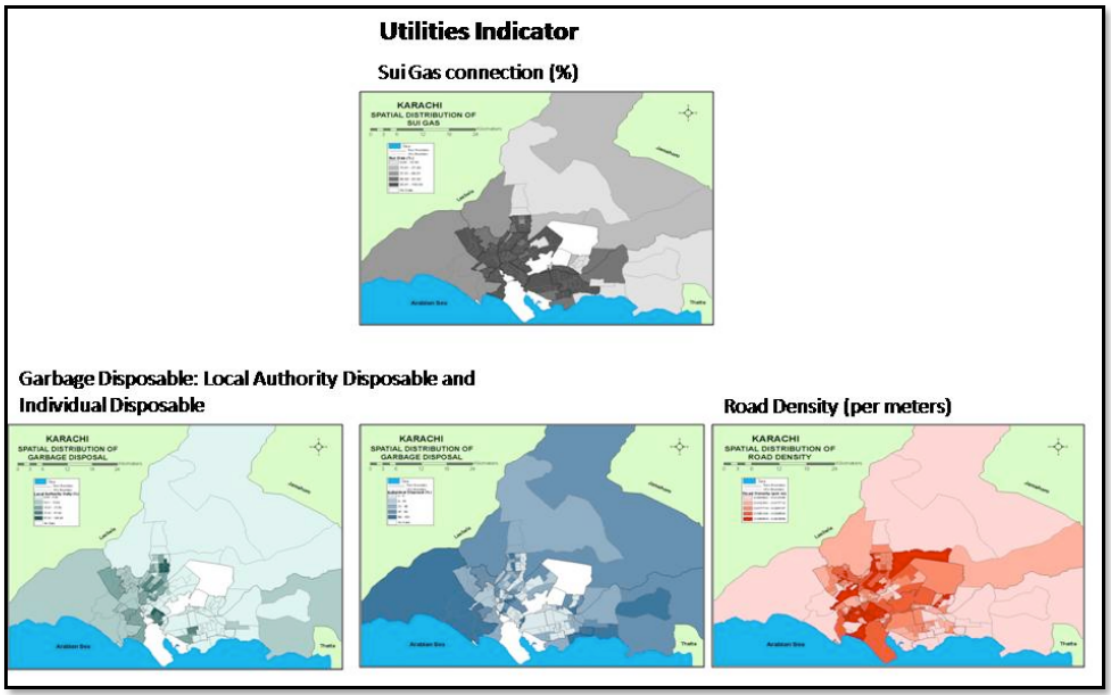


Figure 10: Utilities Indicators.

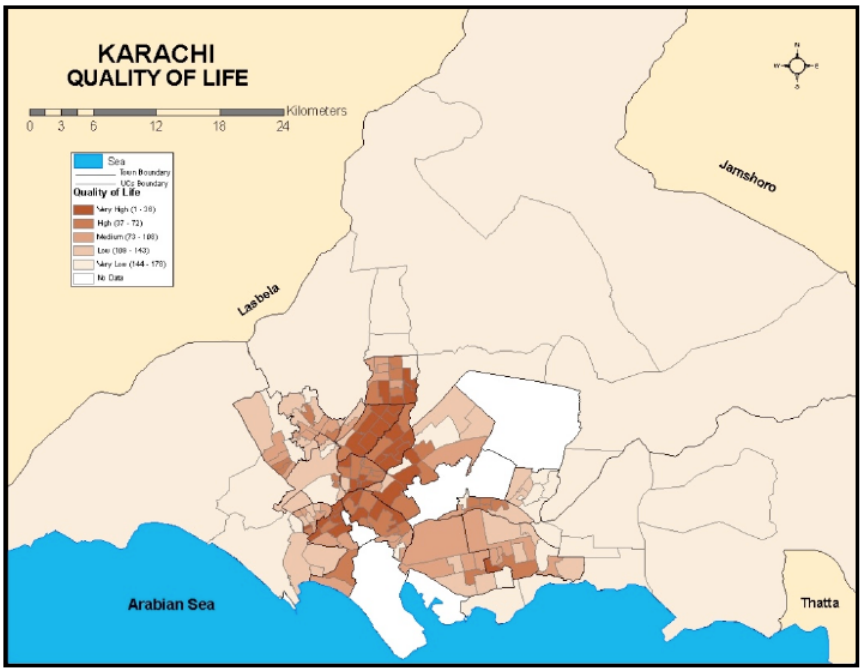


Figure 11: Karachi Spatial Distribution of Quality of Life.

High Quality of Life is found in town Gulberg Town (uc 5), Naseerabad and lowest value is found in Gadap Town (uc 3) Gadap.The Figure **11** shows that the spatial distribution of quality of life. Highest score of QOL in the central part of the city especially in mostly Union Council of Gulberg and North Nazimabad because all areas are well planned and urbanized. Lowest values are found in the rural areas of Karachi. Burke and Afsar (2003, 2005) have also reported a QOL map based on Z Sum method [21, 22].

CONCLUSION

Most probably it is one of the few attempts for the analysis of quality of life indicators in Pakistan through RS and GIS techniques. The assessment of quality of life based on both primary and secondary data has revealed highly credible results. The study explored that for the development of urban areas in developing countries such as Pakistan, the pivotal element is literacy with a focused integration on female education which would become a key factor to improve the Quality of life in urban areas.

The study reveals that in the setting of urban areas in Third World countries the promotion of literacy with a focused integration of female work productivity concurrent with highly explosive increase especially of female education is essential to improve the Quality of life in urban areas. This will lead to marked magnification of income levels. Another factor which is very significant in improving QOL in urban areas is the availability of green and open spaces on which we have already discussed voluminously.

In this study turn, the per pixel environmental data (Land surface Temperature and NDVI) have to be aggregated to the Union Council level.The cartographic work used in this study was never used before any research studies. Assessment of quality of life based on both primary and secondary data rather than use any one of them.

REFERENCES

[1] Afsar S. Appraisal of Urbanization and QOL by Employing RS And GIS Techniques: A Case Study of Karachi, Unpublished Ph.D Thesis, Department of Geography, University of Karachi 2011.

[2] Zaid YA, Popoola SO. Quality of Life among Rural Nigerian Women: The Role of Information. Library Philosophy and Practice 2010. ISSN 1522-0222.

[3] Grayson L, Young K. Quality of Life in Cities: On Overview and Guide to the Literature. The British Library, London, ISBN: 0712308016, 1994; pp: 148.

[4] Dissart J, Deller S. Quality of life in the planning literature. J Plann Literature 2000; 15: 135-61. http://dx.doi.org/10.1177/08854120022092962

[5] Michalos AC, Zumbo BD. Public services and the quality of life. Social Indicator Res 1999; 48: 125-56. http://dx.doi.org/10.1023/A:1006893225196

[6] McCrea R, Stimson R, Western J. Testing a moderated model of satisfaction with urban living using data for brisbane-South East Queensland. Australia Social Indicators Res 2005; 72: 121-52. http://dx.doi.org/10.1007/s11205-004-2211-x

[7] Sirgy MJ, Rahtz DR, Cicic M, Underwood R. A method for assessing residents' satisfaction with community-based

services: A quality-of-life perspective. Soc Indicator Res 2000; 49: 279-16.
http://dx.doi.org/10.1023/A:1006990718673

[8] Sirgy MJ, Cornwell T. Further validation of the Sirgy *et al*.'s measure of community quality of life. Soc Indicator Res 2001; 56: 125-43.
http://dx.doi.org/10.1023/A:1012254826324

[9] Pithawalla, Maneck, B. D.Sc, F.G.S., An Introduction to Karachi, Its Environs and Hinterland. The Times Press, 1949.

[10] Barsell K, Maser E. Taking indicators to the next level: Truckee Meadows tomorrow launches quality of life compacts. In Community Quality of life Indicators, Social Indicators Research Series, Sirgy MJ, Rahtz DR, Lee D-J, Eds. (Kluwer Academic, Dordrecht/Boston/London), 2004; Vol. 22: pp. 53-74.
http://dx.doi.org/10.1007/978-1-4020-2202-9_3

[11] Lotfi S, Solaimani K. An assessment of Urban Quality of Life by Using Analytic Hierarchy Process Approach (Case study: Comparative Study of Quality of Life in the North of Iran). J Soc Sci 2009; 5(2): 123-33.

[12] Shaw G, Wheeler D. Statistical Techniques in Geographical Analysis. David Fulton Publishers. London 1994.

[13] Kazmi SJH. Incidence of Malaria in Pakistan: A Geographical Analysis, Unpublished Ph.D. Dissertation, Department of Geography, University of Karachi 1997.

[14] Ihsanullah. Evaluation and Prospects of Scientific Management of Water Resources in Karachi City: A GIS Perspective, Unpublished PhD Dissertation, Department of Geography, University of Karachi 2009.

[15] Government of Pakistan, District Census Report of Karachi Central, East, Malir, South and West 1998, Population Census Organization: Statistical Division, Islamabad 2000.

[16] Kulkarni KM. Geography of Crowding and Human Response: A study of Ahmedabad city, New Dehli: Concept Publications 1984; p. 169.

[17] Gatt L. Quality of Life in New Zealand's Six Largest Cities. Manukau City Council, Auckland 2001; p. 29.

[18] Lo CP, Faber BJ. Integration of Landsat Thematic Mapper and census data for quality of life assessment. Remote Sensing Environ 1997; 62: 143-57.
http://dx.doi.org/10.1016/S0034-4257(97)00088-6

[19] Afsar S. Application of Remote Sensing for Urban Growth Monitoring and Landcover/ Landuse Mapping for Change Detection in Karachi, Unpublished M. Phil Thesis, Department of Geography, University of Karachi 2001.

[20] Li G, Weng Q. Measuring the quality of life in city of Indianapolis by integration of remote sensing and census data. Int J Remote Sensing 2007; 28(2): 249-67.
http://dx.doi.org/10.1080/01431160600735624

[21] Burke F, Afsar S. Application of Remote Sensing and GIS Techniques In The Assessment of Quality of Life In An Urban Environment. J Geograp 2003; 4(2): 09-23.

[22] Burke F, Afsar S. Cause and Effect Relationship between Quality of Life and Resources: Case Study of Selected Towns in Karachi (A Remote Sensing and GIS Perspective). J Basic Appl Sci 2005; 1(2): 65-70.

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