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| RESEARCH ARTICLE

Urban Land Use Dynamics and Environmental Planning in Multan, Pakistan

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| ABSTRACT

This study examines land use dynamics and environmental planning in Multan with emphasis on urban sustainability, transportation, watershed management, and environmental impact assessment. Rapid population growth, industrialization, and unplanned urban expansion have significantly affected land use patterns and environmental conditions in the district. The study aims to analyse these challenges and identify suitable planning strategies for sustainable urban development. The research is based on literature review and secondary data collected from government reports, GIS-based land use studies, sustainability assessments, and environmental impact reports. Previous studies conducted by organizations such as NESPAK and other researchers were reviewed to evaluate urban growth trends, transport systems, flood management, and environmental sustainability indicators in Multan. The findings reveal several major issues, including conversion of agricultural land into urban settlements, environmental pollution, inadequate transportation infrastructure, traffic congestion, and flood risks from the Chenab River. Environmental sustainability indicators show a declining trend due to rapid urbanization, reduction of green areas, and increasing pressure on natural resources. Weak land use regulations and poor public transport systems have further contributed to inefficient urban growth. The study recommends integrated land use planning, stronger zoning regulations, improved public transportation, revitalization of old urban areas, and strengthening of flood protection infrastructure such as the Akbar and Nawabpur flood bunds. It also highlights the importance of environmental protection policies and sustainable resource management. The study concludes that effective planning and environmental management are essential for balanced urban growth, environmental protection, and improved quality of life in Multan District.

| KEYWORDS

Land Use Planning, Environmental Planning, Multan District, Urban Sustainability, Urbanization, Watershed Management, Flood Risk Management, Sustainable Development.

| ARTICLE INFORMATION

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1. INTRODUCTION

The landuse and environmental planning concentration focuses on how planners help guide the physical and ecological shape of cities and regions through state and local policy intervention into land-use patterns and environmental protection. Landuse profile of a city describes the relationship of human activities and spatial uses. This is essential for better urban planning in general and landuse zoning in particular. Landuse pattern in Multan, like elsewhere, is controlled by economic forces, mobility of residents and changes/adjustments that occur in the dynamic urban scene (NESPAK 2012).

The same as all urban areas, Landuse pattern in Multan is also a reflection of two elements; i) nature of landuses and their location, and ii) level of spatial accumulation, which shows a high level of spatial accumulation and corresponding intensity of landuses, while peripheral areas have lower levels of accumulation. Landuse is the most stable component of urban dynamics, and its function as a generator and attractor of movements is the main impact of landuse on urban dynamics (Gov. L. Use Fr. 2017).

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Sustainable urbanization in the modern technological age is a challenge to human beings. Urban problems could be assessed on the basis of its three dimensions: environment, economics and social, by developing urban sustainability indices. The present study identifies indicators to develop indices for assessment of sustainability in some populated cities of Punjab. The study focused on the indicators based on environmental, economic and social development to develop a rational indicator system on the basis of secondary data collection. (Ghalib, Qadir, and Ahmad 2017)

The result of the sub-indices indicated that poor performance was evident in the environmental sector, rather than in the economic and social sectors. The cities scored between 0.27 and 0.58 in environmental dimensions, showing a decreasing trend from 2004 to 2014. The declining trend of indices was due to population influx, rapid urbanization, reduction in green areas, industrialization, high level of atmospheric and water pollutants

Millions of people have been affected, besides a large number of infrastructures either damaged or destroyed due to severe floods during the last few decades in Punjab Province. The floods not only adversely affected land and farmers but also badly devastated the on-farm sources of livelihoods and services that were affected by floods. The causes of destruction can be classified into two categories in terms of their impact i.e. (a) Flood- affected and (b) Rain-affected. In Punjab, many districts are affected by the floods in the eastern rivers particularly Multan district, emanating from across the eastern borders. (Due, Report, and Bunds 2016)

Urban mobility offers a unique opportunity to ensure development and radical improvement to the quality of urban life in the Multan City centre. The traditional approach to transport planning usually aims only at solving technical issues, finding the solutions within its own discipline. In the opposite, we define that transport planning is an integrated discipline within town planning and aims to promote an approach based on a reasonable assumption (Yasin, Sattar, and Faiz 2012).

The rapid increase in individual income leads to a physiological increase in the use of private vehicle: to curb this phenomenon it is necessary to develop an adequate, effective, modern, and high-quality public transport network and to limit the uncontrolled growth of road infrastructure. Moreover, together with the new public transport network.There are many recent examples, such as Delhi (India) or Bogota´ (Colombia), among others, that show the effectiveness of similar interventions. (Ghalib, Qadir, and Ahmad 2017)

We suggest a plan that consists of three steps: (1) a cognitive and qualitative analysis of the project area, (2) analysis of the existing transportation system, and (3) an implementation strategy divided in different phases (short, medium, and long term); each scenario has elaborated and defined solutions use constrains of the city's street network have been developed. (Del Bo and Bignami eds. 2014)

Pakistan as a whole is an energy-deficient country and per capita electricity generation has traditionally been low. The electricity demand in the country has grown at a rapid pace since 1985. The consumption grew at a rate of 11% during 1985-99, the growth rate slowed down to 6.9% during 1990-95 and 2.5% during 1996-2000. Since the year 2000 however, the trend has reversed and electricity demand has picked up, mirroring the overall economic growth in the country. (NEPRA 2005).

The Multan Electric Power Company (MEPCO) is planning to undertake the 6th Secondary Transmission and Grid (STG) and Energy Loss Reduction (ELR) project in various parts of its territory. MEPCO is seeking finances from the World Bank for a portion of the 5-year project. In line with the prevailing legislation in the country, and WB safeguard policies, an environmental and social impact assessment (EISA) of the project has been carried out.

2. LITRETURE REVIEW

2.1 Land use planning, policy and regulations

A town's Landuse profile represents the relationship between human activities and spatial uses. This is vital to better urban planning. Like elsewhere, landuse pattern in Multan is influenced by economic factors, resident mobility, and changes / adjustments occurring in the dynamic urban scene.

The same as all urban areas, landuse pattern in Multan is also a reflection of two elements;

1) Nature of landuses and their location, and
2) level of spatial accumulation

Which specifies their intensity and concentration. Central areas have a high level of spatial accumulation and corresponding intensity of landuses, while peripheral areas have lower levels of accumulation. (Yuen and Choi 2012)

A key for understanding urban entities like Multan lies in the analysis of patterns and processes of the landuse system. This system is highly complex and involves several relationships between the transport system, spatial interactions and landuse:

Transport system: Considers the set of transport infrastructures and modes that are supporting urban movements of passengers and freight. Generally specifies accessibility level. Landuse is the most stable component of urban dynamics, as changes are likely to alter the structure of the landuse over a rather long time. Landuse's main impact on the urban dynamics is its function as a generator and movement attractor (Manzoor et al. 2019).

There is no 'standardized' land-use distribution of the activities in any existing urban area. The proportions and forms of urban scape arise from the socio-economic forces of past and present. The market processes have a strong omnipresent power, and therefore the scope of planned interventions in the pattern of urban land use must be understood. Following is an analysis of landuse distribution in Multan:

2.1.1 Landuse at district level : Policy concerns

What will a Multan District proper Landuse Strategy be? It is a fundamental question for the district's orderly growth and unnecessary change of agricultural land for urbanization. There is a well-known trend in the country, which is understandable, to place more emphasis on 'new schemes.' There is money in that for the private sector. The Government is investing in these projects to establish growth symbols. Multan's urban growth is characterized by dispersion of residential, commercial and industrial developments at the City's periphery and adjoining rural areas. The City is expanding with low density linear growth (NESPAK 2012). The urban expansion is largely taking place because of housing schemes, indigenous unplanned residential growth due to population spill-over from inner city, and industrial expansion along inter-city radials and on the trapped agricultural land between these roads.

Thus primary landuse concerns may be itemized as below:

A) Conversion of Prime Agricultural Land

Conversion of District's prime agricultural land for urban use should be a major policy issue for the Government of the City District. There are persistent questions about these adjustments regarding the agricultural sector's productive potential and economic viability. Natural resource carrying capacity is limited, and there is already severe food shortages and depletion of resources.

These landuse transitions, aside from the decreased agricultural productivity, can have negative effects on urbanized areas. Impacts range from overfishing of freshwater supplies, pollution of freshwater from private septic systems and pollution from industrial and commercial sources (NESPAK 2012).

B) Sprawl of Urban Settlements in the District

The urbanized area within the jurisdiction of MDA was about 12,500 acres in 1986, which has increased to about 31,000 acres in 2008, implying that Multan's urbanized area expanded at an average rate of about 2.3 acres or about 18.5 kanals per day during the stated period. The City District Government, Town Municipal Administrations and Multan Development Authority should be concerned about the impacts of unscrupulous urbanization. There is a strong need to balance urban and rural growth, and to track unregulated developments and their negative impacts (NESPAK 2012).

C) Landuse Conflicts

There are significant conflicts in the District as a whole, as well as within the Urban Area, due to the non-compatibility of landuses and their management problems. In addition, rapid population growth and demand for services outstripped even the most basic infrastructure needs, such as drinking water supply, sewage disposal and treatment, and general education and health care facilities (Yuen and Choi 2012).

2.1.2 Airport Landuse planning

Reference to the studies there are many problems in airport planning in Pakistan and two categories of risks is really serious. i) landuses that put too many people on the ground in a harm's way including dense residential housing, subdivision or gathering place like sport stadiums, etc. ii) air space obstructions such as tall buildings and towers and uses that interfere with actual aircraft flight or may distract pilots. Unappropriated landuse planning in vicinity of airport paves the ground for conditions that create risks of injury to people on the ground and damage to property (International et al., n.d.). On 22 May 2020, the Pakistan International Airlines (PIA) flight crashed in the southern Pakistani city of Karachi which at least 97 people have been killed. The flight from Lahore was carrying 99 passengers and crew members in total 97 bodies recovered, 2 passengers survived and 25 houses were severely affected "Pakistan plane crash" (CNN, 2020).

2.2 Urbanization and Urban Sustainability Indicators

In last decades, people started to move quickly to urban areas. Small volume, only 10% of the world's population lived in urban areas in 1900; now, that percentage surpasses 50%, which will rise to 69% by 2050. While only 3% of the world surface is covered with cities and responsible for 75% using of world energy, 60% use of residential water, 80% emissions of greenhouse gases and 76% use of wood for industrial purpose. In addition, competition among the people for resources also triggers the socio-economic problem like public safety, increasing unemployment, social segregation and crime rate that affect the urban quality of life (Ghalib, Qadir, and Ahmad 2017). Such challenges are the obstacles to sustainable development in which adequate preparation, checks and balances have not been applied properly. From this viewpoint, urban center sustainability needs to be taken as an essential phase in both the research and policy arenas.

Sustainability is a dynamic and multi-dimensional process that takes into account different components of local, regional and global development like environmental quality, economic growth and well-being of the population. Sustainability has traditionally been recognized as having three dimensions, or three pillars: social, cultural, and climate, which are also known as the triple bottom

line. While environmental sustainability concerns decision-making on the protection of the natural environment, economic sustainability aims to use resources efficiently and wisely, and make long-term benefits reliable. (Chaudhry, Malik, and Imran 2006) Pakistan is a developing countries and it economy based upon the agriculture and now gradually shifting to words industrial development. Alam et al., reported that the rapid growing population, urban expansion, increasing demand for the energy and the environmental problems are the major constraints in the economic development. There is limited information about the magnitude of Pakistan's cities' environmental, social, and economic problems. Hence this study focuses on sustainability assessment in five Punjab cities, specifically Multan.

2.2.1 Sustainability Indicator Trends for Multan City of Punjab

Environmental dimension indicators showed that the concentration of arsenic and fluoride in drinking water, fecal coliform concentration, and solid waste production was rapidly increased in Multan urbanization rates, which have strongly negative environmental impacts. The increase of urbanization and industries contributed to a decrease in green resources, due to which CO, SO2 and NO2 concentrations were increased in the atmosphere, causing respiratory problems in humans. Indicators, including the percentage of population currently working, the proportion of population with internet, the proportion of population with electricity, the proportion of population with gas in Multan and other respective Punjab cities showed that trends.(Housing et al. 2018).

2.2.2 Sub-Index and Urban Sustainability Index for Multan City of Punjab

A) Environmental Sub-Index of Multan and four other cities

Figure 1 shows the environmental aspect of urban sustainability among the five Punjab towns, indicated that Lahore ranked as moderately sustainable (0.57; Level II) in 2004, rose to 0.62 in 2005 then gradually declined to its ebb (0.38; Level III) in 2014. Faisalabad was categorized as moderately sustainable (0.61; Level II) in 2004 then decayed after 2008 to poorly sustainable (0.37; Level III) in 2014. However, Gujranwala demonstrated 0.62 (Level II) in 2005, and then after ten years in 2014 attained (0.32; Level III). While Multan was moderately sustainable with the value of 0.64 and 0.58 (level II) in 2005 and 2007, this gradually decreased to poorly sustainable (0.27; Level III) in 2014. Moreover, Rawalpindi scored 0.55 (Level II) in 2004 with little variation in eleven years, and decreased to 0.39 in 2014. In 2014, all cities, namely Multan, Faisalabad, Gujranwala, Rawalpindi and Lahore, showed low environmental sustainability in comparison with 2004 (Ghalib, Qadir, and Ahmad 2017).

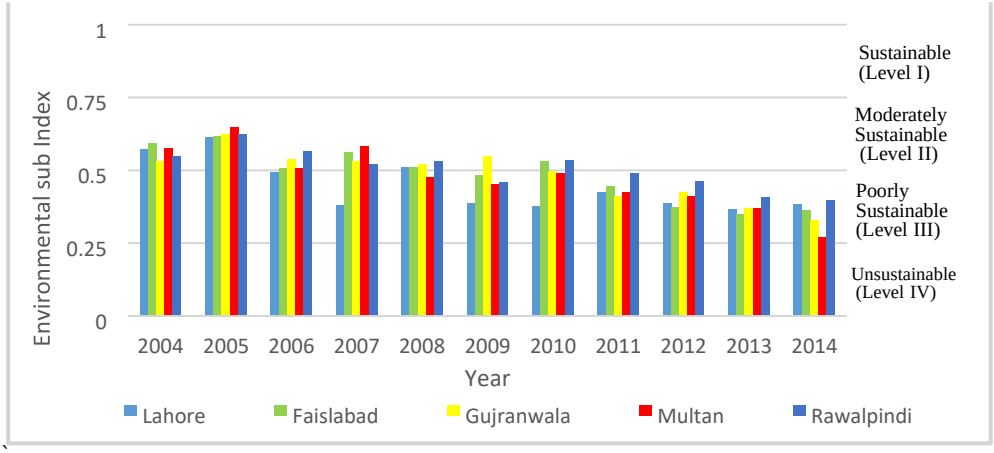


Figure 1. Trend of the environmental dimension (sub-index) for five Punjab cities, Pakistan.

B) Social Sub-Index of the Cities

Figure 2 displays the social aspects of cities from the years 2004 to 2014. In 2004, the social dimension of sustainability of Lahore recorded as 0.41 (Level III), which decreased to lowest (0.31) in 2008 then gradually improved and reached highest (0.59; level II) in 2014. In the case of Faisalabad, the lowest value of the social dimension sub index was recorded as (0.46; Level III) in 2004 then gradually improved to its highest value (0.54; Level II) in 2014. However, in Gujranwala city, it was ranked as Level II (0.55), in 2004, and then declined to the ebb (0.43; Level III) in 2014. Multan scored (0.47; Level II) in 2004 and attained highest level in 2005 to 2011 then declined to lowest (0.42; Level II) in 2014. Similarly, Rawalpindi attained (0.51; Level III) in 2004, increased to highest (0.57; Level II) in 2011 then declined to 0.43 in 2014 (Level III). Among these cities Faisalabad and Lahore showed little social progress while other cities exhibited a decreasing trend. (Ghalib, Qadir, and Ahmad 2017)

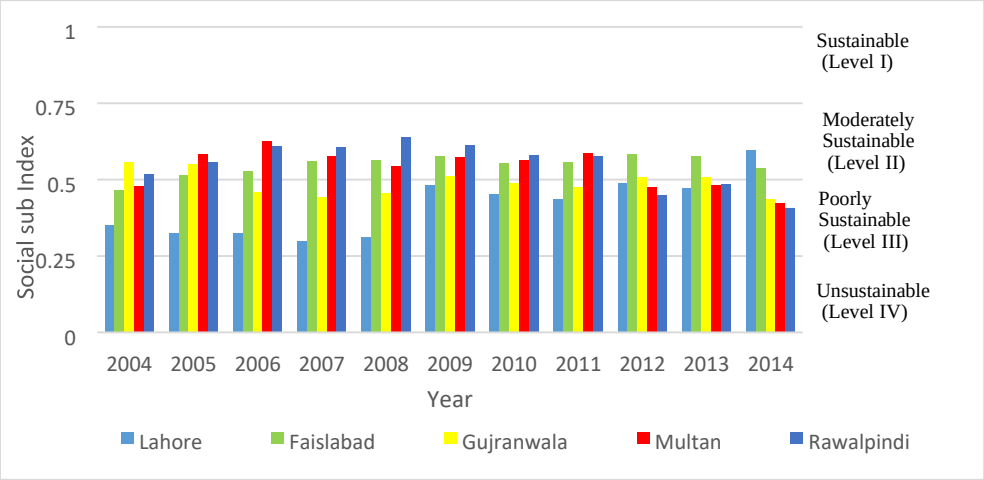


Figure 2. Trend of the social dimension (sub-index) for the five cities of Punjab, Pakistan.

C) Economic Sub-Index of the Cities

The trend in economic growth is shown in Figure 3. An increasing trend in economic dimension of sustainability of Lahore was observed from 2004 (0.30; Level III) to 2014, where it achieved 0.62 (Level II). A similar trend was observed in the case of Faisalabad, with the lowest score (0.37; Level III) in 2004 and highest (0.59; Level II) in 2014. However, Gujranwala was at (0.32 Level III) in 2004, with tremendous progress, showing an increasing trend (0.67; Level II) in 2014. In contrary to other cities, Multan demonstrated negative economic growth from 2004 (0.52; Level II) and decreased to lowest (0.48 Level III) in 2014. Moreover, Rawalpindi showed weak economic dimensions was at (0.32; Level III) in 2004, whereas, 2014 has get rise it achieved moderate (0.63; Level II) in 2014. All cities: Lahore, Faisalabad, Gujranwala and Rawalpindi showed increasing trends followed by Multan (Ghalib, Qadir, and Ahmad 2017).

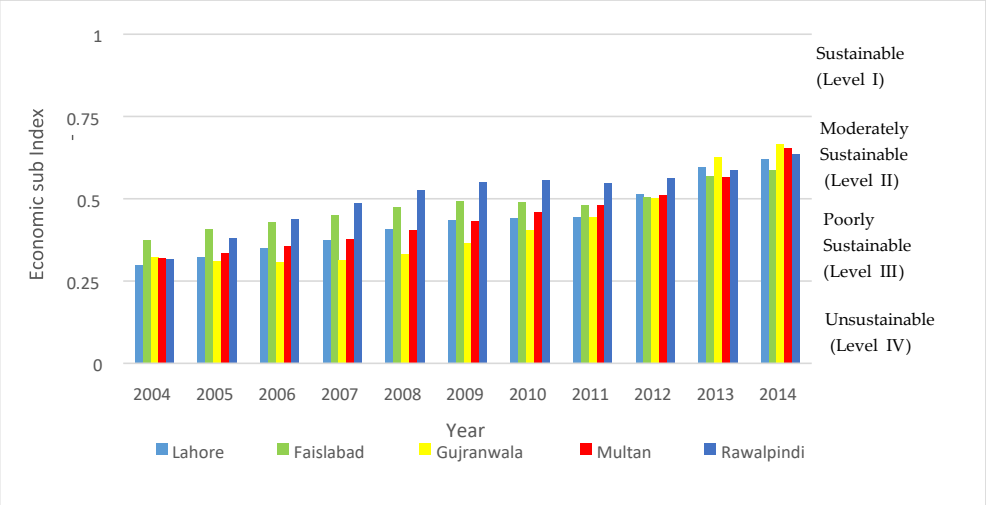


Figure 3. Trend of the economic dimension (sub-index) for the five cities of Punjab, Pakistan.

D) Urban Sustainability Index

Most of the Punjab cities, like Multan, are rising rapidly, so sustainable urban growth in Punjab is very important. The urban sustainability index was calculated as: Lahore (0.52, moderately sustainable), Faisalabad (0.52, moderately sustainable), Multan (0.41; poorly sustainable) and Gujranwala (0.47; poorly sustainable) and Rawalpindi (0.48; poorly sustainable). None of the cities achieved a sustainable level of 0.75 or above. Lahore and Faisalabad attained moderate levels, while Gujranwala, Rawalpindi and Multan fit into the weak category of sustainability (Figure 4).

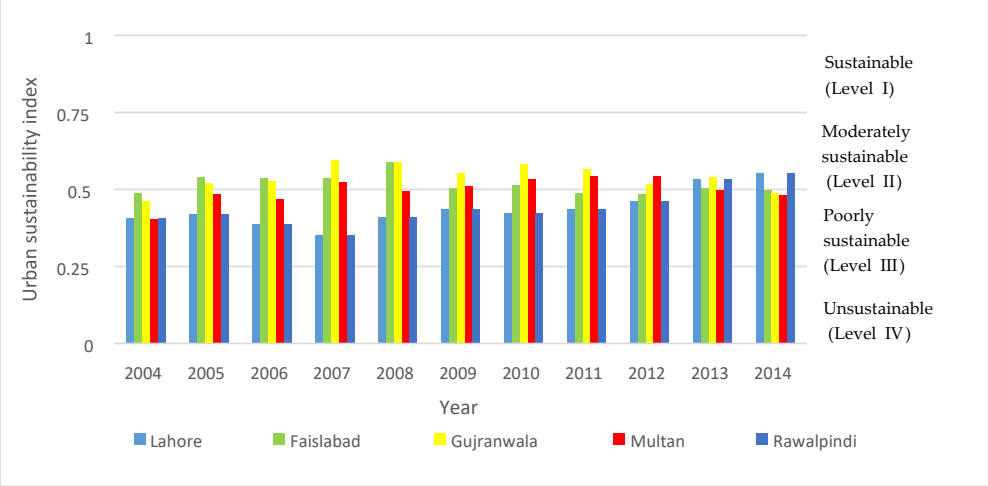


Figure 4. Trend of urban sustainability index for the five cities of Punjab, Pakistan.

Principal Component Analysis identified as major contributors the first four Principal Components and explained the maximum variations within the data set. The first main component relates to urban infrastructure indicators and socio-economic factors. Urbanization and air and water pollution were associated with the second main component. The third main component exhibited correlation with the people and services. (Ghalib, Qadir, and Ahmad 2017).

2.2.3 Urban Transport

Demand for motorized urban transportation facilities has grown enormously in all expanding cities in Multan and other Punjab cities. With some exceptions, the current public transport consists of low-quality buses, mini-busses, wagons, and individual operator-owned vans. The use of private motorized transport on urban roads is on the increase due to lack of quality public transport. Traffic in large cities is estimated to increase by 12% per year compared to the national average of 8%. Car ownership rose from 6 cars per thousand people in 1998 to 13 in 2009. About 12 million trips are made on a usual weekday in Lahore, out of which 8.3 million are on motorized forms of transport. (Housing et al. 2018)

One of the most important sectors facing significant challenges due to rapid urbanization and motorization is urban transport in Multan. Current public transport services suffer from inappropriate timetables of operation, inefficient use of road space and poor condition of public transport facilities (including bus and bus terminals) due to the lack of proper government regulations. Nevertheless, the government is bent upon to increase the transport network in urban areas of Punjab especially in big cities (Yasin, Sattar, and Faiz 2012).

2.3 Watershed hydrology and management

In addition to a large number of infrastructures, millions of people have been affected, either damaged or destroyed as a result of severe flooding in Punjab cities, especially in the Multan district, over the last few decades. The strong monsoon rains in 2014 triggered flash floods in eastern river catchment areas (Chenab, Ravi, Sutlej and Jhelum). The rain-hit areas in various districts of the province damaging community physical infrastructure as well as bringing destruction to private housing and agriculture. The causes of destruction can be classified into two categories in terms of their impact i.e. (a) Flood- affected and (b) Rain-affected. In Punjab, the floods affected seventeen districts, and twelve additional districts also suffered severe damage due to heavy rainfall leading to destruction of flash-causing catchment areas.

2.3.1 The Irrigation Component

The irrigation portion in Punjab Districts focuses on the reconstruction and upgrade of damaged irrigation, drainage and flood protection schemes, including upgrade priority flood protection schemes to multi-hazard resilience levels in the flood-affected districts of Punjab. The list of irrigation and flood management schemes include many subprojects of emergent rehabilitation works, 30% subprojects under critical rehabilitation/reconstruction works and another 30% subprojects of inescapable works involving remodeling of flood protection bunds in Punjab. (Due, Report, and Bunds 2016)

2.3.2 Necessity of Akbar and Nawabpur Flood Bund

One of the sub-projects to be implemented is the Remodeling of the Akbar and Nawabpur Flood Protection Bund. The Nawabpur flood bund is continuation of the Chenab flood bund, while the Akbar flood bund is continuation of the Nawabpur flood bund, these flood bundles were built on the left bank to test River Chenab's spill into Multan City and neighboring residential areas. The

J-Head Spur was constructed during 2005-06 by extending guide bank head Spur at RD 0+920 of Nawabpur Flood Bund. During flood 2014 about 6.50 to 7.00 lac Cs discharge passed Nawabpur flood bund and J-Head Spur were affected partially. To protect the fertile land from the fierce River action the safety measures are required to remodel and strengthen of Akbar and Nawabpur flood bunds along with J-Head Spur (Due, Report, and Bunds 2016).

2.3.3 Akbar and Nawabpur Flood Protection Bund

Multan City is one of the major cities in the province of Punjab that has always remained under pressure from the Chenab River floods. The Nawabpur Flood Bund is a continuation of the Chenab Flood Bund and the Akbar Flood Bund is an extension of the Nawabpur Flood Bund established on the left bank to test the spill of the Chenab River into Multan City and adjacent residues. Keeping in view of flood intensity during flood 2014, the protection measures are required to strengthen the both flood protection bunds and J-Head Spur (Manzoor et al. 2019).

2.4 Site Planning Techniques and Traffic Analysis

Urban mobility offers the center of Multan City a distinctive opportunity to ensure growth and fundamental change in the quality of urban life. The conventional approach to transport planning generally only aims at solving technological issues, finding solutions within its own discipline, but on the contrary, we argue that transport planning is an integrated discipline within town planning. The quick increase of family's income leads to a physiological increase in the use of private vehicle: to control this issue it is necessary to develop an adequate, effective, modern, and high-quality public transport network and to limit the uncontrolled growth of road infrastructure. There are many recent examples, such as Delhi (India) or Bogota´ (Colombia), among others, that show the effectiveness of similar interventions. We propose site planning that consists of three steps:

1) A cognitive and qualitative analysis of the project area
2) Analysis of the existing transportation system, and
3) An implementation strategy divided in different phases (short, medium, and long term)

For each scenario numerous design solutions and use constrains of the city's street network have been developed. Our study also aims to characterize Multan's roads and squares for achieving rebalanced urban space, multifunctional and multidimensional spaces not just only for motorized traffic (Del Bo and Bignami eds. 2014).

2.4.1 Current Situation and Critical Aspects

Cities all over the world are expanding rapidly. Over 50 per cent of the world 's population will live in urban agglomerations by 2025 (Kaltheier Ralf 2002), according to UN estimates. The transport situation in most cities is catastrophic, particularly in developing countries due to the negative impacts of urban economic growth. The increasing need for mobility thanks to a rising local economy. Sustainable revitalization cannot be separated from the resolution of problems described below, mainly with regard to the restructuring of micro- and macro-urban issues, the reduction of traffic and the redesign of certain roads , public transport and the assessment and analysis of the potential development of productive activities in the Multan district (Due, Report, and Bunds 2016).

The district of Multan, with a population inhabitants 1.8 M/in. (only for the MDA area), (NESPAK 2009a). The road network around the Walled City is suffering from the consequences of an increasing demand for mobility not being met by adequate infrastructure systems and services. In order to improve the roadway network capacity, the most important interventions need to be made on infrastructures.

2.4.2 Mobility Demand and Transportation Supply in Multan City

Reference to the data given by a Multan operator office we have been elaborated a better understand the modal share of the city. For a better comparative analysis the number of registered vehicles has been converted to equivalent Passenger Car Units (PCUs). The current fleet that circulates daily consists mainly of 575,000 motorcycles corresponding to 77 % of vehicles operating, out of a total of 745,000. The component of cars is currently limited to 82,000 vehicles equal to 11 %. If we consider equivalent vehicles in order to compare the different modes of transportation, the component of the motorcycles goes down to 53 %.

From the above data the following considerations can be extracted:

- Motorcycles represent 78 % of the vehicles and 36 % of equivalent Passenger Car Units.
- Public transport vehicles (busses, mini busses, motor cab rickshaws, motorcycle rickshaws and motor cab taxis) represent 2.7% of vehicles in circulation and 4.5% of equivalent vehicles. In short, in terms of equivalent vehicles, public trans-port is absolutely marginal regarding the rest of the road network to equivalent Passenger Car Units (PCUs).
- Given a medium average car occupancy of at least 1.8 individuals, and given that peak hours represent at least 12 % of mobility demand, we can deduce that during rush hours at least 104,000 individuals are in transit. An important part of this traffic is concentrated in the city center of Multan as incoming and outgoing flows.
- To sum up, public transport equivalent PCUs constitute 4.5 percent of the total number of vehicles and meet at least 38 percent of the demand for mobility. It reflects a large amount of overall demand at present, without taking into account the quality of the service.

The current road network and the morphology of the historic center of Multan is in no way capable of absorbing changes without significant urban planning interventions and in particular upgrades in the public transit sector (Del Bo and Bignami eds. 2014).

2.4.3 Reference Scenario by Multan Development Authority

The urban plan report (Multan Master Plan 2008–2028 prepared by Nespak) estimates a population growth forecast for 2020 at 2,570,000 in the MDA area arriving at 5,480,000 for the entire district (NESPAK 2009a). The key policy developed to strengthen the transport infrastructure is focused solely on changes to the road network. As far as long-term planning is concerned, the most important work will be to complete a new highway connecting Lahore and Karachi through Multan through a new bypass outside the urban area. As for the public transportation system, new regional bus terminals are proposed (Mughal 2019).

The land use punctually described in the Multan Master Plan shows the current distribution of major (public / private) functions and population density in urban Multan, basic elements for understanding the demand for mobility, and the distribution for daily trips. The highest population density lies within or in areas immediately adjacent to the Walled City. The highest concentration of industrial areas is located south especially along Sher Shah Road and Multan bypass. The large industrial fertilizer factories are located in the northeast (Del Bo and Bignami eds. 2014).

The health services are spread uniformly in the city with a higher concentration in the northwest (between the Walled City and the airport) where there are many clinics and hospitals. With this city configuration and without the delocalization of major traffic generators (with a better public function distribution in each city neighborhood), the pressure of mobility demand will be destined, in the next few years, to increase more rapidly.

2.4.4 Reference Scenario by Multan Development Authority

We analyzed exemplary cases of cities in developing countries where mobility issues were resolved successfully. The most interesting example is Delhi's because of its index of motorization and strong cultural similarities to Multan's. If we take Delhi's main data (population 16,753,000, density 11,297 in./ km2, motorization index 50 cars per 1,000 persons, 74 motorcycles per 1,000 persons) and compare it with that of Multan (density 4,933 in./km2, 21 cars per 1,000 persons, 74 motorcycles per 1,000 persons), the motorization systems back- ground is very similar (Carlos et al. 2008).

In Delhi the composition of the population is much more heterogeneous, and this mix is reflected in the heterogeneous use of street space. Delhi's roads have cars, hand carts, cycle rickshaws, a very high proportion of motorcycles, and three-wheeled scooter taxis to cater for. Between 1951 and 1961, the population of Delhi increased from 1.7 to 2.7 million (Pendakur 2002). The rapid increase and the trend in urbanization and its associated problems were intended to be tackled by the development of a Regional Master Plan for Delhi. Public transport networks and land-use patterns were reviewed to complement the plan. The idea of the introduction of a BRT system (bus rapid transit) began in 1996.



Figure. 5: Delhi: before and after the introduction of BRT system

By September 2002, a detailed design project for the first corridor was ready, the first lane opened in 2008, and 16 corridors (310 km) were planned for the next 10 years. In 2002, the first line of the MRT was opened to public use; ever since, six other MRT lines were implemented in the urban area and are operational (2012) (Carlos et al. 2008) (Fig. 5).

Another model of a successful mobility program is that of Bogotá City, where safe dedicated lanes were provided for cyclists and pedestrians, separated from those of motor vehicles, thereby improving the quality of urban public spaces and structuring a sustainable mobility network; all of this has resulted in significant economic benefits as well as the restoration of social dignity in places and places.

2.5 Social and Environmental Impact Assessment

The Multan Electric Power Company (MEPCO) aims to undertake the project Sixth Secondary Transmission and Grid (STG) and Energy Loss Reduction (ELR) in various parts of its territory. MEPCO is seeking World Bank (WB) support for a portion of this 5-year project. In line with the prevailing legislation in the country, and WB safeguard policies, an environmental and social impact

assessment (ESA) of the project has been carried out. This study presents the report of the assessment (Project, Electric, and Company 2006).

2.5.1 Study Methodology and Legislative Framework

The present study was conducted using a standard methodology prescribed by national and international agencies. Various phases of the study included screening, scoping, data collection and compilation, stakeholder consultation, impact assessment, and report compilation.

The Pakistan Environmental Protection Act, 1997 (PEPA 1997) requires the promoters of any construction project in the country to perform an environmental assessment and to send its report to the appropriate environmental protection authority. In addition, the World Bank Operational Policy 4.01 (OP 4.01) requires that environmental and social assessment be carried out before commencing projects such as the 6th STG and ELR. The OP 4.12 specifies the procedure that needs to be followed to address the involuntary resettlement the project would cause. The WB's other relevant safeguard policies include OP 4.36 (Forestry), OP 4.04 (Natural Habitat), OP 4.10 (Indigenous People), OP 4.11 (Cultural Property) and OP 7.60 (Projects in Disputed Areas). However, the ESA concludes that none of these OPs are triggered.

2.5.2 Description of the Environment

The project region lies in the Upper Indus Plain, which largely forms Indo-Gangetic Plain 's western expanse. The Indus Plain is composed of the silt carried by the Indus and its many tributaries (Road and Gulberg 2015).

Farming is by far the main economic activity in the project area which lies within the irrigation system of the Indus Basin. The mining of groundwater improves the area's canal supply for irrigation. The project area can be ecologically divided into three large Eco zones: tropical thorn forest Eco zone, riverine forest Eco zone, and desert habitat. Administratively, the project area falls under thirteen districts of the Punjab Province: Multan, Sahiwal, Khanewal, Vehari, Pakpattan, Bahawalnagar, Layyah, Muzaffargarh, Dera Ghazi Khan, Rajanpur, Lodhran, Bahawalpur and Rahim Yar Khan.

2.5.3 Impact Assessment and Mitigation

Potential social and environmental impacts of the project were identified during the present ESIA. Thereafter, each defined impact was described in terms of its existence, reversibility, geo-extent, consequence-severity and likelihood. The impacts were then assessed as of high, medium or low significance based on this specification (Series 2003).

The ESIA revealed that most of the impacts of the proposed project were confined to the construction phase and temporary in nature. Appropriate control and housekeeping measures recommended in the ESIA and it would address these issues adequately. The primary social problems defined and evaluated as outlined above included land purchase, crops damaged and hazards to health. The ESIA has recommended that the land for the grid stations be purchased directly from the owners on the basis of a willing seller – a willing buyer, at mutually acceptable market price. It will be ensured that the seller has the right of refusal. Furthermore, the entire process will be documented. The project will purchase a total of about 20 acres of land in this manner. (Study et al. 2017) To mitigate the damage crops – caused by the transmission line construction activities – compensation should be paid to the landowners/cultivators. The ESIA has estimated that crops would be damaged over a total of 1,339 acres of land belonging to 669 landowners/cultivators. The related amount of compensation has been valued at around Rs.9.6 million. Finally, precautionary steps have been included in the ESA to resolve the safety issues associated with the construction activities and the possibility of electrocution (Project, Electric, and Company 2006).

The key environmental impacts of the proposed project as identified in the ESIA included soil erosion and degradation and water contamination. The soil erosion would be caused by the grid station and transmission line construction activities, particularly in the hilly terrain of the project area. The correct design and construction methods used during the planned project would resolve these concerns. Inappropriate waste disposal and leakage / spillage of oils and chemicals may cause pollution of the soil and water.

3. METHODOLOGY

National Engineering Services Pakistan (NESPAK 2012) released the result of their survey for Multan in 2012. They raise that landuse pattern in Multan city, like elsewhere, is controlled by economic forces, mobility of residents and changes/adjustments that occur in the dynamic urban scene. In addition (Adeel, Yeh, and Feng 2016) performed a study related to landuse change based on the primary and secondary data. In December 2014, he gathered the primary data through field surveys based on GPS. He also overlaid the field data freely accessible on the online street map via ArcGIS for GIS based buffer analysis by ESRI. Their landuse survey was conducted over the city's most developed area, spread over 362 square kilometres. The information gained from landuse surveys has been fed into GIS.

For the urban sustainability of Multan, (Ghalib, Qadir, and Ahmad 2017) has developed the construction of Urban Sustainability Index. To develop the urban sustainability index, they had considered a set of indicators based upon environmental, social and economic parameters. The procedure of calculating the index has been carried out by following the various steps which are shown in Figure 6.

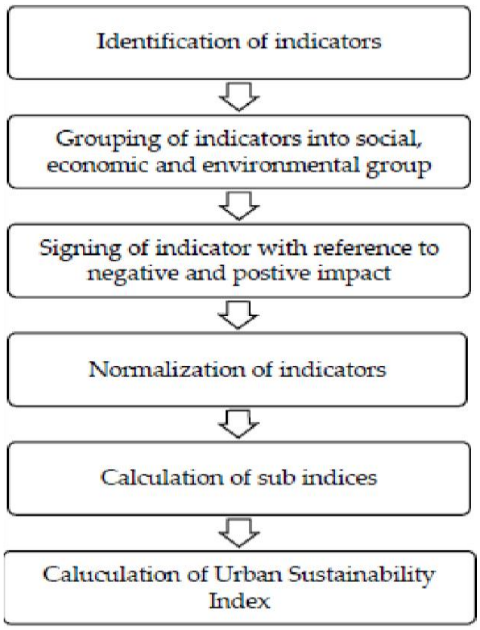


Figure 6. Procedure of calculating urban sustainability index.

They conducted an indicator framework for the cities of Punjab which was determined by accessing the data from 2004 to 2014, and were extracted from different sources, i.e., District census reports of Punjab (Punjab Development Statistics 2004–2014); Pakistan social and living standards measurement (PSLM 2004–2014); Multiple indicator cluster survey for Punjab (MICS) and Compendium of Environmental statistics. Missing data was managed using an ad hoc method. Some data were gathered from departments, i.e., Punjab Health Department, Punjab Environmental Protection Departments, The Urban Unit, Punjab Industries, Commerce and Investment Department and Lahore Waste Management Company.

The irrigation component in Punjab (Due, Report, and Bunds 2016) described a review of Multan watershed and hydrology management. They concentrated on the remodeling of the Akbar and Nawabpur Flood Protection Bunds, their revision carried out the reconstruction and upgrade of damaged irrigation, drainage and flood protection schemes, including the upgrade to multi-hazard resilience levels of priority flood protection schemes in the flood-affected districts of Punjab. For a better understanding of the temporal changes in the watershed landuse, (Asharf et al. 2014) used satellite image data of LANDSAT-5 TM (period 1992) and LANDSAT-7 ETM+ (2010 period) (Path-Row: 150-37) with spatial resolution of 30m. He used the basic input data for SWAT 2005 model were digital elevation model (DEM), hydrology, soil and landuse distribution extracted from image data. Also another study was done by Shahid et al., (2020) in Multan. He used Hydrologic Engineering Centre Hydrological Modelling System (HEC-HMS) is the rainfall-runoff semi-distributed hydrological model, which uses empirical techniques to convert the rainfall to runoff volume to assess the impact of land use and climate changes. HEC-HMS hydrographs are used independently or in conjunction with other instruments to research land use land cover, flood prediction or urbanization effects on flood severity, flood risk management, and flood control.

The Pakistan Environmental Protection Act, 1997 (PEPA 1997) requires the proponents of every development project in the country to conduct an environmental assessment and submit its report to the relevant environmental protection agency. In addition, the World Bank Operational Policy 4.01 (OP 4.01) requires that environmental and social assessment be carried out before commencing projects. The OP 4.12 specifies the procedure that needs to be followed to address the involuntary resettlement the project would cause. The present research carried out an Environmental and Social Impact Assessment (ESIA) using a common approach recommended by national and international agencies. The study's various stages included screening, scoping, data collection and compilation, stakeholder consultation, impact assessment, and compilation of reports.

4. DISCUSSION AND RECOMMENDATIONS

For the Landuse Planning in Multan city there are different problems, some identified above, have erupted because of flawed landuse policy that lacks incentives or regulatory controls to revitalize residential, commercial and industrial landuses in established urban area or close to it. Some possible measures to rectify the situation may include the following:

Revitalize Old City: Vibrant and economically viable entities is needed to restore the old city. The demand for additional land can be reduced by reinvesting in the Old City.

Re-Develop Abandoned Sites: The vacant sites within urban area, including abandoned sites of Old Vegetable & Fruit Market, and other underutilized properties should be redeveloped.

Emphasize Urban Renewal and Slum Upgrading: The goal to optimize expansion can be accomplished by reviving the functionality of the built-up area.

In addition, for airports the greatest risk of an aviation-related accident is during take-off and landing within a few miles of an airport, particularly in areas closest to the ends of the runway and the runway centreline extended. If there are few structures in this area, pilots can avoid, the risk to both people on the ground and in the airplane is reduced significantly. As described, 25 houses were affected in the Karachi airplane crash, and reportedly at least 11 people from the houses' residents were injured. In areas where aviation accidents are more likely to occur, especially off the ends of runways, the primary way to reduce the risk of damage and personal injury is very easy, limited population and building density.

A good regulatory approach is to ban certain high-density residential uses and places of public assembly in airport approach corridors (i.e., Safety Zones A and B) that, by their very character, attract or house large crowds of people at once (e.g. a sports stadium or church) or exceeding a specified population density per acre. For example, a residential development in Zone B would not be permitted with a density of one dwelling unit per acre.

In addition, for the urbanization and transport, cities are the centers of economic, administrative and cultural activities which are governed by some regulatory authorities. The urban sustainability index for Lahore, Faisalabad has attained a moderate level, whereas, Gujranwala, Rawalpindi and Multan have a weak level of urban sustainability. While all five measured cities have succeeded in achieving sustainable urban growth, economic dimensions make major positive contributions to overall urban sustainability; however, the decrease in natural resources and environmental degradation have had a negative effect on overall urban sustainable development. Therefore, it is suggested to take some concrete steps for environmental protection and management in Punjab.

There are several reasons for the low scoring of urban sustainability in major cities of the Punjab particularly Multan. In Multan there are several factors responsible for this growing challenge such as high population growth rate, industrial growth, migrations, and employment and socio-political factors. In this regards, a regular monitoring required for the social and political situation because improved socio political situation can lead the cities to words sustainability.

Regarding watershed hydrology and management, Multan city is one of the big cities in Punjab Province which always remained under threat to floods in the Chenab River. Nawabpur flood bund is a continuation of Chenab flood bund and Akbar flood bund is an extension of Nawabpur flood bund which were constructed on left bank to check spill of River Chenab to enter Multan city and adjoining residuals. Keeping in view of flood intensity during flood 2014, the protection measures are required to strengthen the both flood protection bunds and J-Head Spur.

On the other hand, for the Site planning techniques there is need to propose a master plan to protect and improve the quality of Multan's well established residential areas. Zonal boundaries have to be clearly delineated to distinguish residential, large-scale commercial, industrial and other landuses in the City. The purpose is to control and direct the use and development of those properties. Primary objective of zoning is to improve the efficiency derived from agglomeration economies, ensure minimum standards of health and safety.
The criteria for earmarking the zones were based on the following characteristics:

- ✓ Physical and Urban Characteristics
- ✓ Predominant landuses
- ✓ Intensity of development
- ✓ Land requirements for urban expansion

Finally , on the basis of the overall impact assessment and, in particular, the existence and extent of the residual environmental and socio-economic impacts found during the current ESIA, it is concluded that the proposed project is unlikely to have any major, permanent effect on the area's social , physical and biological climate, provided that the proposed activities are carried out as mentioned in this report, and the mitigation measures included in this report are completely and effectively implemented. The key recommendations pertaining to the environmental and social assessment of the proposed project are as follows:

- ✓ The Company should follow the RP for addressing the involuntary resettlement issues and to compensate the project affected persons (PAPs).
- ✓ MEPCO will not purchase transformers having PCB-containing oil. However, old transformers in the MEPCO system may still have PCB-containing oil. Therefore, a program should be developed to eliminate the PCB-containing transformer oil from its entire system. To start with, the grid stations and workshops should be provided with the PCB testing kits.

- ✓ In-house environmental and social management capacity should be developed in MEPCO. For this purpose, an Environmental and Social Cell should be established within the company.
- ✓ Every MEPCO should develop its environmental and social policy, demonstrating the commitment of the company to sound environmental and social management practices throughout its operations. MEPCO should adhere to the environmental legislation and regulations, particularly for carrying out environmental and social assessments for all its future projects.

5. CONCLUSION

Landuse profile of a city describes the relationship of human activities and spatial uses. This is essential for better urban planning in general and landuse zoning in particular. Landuse pattern in Multan, like elsewhere, is controlled by economic forces, mobility of residents and changes/adjustments that occur in the dynamic urban scene.

The same as all urban areas, Landuse pattern in Multan is also a reflection of two elements; i) nature of landuses and their location, and ii) level of spatial accumulation, which shows a high level of spatial accumulation and corresponding intensity of landuses, while peripheral areas have lower levels of accumulation. Landuse is the most stable component of urban dynamics, the main impact of landuse on urban dynamics is its function of a generator and attractor of movements.

Urban problems could be assessed through development of indices of urban sustainability on the basis of its three dimensions: environment, economics and social.

The result of the sub-indices indicated that poor performance was evident in the environmental sector, rather than in the economic and social sectors. The cities scored between 0.27 and 0.58 in environmental dimensions, showing a decreasing trend from 2004 to 2014.

Millions of people have been affected, in addition to a large number of infrastructures that have either been damaged or destroyed as a result of severe floods in Punjab Province over the last few decades. Not only did the floods negatively impact land and farmers but they also destroyed the on-farm sources of livelihoods and infrastructure impacted by floods.

The rapid rise in individual income contributes to a physiological increase in the usage of private vehicles: in order to curb this trend, an appropriate, reliable, modern and high-quality public transport network must be built and unregulated growth in road infrastructure limited. In addition to this, along with the new public transport network.

Pakistan as a whole is an energy-deficient country and per capita electricity generation has traditionally been low. The electricity demand in the country has grown at a rapid pace since 1985. The consumption grew at a rate of 11% during 1985-99, the growth rate slowed down to 6.9% during 1990-95 and 2.5% during 1996-2000.

The Multan Electric Power Company (MEPCO) is planning to undertake the 6th Secondary Transmission and Grid (STG) and Energy Loss Reduction (ELR) project in various parts of its territory. MEPCO is seeking finances from the World Bank for a portion of the 5-year project. In line with the prevailing legislation in the country, and WB safeguard policies.

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