AN ASSESSMENT OF SUSTAINABLE URBAN TRANSPORTATION SYSTEM IN PAKISTAN

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Abstract

Transportation system in urban areas of Pakistan is facing issues of sustainability. Transportation sustainability challenges must be processed. The sustainable practices deployment is necessary solution to the increasing traffic. While effectiveness of these sustainable solutions mainly depends on the public awareness and their attitude towards them. This research is conducted to assess the sustainable transportation practices with the awareness level of citizens and how they think about them during their interaction to these solutions. The method of this research is selected as quantitative somehow mixed with the qualitative research. To assess the public attitude questionnaire was developed based on the indicators of the sustainable transportation practices. This questionnaire is spread among the resident of Lahore and Karachi city after evaluating their needs for better and sustainable transportation to overcome increasing urban development. The results show that people have overall positive attitude towards sustainable development.

Keywords: Sustainable Transportation, Urban Transportation, Transportation System, Pakistan

I. Introduction

The urban transportation is getting extremely difficult to plan considering the challenges regarding the environmental sustainability. The development of transportation networks in such a way to ensure the safety on the roads, streets and corridors getting complicated day by day (Litman & Burwell, 2006) [I]. As the continually increasing population of and economic activities impose the pressure on current transportation facilities and demands enlarged transportation infrastructure with greater capacity (Mohan & Tiwari, 1999) [II]. This scenario has already initiated the process of better transportation practices. In Pakistan currently private vehicles as mobility mode caused the city to avoid cycling and pedestrian movement on the roads...
The private vehicles mobility increased the rate of motorization so as the amount of carbon emission to environment (Cervero, 2013) [IV]. This increasing transportation demand and rapid motorization and urbanization in Lahore and Karachi directly impacted sustainable development of city. It is evaluated that GHG emission and energy emission from transportation sector will be doubled by the 2025. However, the social and environmental impacts of increasing transportation is significant threat to the sustainability.

Urban Transportation externalities mitigation demands the alteration of current transportation to sustainable transportation system. The sustainable development in transport sector is the source of sustainable transportation. The sustainable solutions for transportation system include the economic, social and environmental friendly transportation strategies (Pojani & Stead, 2015) [V].

In Pakistan public transport sectors and government, itself is working for sustainable transportation implications. Provincial institutes are currently modifying the urban transportation problems and defining the urban public transport including the public and private bus ownership. In order to meet the transport demand for ever growing urbanization, motorization, population and freight, the congested cities will have no other choice but to consider developing a sustainable transportation system. Having a sustainable transportation system is not just an option but a necessity for Pakistan to meet the growing demand as well as to maintain the quality of living for the city residents.

Population is increasing day by day and availability of inadequate public transportation system has increased the trend of personal vehicle ownership to overcome the demand of mobility. These growing vehicles and motorization overruled current traffic management strategies in Pakistan. This situation combined with the improper transportation planning, vehicle’s inadequate conditions and complex land use accessibility impacted the current transportation systems causing the traffic congestion, fuel consumption, extraordinary traffic delays. This scenario increased the pollution level in major cities of Pakistan and deteriorated the overall environment. To overcome these environmental problems sustainable transportation development is necessary part of the survival in urban areas. So, the adoption of sustainable transportation system in Pakistan has become more important with the increasing population.

II. Objectives and Significance

The research aim of this study is to provide the brief introduction for implementation of sustainable urban transport system in Pakistan

- To investigate the need of sustainable urban transport system in Pakistan
- To assess the awareness of sustainable Transportation System among citizen of Pakistan
- To evaluate the attitude of people towards sustainable transportation practices in congested cities of Pakistan.
This study evaluates the strategies for sustainable transportation system which can be useful for future prediction of transportation condition and can be helpful for planning purpose. Transportation Public sector and planning department can get advantage of this study. This research will directly be proved to be helpful for general public to ensure sustainable transportation system implementation. This research can be beneficial for future research on transportation sustainability in Pakistan.

III. Literature Review

Sustainable Transportation

Defining sustainable transportation is difficult since it is based upon the definitions of sustainable development, for which there are numerous descriptions which have many meanings and implications (Holdren, 1995) [VI].

There is no standard statement that ought to provide the meaning of mobility and sustainable transportation. Sustainability is defined as the portrayal of condition, economy and value (organization) by (Achairi, 2013) [VII]. A sustainable transportation system is one that meets the current transport and mobility needs without compromising the ability of future generations to meet these needs (Black, 2000) [VIII]. Transportation system should utilize renewable resources without exceeding regeneration rate, should use non-renewable resources without exceeding the rate of development of sustainable resources, should emit pollution without exceeding assimilative capacity of the environment (Daly & H.E., 1991) [IX]. Sustainable transport is transportation where the beneficiaries pay their full social costs, including those that would be paid by future generations (Schipper, 1996). According to Centre for Sustainable Transportation Canada (CSTC), a sustainable transport framework, allows the basic needs of individuals and societies to be met safely and in a manner consistent with human and ecosystem health with equity within and between generations. It provides central access and headway needs of individuals, associations and social requests to be met safely, offers choice of transport mode, and support a vibrant economy, limits emissions and waste within the planet’s ability to absorb them, minimizes consumption of non-renewable resources, reuses and recycles its components and minimizes the use of land and production of noise. Mobility report of 2001 defines the sustainable mobility as the ability to meet the needs of the society to move freely, gain access, communicate, trade and establish relationship without losing essential human or ecological values at present and in the future. A sustainable transportation system is that which addresses the general population's issues, i.e. as far as mobility, openness and security inside the accessible or moderate natural, money related and social assets (Akinyemi, 2000) [X]. According to California High-Speed Rail Authority, sustainable transportation is that does not depend on the utilization of non-renewable energy sources.

Sustainability is sometimes defined in a limited sense, for example, biggest ecological risks like air pollution and depletion of resources faced by humanity might be neglected by conventional planning (environment, 1997) [XI]. But sustainability is increasingly defined more broadly to include the issues in Figure 1.
According to Figure 1 every issue fit into a specific category, in practice they often overlap. For example, pollution is an environmental concern, which also affects human health that is a social concern, and fishing and tourism industries which are economic concerns. Narrowly defined sustainability tends to overlook many relationships between issues and opportunities for well-coordinated solutions. For example, some climate change emission reduction strategies may worsen other economic, social and environmental problems, while other strategies provide multiple benefits (Litman, 1999) [XII]. A detailed analysis can take into account these additional impacts, which a narrow analysis overlook. A detailed analysis can identify solutions, which help achieve multiple objectives and are therefore justified regardless of the value assigned to costssuch as global warming.

Present Transportation Scenario
In recent times the urban areas around the world have faced the problem of automobile domination thus leading to lesser sustainability. Developing cities are facing challenges like pollution, congestions, accidents, climate change, energy depletion, decline of public transport, visual intrusion. Some cities are trying to cope up with the situation by reclaiming urban areas from automobiles by prohibiting cars in major downtown areas and other certain areas at rush times. Steps are also being taken to obtain sustainable urban development in transportation sector. Acts like improving public transport, creating pedestrian zones, promoting non-motorized travelling modes and discouraging use of private cars are helping reverse the negative effects caused by automobile dominance. Countries are focusing on areas like road infrastructure, rail-based public transport, road-based public transport, non-motorized travel modes, technological solutions, awareness campaigns, vehicle access restrictions and land use control to achieve sustainable urban development in transport sector. A focus on smaller urban cities i.e. lesser than one million
inhabitants, is important for countries to achieve sustainable urban development because nearly half of the world’s 3.9 billion urban dwellers reside in cities with fewer than 500,000 inhabitants, while only one in eight live in 28 megacities of 10 million inhabitants or more (United Nations, 2011) [XIII].

At present the transport sector accounts for about 25 percent of the total commercial energy consumed worldwide (United Nations Nations Department of Economic and Social Affairs (UNDESA), 2001) [XIV]. In year 2020, the energy demand for transport will grow by approximately 1.5 per cent per year in developed countries and by 3.6 per cent per year in developing countries. The rapid urbanization and suburbanization across much of the world means that an increasing number of people will be living and working in cities. As a result, more goods will be making more trips in urban areas, often over longer distances (United Nations Center for Human Development (UNCHD), 2001) [XV]. The methods by which cities meet the increased demand for urban transport will have dramatic effects on the global environment and the economic productivity of human settlements. As economic growth occurs in developing countries, incomes rise, increasing the demand for travel and the level of automobile ownership, and the trend toward urbanization will continue. As urbanization gradually increases, the process of globalization will move forward, resulting in expected increases in world trade and personal travel. The utilization of non-renewable energy sources to meet this growth in transportation demand is not only unsustainable, since the resources are finite, but is also harmful to public health and the environment. It is because of the emissions of particulate matter like, Carbon Monoxide, NOx, VOCs and greenhouse gases. While technology plays a significant role in reducing the pollution levels at the source, the benefits that technological improvements can offer are likely to be overshadowed by the predicted worldwide growth in transportation (World Business Council for Sustainable Development (WBCSD), 2001) [XVI]. In addition, the increasing noise and land use impacts of transportation combined with growing levels of accidents and congestion represents a significant burden on society and thus adversely affects sustainable development.

Principles of Sustainable Transportation

Institute for Transportation and Development Policy (ITDP) for sustainable transportation proposed eight major principles for sustainable transportation i.e. Walk (Develop neighborhoods that advance walking), Cycle (Prioritize non-mechanized transport systems), Connect (Create thick systems of boulevards and ways), Transit (Locate improvement close to top notch open transport), Mix (Plan for mixed utilize), Densify (Optimize thickness and transit limit), Compact (Create areas with short drives), Shift (Increase portability by controlling stopping and street utilize). Countries around the world are worried about the environmental changes, energy utilization, ecological effects, and points of confinement to money related assets for transportation framework. This requires new ways to deal with outlining arranging, working, building and keeping up transportation arrangements and frameworks (Hill, 2009) [XVII]. It is important to diminish emissions, enhance fuel productivity, advance transit, and enhance activity control, particularly in the industrializing scene (Opdam, 1994) [XVIII]. It is required by the transportation experts to be all the more straightforwardly associated with this due to the dedication done by governments to
create transportation frameworks, which are perfect with this supportable advancement (Zuidgeest, 2000) [XIX]. The rise of sustainable transport in worldwide talks and strategy making on sustainable advancement is a key target for Sustainable, Low Carbon Transport (SLoCaT) and SLoCaT has built up an Outcomes System for Sustainable Transport. Public transport administration and safe foundation for non-mechanized transport, for example, cycling and walking are deficient in most creating nation urban areas (Sayeg P, 2014) [XX]. Methodologies for more road advancement have clearly failed to adjust to reliably growing interest from quick automation, achieving an interminable hover of blockage as appeared in Figure 2 (Buis, 2009) [XXI].

Sustainable Transport System in Pakistan

Due to the urban congestion issues, Pakistan’s largest urban centers, notably Karachi, Lahore and Rawalpindi-Islamabad, have been preparing sustainable transport solutions for a number of years. The city of Karachi has completed several feasibility studies; implementation plans and design drawings for Light Rail Transit (LRT) and Bus Rapid Transit (BRT) systems since 1990 along with international technical assistance from Asian Development Bank (ADB) and Japan International Cooperation Agency. Lahore’s transit situation has been studied several times since 1990 with LRT being a preferred mode for study until this year with a new government being formed. The Punjab Provincial Government wanted to pursue Bus Rapid Transit (BRT) for their mass transit needs. City of Rawalpindi-Islamabad recruited an international consulting firm to develop a master transport plan for twin cities and included designs for mass and bus rapid transit corridors. The 8-month study started in 2009 and assessed current traffic use patterns and identified routes for development of BRT and other traffic management measures. As road freight transport sector contributes heavily to the overall economy of Pakistan, the Government of Pakistan gave the trucking sector a formal industry status in January 2008 and adopted a “Trucking Policy” prepared under the efforts of the Ministry of
Industry Production and Special Initiatives (now known as MoIP) to improve the performance of the sector. The Policy was the combination of a number of assisted initiatives to increase the energy efficiency of commercial vehicle fleets including: The National Trade Corridor Improvement Program (NTCIP) adopted by the Government of Pakistan in 2005 to improve Pakistan’s falling trade transport and logistics infrastructure. The World Bank, ADB and JICA over the years have provided targeted investments into key reforms, infrastructure improvements and operations efficiencies; Fuel Efficiency in the Road Transport Sector (FERTS) was executed by ENERCON and implemented and funded through UNDP-GEF between 1996 and 2005. FERTS conducted a number of studies directed to improving the fuel efficiencies of commercial vehicles including trucks and buses. The CO2 emissions in Pakistan from the transport sector were estimated to be 37.1 million tones CO2 in 2008. By 2020, GHG emissions from the transport sector could be as high as 66.6 million tons CO2 if there are no GHG mitigation interventions in the sector. The in-depth analysis indicated that GHG emissions from the transport sector were already more than 38.6 million tones CO2 in 2009 and were expected to increase by at least 5% every year. This translates into a rise in direct carbon emissions from transport alone to 49.3 million tons annually by 2014 or earlier depending on the growth rate of transport.

PAKSTRAN:

With increasing population and urban centers, a number of issues regarding urban mobility has created challenges to achieve sustainability. Although the number of roads is increasing throughout the country to cope with the increased demand of vehicles but has neglected the concerns of increased travel times and decreased air quality. Increased traffic congestion, high energy consumption and greenhouse gas emissions is causing environmental degradation. As a result, there is a need for the Government and stakeholders to take steps in order to solve the related issues. In this regard the government of Pakistan has joined hands with United Nations Development Program and the Global Environment Facility to achieve sustainability in transport sector of Pakistan. Objectives of the project are:

- Reduce the growth of energy consumption and related greenhouse gas emissions from Pakistan’s transport sector
- Improve the urban environmental conditions and increase Pakistan’s competitiveness

Expected outcomes of PAKSTRAN are:

- Demonstrate international best practices in planning and implementation of integrated urban transport systems
- Strengthen the institutional and policy framework for urban transportation
- Demonstrate international best practices for modernizing the trucking fleet; creating an investment environment with widespread stakeholder acceptance
- Raise public awareness and knowledge of issues in sustainable urban transport and fuel-efficient transport in Pakistan
Lahore BRT:
Lahore Metro Bus was one of the projects under PAKSTRAN. This is a bus rapid transit (BRT) that became operational on February 11, 2013. This BRT is integrated with LTC (Lahore Transport Company) and provide transport service across Lahore from Shahdara to Gajumata through a 27km track.

Orange Line Metro Train Lahore:
This project was initiated with a signed memorandum of understandings between the governments of Pakistan and China in May 2014 to help take further steps towards sustainable transport system in Pakistan. Orange Line Metro train is an automated rapid transit system in Lahore, Pakistan and will be the first metro in Pakistan. The line will span 27.1 km with 25.4 km elevated and 1.72 km underground track. There are 26 stations across the track. This project is part of the China Pakistan Economic Corridor (CPEC). The project is still under construction.

Islamabad Metro Bus:
The Rawalpindi-Islamabad Metrobus is another project under the PAKSTRAN initiative. It is a 22.5 km bus rapid transit system operating between the twin cities of Islamabad and Rawalpindi and connecting the metropolitan areas. The project was operational in June 2015 and stretched 22 kilometers between Pakistan Secretariat, in Islamabad, and Saddarin Rawalpindi. The second stage is currently under construction and stretched 25.6 kilometers between the Peshawar Mor Interchange and New Islamabad International Airport.

Peshawar BRT
In order to address the chaotic traffic and public transport system in Peshawar, the Government of Khyber Pakhtunkhwa along with the technical support from the Cities Development Initiative for Asia in 2013 initiated the project of BRT in Peshawar city. After feasibility studies the project started construction in October 2017. Peshawar Bus Rapid Transit is a bus rapid transit system currently under construction by the Peshawar Development Authority (PDA) in Peshawar. This project is divided into two separate phases, the first phase of the Trans-Peshawar BRT system will encompass an east-west corridor to be served by 31 stations with an initial 255 buses.

Karachi Green Line:
Green line Karachi is a bus rapid transit line project initiated by Government of Pakistan to address the matter of sustainable transport system in Karachi city. The construction of the project was started in 2016 and will consist of a 35km track in its first phase with 37 bus station.

Karachi Orange Line:
Karachi orange line is another project started by Government of Pakistan to address the sustainable transport needs of the city of Karachi. The construction of the project was started in June 2016. This project consists of a 3.9 km bus rapid transit line of the Karachi Metrobus. This orange line project will have the capacity to carry up to 20,00,000 passengers daily.

Karachi Metrobus:
The Karachi Metrobus project was launched in February 2017. This project is also a steppingstone towards the sustainable transport system in Pakistan. It consists of a 112.9 km bus rapid transit network in Karachi. The expected daily ridership is estimated at 350,000 with a total of 109 km of dedicated bus route and upon completion will become the largest metro bus network in Pakistan.
IV. Methodology

Research Design

The study is structured considering the aims and technique to accomplish these targets in this segment. The particular approaches used are the writing study, overviews, and examination thinking about the level of research, sort of research task, looking into center and arrangement of factors. The techniques for research are adopted in perspective on characterizing links between information accumulation and examination and tending to the inquiries or targets and results. This project is designed on the quantitative methods. This quantitative strategy is established to characterize the components for sustainable development and its requirement on demographic behaviors and collecting and analyzing related data. The deductive research approach for this study distinguishes the current transportation system and sustainable transportation system for urban development viewpoint. This deductive methodology decides the variables controlling the execution procedure. The purpose of this research is descriptive and explanatory.

This research is administrated through the questionnaire survey after investigating the appropriate method for this kind of research. After collecting the data, the analysis is performed using the MS Excel and IBM SPSS-23. The analysis includes the reliability analysis, factor analysis, frequency, distribution and characteristics analysis of the respondents and mean comparison analysis for responses. The data analysis and results are further discussed in relevant section.

Survey Sampling

The survey sampling is characterized in sample selection and sample size sections for a brief discussion on the population size and selection of the relative population.

Sample Selection: The sample selection is considered as the crucial part of the research and performed correspondingly for true representative of population. The process of sample selection is clearly reviewed for the statistical summary through the multiple methods of sample selection like judgmental, random and nonrandom sampling. The random and nonrandom sampling techniques are utilized for sample selection.

The sample of the study is selected from a population of the transportation professionals and general public using various transportation modes. These respondents were chosen from the major cities of the country like from (Lahore and Karachi). This population includes different working-class people like engineers, workers, labors, government employees. This population and survey design are based on the random sampling technique.

Sample Size: The sample size for research can also be calculated with this formula (Whitley& Ball, 2002) [XXII].

\[ Sample\ Size = \frac{z^2 \times p (1-p)}{e^2} \]  

Where

- e = Margin of error = +/- 10% or 0.1
- N = Population Size = 26,000,000 (population of Lahore and Karachi)
- p = Percentage of sample = 0.5
z = z-score = 1.96 based on desired confidence level and used 95% confidence level for this research. It is impossible for the researcher to get the sample from whole population so the sample size is selected representing the targeted audience effectively. So, the sample size selected to distribute almost 100 questionnaires randomly to the potential respondents in Pakistan. The location in this sample size are specifically chosen as Lahore and Karachi. Hence the samples cover both major cities. therefore, the data collected depicts reliability.

Survey Design
This research is conducted after considering the opinions from various transportation engineers. The design of questionnaire is adopted to assess the sustainable transportation facilities specifically in Lahore and Karachi from the commuter’s perspective. Before distributing the questionnaire, it was tested on three transportation professionals to ensure that its questions and statements are understandable. The survey adopted for this study is based on mixed mode survey to increase the response rate. Some respondents were interviewed to fill the questionnaire and other questionnaire were filled by spreading via printed questionnaire, Google forms and electronic questionnaire. To enhance the response rate Tailored Design Method formulated by Dillman (2000) [XXIII] utilized and questionnaire developed accordingly. The instructions on questionnaire were mentioned to avoid any ambiguity.

The questionnaire was designed in two parts, the part one is about the general information regarding demographics of the respondents like, gender, age, job sector, city vehicle ownership etc. The other part is designed based on the research related question specific to the study. This 2nd part of questionnaire was based on the five-point Likert scale not simply on the “Yes/No” answers. The concept of using the Likert scale is to investigate the extent of availability of specific sustainable transportation options. The scale used in the questionnaire is depicted in Table below.

| Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree |
|-------------------|----------|---------|-------|----------------|
| 1                  | 2        | 3       | 4     | 5              |

V. Analysis and Results
Demographic Characteristics of Respondents
The demographic characteristics of respondents are depicted based on the demographic data collected from the survey responses. These characteristics includes the gender of respondents, age of respondents, occupation of respondents, education of respondents and their residing city.
Table 1: Summary of Demographic Results

| Parameter     | Unit | Range Min | Range Max | Average |
|---------------|------|-----------|-----------|---------|
| Gender        | %    | 1.64      | 2.62      | 2.28    |
| Age           | %    | 19        | 35        | 26      |
| Occupation    | %    | 2         | 22        | 16      |
| Education     | %    | 0         | 23        | 11      |
| Residing City | %    | 8.4       | 18.4      | 11.6    |

Frequency Analysis

Frequency analysis is performed on the respondent’s opinions to check their attitude towards sustainable transportation awareness and deployment.

Table 2: Summary of Frequency Analysis Results

| Questions                                                                 | Minimum | Maximum | Mean  | Std. Deviation |
|---------------------------------------------------------------------------|---------|---------|-------|----------------|
| you are protecting environment?                                           | 1       | 5       | 2.75  | 1.055          |
| Environmental concern should be important for transportation policy making? | 1       | 5       | 4.22  | .901           |
| You have enough information about transportation sustainable practices in | 1       | 5       | 2.65  | 1.055          |
| Pakistan?                                                                  |         |         |       |                |
| Sustainable transport effectiveness can be achieved through public participation? | 1       | 5       | 3.96  | .848           |
| The most effective way to reach sustainable transport is reducing car use? | 1       | 5       | 3.55  | .966           |
| Policies to encourage walking, bicycling and public transport use can increase sustainability? | 1       | 5       | 4.49  | .758           |
| Increasing use of public transport can increase sustainability?            | 1       | 5       | 4.14  | .775           |
| Reduced fares for public transport users can increase sustainability?      | 1       | 5       | 3.57  | 1.171          |
| BRT system like Metro and Urban Train can improve the sustainability?      | 1       | 5       | 4.31  | .927           |
| Are you willing to reduce luxuries for sustainable transportation improvement on national level? | 2       | 5       | 4.20  | .775           |

VI. Conclusions

Awareness Level of People Towards Sustainable Transportation System:

The research evaluated awareness level among people regarding sustainable transportation system in Pakistan. The assessment revealed that 45.1% of people did not know anything about transportation sustainability and cumulatively 76.5% people...
just have an idea of sustainable transportation while only 23.5% people know about sustainable transportation practices.

**Attitude of People Towards Sustainable Transportation System/Practices:** The majority of people revealed that they do not much concerned about the sustainability in transportation sector.

The specific assessments listed are:

- Almost 88% of people think that environmental factors should be considered during transportation policy making.
- According to assessment it is observed that more than 60% people believe that participation of people in sustainable transportation will not offer the much improvement.
- According to more than 70% respondents reducing the car use is valid point for sustainable transportation.
- More than 90% people agrees that walking, bicycling and public transport use can increase sustainability in transportation system.
- Also 90% people opinioned use of public transport is effective option for sustainable transportation system in the city.
- And more than 80% people thinks that availability of mass transit system like metro bus system can ensure significant improvement in transportation sustainability.

The interesting factor evaluated in this study is that more than 80% respondents are willing to reduce their luxuries for sustainable transportation improvement on national level.

**Recommendations:** The general recommendations for improving sustainable development in Pakistan are that the government of Pakistan should develop legislation and rules regarding sustainable transportation practices to ensure better implementation of sustainable transportation strategies. All stakeholders, specifically transportation sector should arrange sustainable development awareness campaigns, workshops and training programs for public awareness to encourage them to adopt sustainable practices.

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