NOVATEUR PUBLICATIONS
JournalNX- A Multidisciplinary Peer Reviewed Journal
ISSN No: 2581 - 4230
VOLUME 8, ISSUE 2, Feb. -2022

# GREEN AND SUSTAINABLE TRANSPORTATION SYSTEM FOR KABUL: (RECOMMENDATION FOR SHORT MEDIUM AND LONG TERM OF KABUL MUNICIPALITY)

Akbar shah Mohammadi
Engineering School, Kabul University, Kabul, Afghanistan
(akber1415@gmail.com)

Professor Najib Rahman Sabory
Engineering School, Kabul University, Kabul, Afghanistan
(abed.anwerzai@gmail.com)

Dr. Mohammad Abed Anwarzai
Engineering School, Kabul University, Kabul, Afghanistan
(najibsabory@gmail.com)

**ABSTRACT:**

**Kabul city capital of Afghanistan this city is suffering from a highly congested traffic, caused by a dramatic increase of its population and air pollution.this research is very important for the green sustainable transportation system for Kabul city because transport is a major user of energy and burn most of oil that causes to release nitrous oxides, carbon dioxides and particulates. When we want to take step toward green transportation system and should be pay attention the consumption of its fuel in the internal combustion engine. And also decrease the contamination of harmful material to the environment. Because transportation system is one of the vast contribution to the global warming and also recommended those who to drive old cars in the large populated urban city and prevent them from driving old cars in the urban city. The existence transportation system and the crowded urban city that particulate large quantity of carbon monoxide, carbon dioxides, nitrous oxides, methane and other harmful material to the environment. Which is dangerous for the existence ecosystem of world.the clean environment for the existence of ecosystem is very essential because that impair the growth of ecosystem. And also struggle to create attractive environment for the existence and development of ecosystem. Thus, to rebuild green and sustainable environment for the ecosystem. And should undertake to handle that tools and machines to particulate vast amount of harmful material into the atmosphere.and to rebuilt clean, green, safe, affordable, accessible, secure and less harmful transport for the city.**

**Keywords: Green and sustainable transportation system for Kabul (recommendation for short medium and long term of Kabul municipality)**

## INTRODUCTION :

Sustainability a set of environmental, economic and social conditions in winch all of society has the capacity and opportunity to maintain and improve its quality of life indefinitely without degrading the quantity, quality or the availability of natural, economic and social resources. Sustainability of urban transport services requires a significant degree of commitment to public transport service improvements across multiple agencies, as comprehensive and integrated solutions are needed across traffic management, traffic

sustainable, planning for future high capacity of public transport systems, and specialy laying the building blocks for a modern urban the transport system in Kabul.Service delivery of sustainability from Kabul municipality's road infrastructure assets depends on adequate finance and appropriate equipment, and in-house management capacity for systematic and routine maintenance of the road network. Management of the network requires (i) support for institutional and human resource development; (ii) introduction of asset management and maintenance practices; and (iii) initiating a culture of data-driven policy-making, modernization of engineering practices and business procedures in Kabul municipality. Support Kabul Municipality is designed to reduce the huge backlog of infrastructure investment and improve basic municipal service delivery. (i) Maintenance of the newly rehabilitated network (ii) traffic management and safety improvements (iii) improvements in transport efficiency through prioritization of public transport and (iv) improve the accessibility of the city center. Investments in key road infrastructure will improve connectivity and make Kabul more inclusive, while technical and knowledge support will gradually transform Kabul municipality into modern planning and implementing agency by adopting the best international practice.

**PROBLEME STATEMENT :**

**The Issue of Transport and the Environment**

In this part we discuss the environmental impact of the Kabul transportation system. In Kabul city, a large number and different kinds of vehicles exist which makes this city crowded. An increase in the number of vehicles has created many problems such as air pollution, noise pollution, water pollution and transport is a major user of energy and burns most of fuel that causes to release nitrous oxides carbon dioxides and particulates. That creat air pollutant into the atmosphere because transport is the largest source of greenhouse gas emissions to global warming. And air pollution is also concern to the health of human that must be taken under control, and to decrease air pollution on the environment.so in this part, we study the environmental impact of the transportation system in Kabul city. From one side, transportation activities support increasing mobility demands for passengers and freight. While, on the other transport activities are associated environmental externalities with growing levels. Further, environmental conditions have an impact on transportation systems in terms of operating conditions and infrastructure requirements such as construction and maintenance. The growth of personal and freight mobility in recent decades has expanded the role of transportation as a source of emission of pollution and their multiple impacts on the environment. The transportation sector is becoming increasingly linked to environmental problems. Include of most important impacts. (7), that we have in Kabul city according to the Statistics of Kabul Traffic Management we have totally **634696** cars in Kabul city.(6)

**SOLUTION MECHANISM :**

**Road Infrastructure**

It is believed that rehabilitating these roads without addressing the seasonal flooding would not be sustainable since road conditions would deteriorate immediately the next wet season. to address the flooding problem two engineering options, namely base and comprehensive options will be considered. The base option is just to raise up the roadbed above the flood level and rehabilitate the road pavement. the capacity and opportunity to maintain and improve its quality of the road

infrastructure for Sustainable transport service is about finding ways to move people, goods and information in ways that reduce its impact on the environment, economy and society. (8)


Figure 2 Road safety procedures in each stage of road development. (5)

**CAPACITY IMPROVEMENT :**

The aims to increase the overall capacity of Kbul municipality to provide transport modes such as walking or cycling, and use public transport more efficiently. improving transport choice by increasing the quality of public transport, cycling and walking facilities, services and environments. the Kabul municipality.will finance the following carefully selected areas after a thorough institutional assessment of the transport service delivery of Intervention to address city center accessibility. An immediate practical solution to tackle traffic gridlocks and accessibility difficulties at city center will be improve based on the principle of 'accessible for all these would be engineering solutions like junction channelization and traffic signal improvements in the city center. nevertheless, the city center area, ranging from, is the major employment area of the country home to densely concentrated shops, businesses and government offices. besides the short term traffic engineering improvements, a series of studies will be financed to develop an impactive and integrated solution that combines traffic management,road infrastructure, and interventions of public transport.


Figure 1.Project Corridors. (8)

Impactive Traffic Management and Enforcement the Kabul urban transport efficiency improvement cannot be implemented without and Impactive traffic management and enforcement system. We need to ensure that the usage of sustainable transport infrastructures are properly managed to boost transportation system efficiency, Enhance mobility Improve safety, reduce consumption of fuel and environmental cost, and increase productivity of economic growth. (8)

**SAFETY AND SECURITY OF THE TRANSPORT SYSTEM :**

Safety is a serious issue of transportation sector service. Accidents may occur to loss of life, injury or property impairs and never of these is acceptable. eventhough, accidents also have an economic cost. the road crashes economic cost including both urban and national in poor countries. For this reason it is essential to have safe and reliable transportation service. a transportation system Safeties can be bedivided into three areas

which are road safety, pedestrian safety and public transport safety.

The security of the transport service has to be ensured to make a transportation sector sustainable. Security of a transportation sector includes security of the people while they are travelling on the road, sidewalks, bike paths and as well as when they are using the transit system. The users of a transport system need to be protected against all sorts of criminal activities, such as mugging, harassing or other acts. Though, security is critical issue for all, it is especially significant for women, children, elderly and people with special requirement because they have higher risks of being the victim. If a city cannot provide security to the transportation users especially to the above mentioned groups, then they may be reluctant to travel, which may effect their well delivery.

Enhance the security and safety of urban transport systems, major problems mitigate and to performancee Impactive practices by means that are both cost-Impactive and a significant majority to acceptable of the public. both domestic and international practices show that safety, security, and environmental issues of the transport system are improved, Education, Enforcement, Emergency, Environment, and Enactment of Laws. based on our government mandates, the traffic police are the responsible agency to the all activities aspects in a transpotation sector and some part of Emergency measures.

Whereas the municipal government is in charge of the Engineering measures. Cooperation among government agencies is essential and the coordination should result in a reduction in number and severity of accidents as well as more security of accessing to transport infrastructure.Improve reliability of travel times and connections and to reduce the travel time and costs from door to door to build prosperous cities and tackle congestion and the lack of integration and connections in transport which impact on our high-level objectives for economic growth, social inclusion, integration, mobility, and safety. Improve quality, accessibility, and affordability of public transport to give people a choice of public transport, value for money and a realistic alternative to the car.(10)

**SUSTAINABLE TRANSPORT :**

Support to Kabul Municipality is designed to reduce the huge backlog of infrastructure investment and improve basic municipal service delivery. (i) Maintenance of the newly rehabilitated network (ii) traffic management and safety improvements (iii) improvements in transport efficiency through prioritization of public transport and (iv) improve the accessibility of the city center. Investments in key road infrastructure will improve connectivity and make Kabul more inclusive, while technical and knowledge support will gradually transform KM into modern planning and implementing agency by adopting the best international practice.


Source: GIZ, 2012.

Figure 7. Sustainble transportation system efficiency improvement (2)

Sustainability of urban transport services requires a significant degree of commitment to public transport service improvements across multiple agencies, as comprehensive and integrated solutions are needed across traffic management, traffic engineering, planning for future high capacity public transport systems, and eventually laying the building blocks for a modern urban the transport system in Kabul. Kabul municipality has taken the lead in convening the relevant stakeholders, initiating dialogue, and establishing an institutional architecture for coordination through the creation of two steering committees to provide leadership and technical guidance to the project. ( 8)

**ENVIRONMENTALLY FRIENDLY TRANSPORT :**

Reduce greenhouse gases emissions and to tackle the challenge of climate change, air quality, and health improvement which impact on our objective for maitining the environment and enhance health improvmen(1). Environmentally Friendly Transport can be available by ensuring efficient use of scarce resources. This would be obtained, by improving fuel-efficient and green vehicles, car sharing and encouraging the use of non-motorized transportation. by improving public transportation and non-motorized transportation the transportation system is made more efficient to both the suppliers and the users. As less people uses personal vehicles, the lower is the level of traffic congestion and demand for new roadways. Environmentally friendly Transport about finding ways to move people, goods and information in ways that reduce its impact on the environment, economy and society. Environmentally sustainable transportation is transportation that does not endanger public health and that meets needs for access consistent with: Sustainable transport is not just about encouraging people to use public transport. It is about reducing carbon emissions on all transport modes across the entire transport system and designing the transport system and our cities so there is less need to travel. The climate change is one of the greatest environmental, economic and social challenges of our time. improving the efficiency of our car use, such as using more fuel efficient vehicles, driving more efficiently for environmentally sustainable transportation. (10)

**METHODOLOGY :**

**Recommendation: for Short term of Kabul Municipality**

It can clearly have depicted that in the short term the physical capacity of a road network in Kabul city is capable of private transportation. Therefore, there is no need to introduce any new link for private transportation in the near future. It is recommended that the actual capacity of the road network should be raised to the physical capacity of road network with traffic management and building road infrastructures in Kabul city. it can be realized that public transportation demand is the main factor in creating congestion. Therefore, in the short term period of time, it is recommended that public transportation facilities with higher capacities than cars should be introduced to reduce the congestion in shown congested links. (3)

**PUBLIC TRANSPORTATION CAPACITY COMPARED TO CAR :**

Light rail transit (LRT) is a mode of transit service (also called streetcar, tramway, or trolley) operating passenger rail cars singly (or in short, usually two cars or three-car, trains) on fixed rails in right-of-way that is often separated from other traffic for part or much of the way. light rail vehicles are typically

driven electrically with power being drawn from an overhead electric line via a trolley [pole] or a pantograph; driven by an operator on board the vehicle; and may have either high platform loading or low-level boarding using steps. Table 1 illustrates the capacity of a light-rail train (the Siemens S70) compared to that of a standard car with five seats. The average length of a standard five-seat car is about 4.74 meters. The length of a Siemens S70 light rail vehicle is 27.7 meters, approximately the same length as 5.8 cars. The maximum occupancy of a car is five people. the maximum capacity of the Siemens S70 is 220 people. This means that one meter in a car has a capacity of one person and one meter in a light rail vehicle has a capacity of almost eight persons, so the capacity of light rail is about eight times higher than that of a car if only the length of the vehicles is taken into consideration. the average width of an automobile is about 1.77 meters, while the average width of the Siemens S70 is about 2.7 meters. The area of a car is about 8.4 $m^2$, while the area taken up by a light rail car is about 74.8$m^2$. in a car each.

| Type | Car | Siemens S70 LRT |
|---|---|---|
| Length (m) | 4.75 | 27,5 |
| Widht (m) | 1.75 | 2.5 |
| Area ($m^2$) | 8.31 | 68.75 |
| Max passengers | 5 | 220 |
| Person per $m^2$ | 0.6 | 2.9 |

Table 1 Capacity of car compared to light rail transit. (3)

A bus line using its own lanes can have a capacity of 7,000 passengers per hour (30 buses per direction, 120 passengers in articulated buses). Bus rapid transit is the traditional alternative to light rail, at least if very high capacity is not needed. Using buses, roads can achieve a high transit capacity. to have 30 buses per direction an hour, they must have priority in traffic lights and have their own lanes, as must tram to reach this density. Buses can travel closer to each other than rail vehicles because of better braking capability. However, each bus vehicle requires a single driver, whereas a light rail train may have three to four cards of the same capacity in one train under the control of one driver, increasing the labor costs of high-traffic BRT systems.the peak passenger capacity per lane per hour depends on which types of vehicles are allowed on the roads. If only cars are allowed, the capacity will be less and will not increase when the traffic volume increases. When there is a bus driving on this route, the capacity of the lane will be more and will increase when the traffic level increases. And because the capacity of a light rail system is higher than that of a bus, there will be even more capacity when there is a combination of cars and light rail. Table 2 shows an example of peak passenger capacity.

| Volume | Car | Car+Bus | Car+Light Rail |
|---|---|---|---|
| Low | 900 | 1650 | 2250 |
| Medium | 900 | 2350 | 3250 |
| High | 900 | 3400 | 4600 |

Table 2 Peak passenger capacity per lane per hour. (3)

It can be understood (As given in Table 1 and 2) that if the light rail transit (LRT) is introduced to the proposed route, it will enhance the capacity of the public transportation system. Public transportation is consisting of 4 parts; taxi, microbus, minibus, and large bus. (3)

**IMPACT OF INTRODUCING LIGHT RAIL TRANSIT (LRT) SYSTEM:**

From the traffic assignment, it was found that Kabul city roads are capable of private transportation demand. On the other hand, congestion occurs due to a high amount of public transport demand and small capacity

of microbus in Kabul city. In this study, for instance, the Light Rail Transit is considered on the proposed route to increase the capacity of public transport demand. It has been studied that if the Light Rail Transit system with 4 meter right of way is built on the proposed route, that in the short term after the introduction of Light Rail Transit, the private transportation capacity will decrease to a certain level but will not make high congestion in most of the links. Though, in the near future, the congestion will occur in some part of the links which should be enhanced by increasing their capacity by widening the road or introducing a new link. (3)

**RECOMMENDATION: FOR MEDIUM-TERM OF KABUL MUNICIPALITY:**

**Trip Generation and Attraction Model**

Trip Generation model is used to estimate the number of person-trips that will begin or end in a given traffic analysis zone. The objective of the trip generation step is to understand the reasons behind the trip making behavior and to produce mathematical relationships to synthesis the trip-making pattern on the basis of observed trips, land- use data and household characteristics. (4), The equation (**1a**) and (**1b**) were considered trip generation and attraction models in this study.

gi =β0 +β1Pop+β2Empi (1a)

a j =β0 +β1Pop j+β2Empj (1b)

In Kabul city, the trip generation and attraction models have been achieved from the equation (2)

$$Tij = k\frac{G_i^{\alpha} * A_j^{\beta}}{D_{ij}^{\gamma}}$$

Tij - Trips between zones I,j

Gi - Generated trips from zone i

Aj - Attracted trips to zone j

Dij - Impedance (Kabul municcipality)

k - Parameter

Is a gravity model that is used for trip distribution modeling? the gravity model is based on Newton's gravitational theory from physics, interpreted in a transportation context. The gravity model assumes that the trips produced at an origin and attracted to a destination are directly proportional to the total trip productions at the origin and the total attractions at the destination.Trip distribution usually occurs through an allocation model that splits trips from each origin zone into distinct destinations. There is a matrix which relates the number of trips originating in each zone to the number of trips ending in each zone. Trips between zones I,j data, generated trips from zone I and attracted trips to zone j are given. In this study, the impedance is minimum route distance which calculated using the road network of Kabul city. (3)

**TRIP DISTRIBUTION MODEL:**

The purpose of the trip distribution analysis is to develop a procedure that synthesizes the trip linkages between traffic zones for both transit captive and choice trip makers. trip distribution is the second component (after the trip step transportation forecasting model. Trip distribution is a model of the number of trips that occur between each origin zone and each destination zone. It uses the predicted number of trips originating in each origin zone (trip production model) and the predicted number of trips ending in each destination zone (trip attraction model) Therefore trip distribution is a model of travel between zones trips or links. (3)

**MODAL SPLIT MODEL:**

The socioeconomic characteristics of trip makers were defined on zonal basis, in terms of the average number of cars per household in a zone. The characteristics of the transport system relative to a given zone were defined by an accessibility index calculated

from the following equation. (9), Modal split models aim to determine the number of trips on different modes given the travel demand between different pairs of nodes (zones). These models try to mathematically describe the mode choice phase of the sequential demand analysis procedure. in this study equation (3) is considered for the modal split model.

$$P_{ij} = \frac{1}{1 + e^{(aD_{ij} + b)}} \qquad (3)$$

Pij - Modal Share
Dij - Distance between zone i and j (Kabul municcipality)
a, b – Parameter

Distance between zones i and j or in other words the impedance is calculated from the minimum path distance from one zone to another zone in kilometer. at the first stage, the total trips were divided into trips by walk and vehicles. Then at the second stage, the trips using vehicles were split to trips by public transport and trips by private transport. (3)

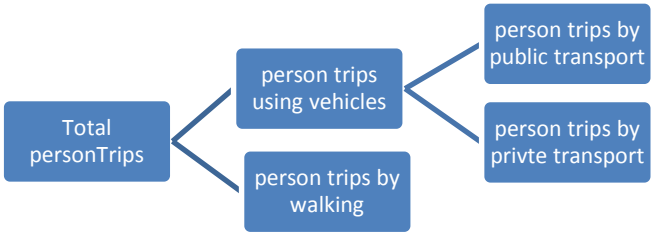


Figure 3 Modal split methodology. (3)

**RECOMMENDATION : FOR LONG TERM OF KABUL MUNICIPALITY :**

**Demography**

There is no specific demography data in Kabul city and the data differs in each organization. a census is recommended for Kabul city which is the common direct method of collecting demographic data. a census is usually conducted by a national government and attempts to enumerate every person in a country.Censuses typically occur only every 10 years or so. Censuses do more than just count people. They typically collect information about families or households in addition to individual characteristics such as age, sex, marital status literacy, education, employment status, and occupation, and geographical location.Travel Survey The survey should be conducted to all them related zones in Kabul city by the responsible organization after some period of time such as every 5 years to capture the updated transportation conditions in Kabul city.(3)

**MODEL :**

In this study, the minimum route distance impedance is used for travel demand forecasting models. The best data for using as impedance is the travel time data which was not available (4). Travel time impedance is one of the most important data for forecasting the travel demand and should be measured from one zone to another zone, by each mode of travel such as a car, bus and walking. (3)

**NETWORK :**

In this study, only the Major arterial and Arterial types of roads were considered in the road network of Kabul city. In Kabul city, the roads are not categorized on the basis of international standards. Road network density can be increased by considering the secondary and community roads of Kabul city for achieving more precise results. Calibration data is necessary in order to check how much the estimations fit the actual conditions. Traffic count survey should be done to find the goodness of fit for the travel demand models. The researcher may conduct a traffic count

survey to compare with the forecasted results. (3)

**RESULT AND DISCUSSION :**

This study has focused on congestion main cause in Kabul city by studying public and private transportation. This study is a very important achievement for Kabul urban studies because it identifies the short term and long term transportation needs in Kabul city. large cities face major problems, which the smaller ones have, so far, not been noticeably affected by. Most prominent among them is the high level of air pollution caused by motor vehicles. an Environmentally Sustainable Transport System will meet today's needs for mobility, access, and economic growth without compromising the ability of future generations to meet their needs and environmental protection. Adequate, efficient and effective transport systems are important for access to markets, employment, education and basic services critical to poverty alleviation. However, current patterns of transportation development are not sustainable and may compound both environmental and health problems. Especially for the poor, has increased considerably. This is largely because the use of cheaper non-motorized modes like cycling and walking has become extremely risky since these modes have to Share the same road space with motorized modes. Special focus is being given on the development of an integrated public transport system. A broad scheme for providing requisite central assistance to the States for the development of better public passenger road transport system is in force.Proposal to set up an independent road safety organization for the road transport sector to ensure best practices in Kabul to promote road safety is also in an advanced stage to promote sustainability. to allow cities to evolve into an urban form that is best suited for the unique geography of their Locations and is best placed to support the main social and economic activities. The initiatives and policies must preserve economic vitality, provide the flexibility that determines the best ways to meet targets, emphasize market-based solutions rather than Government regulations.

**NEW FINDING :**

Transportation which does not endanger public health or ecosystems and meets needs for access consistent with (a) use of renewable resources below their rates of regeneration, and (b) use of non-renewable resources below the rates of development of renewable substitutes. an Environmentally Sustainable Transport System will meet today's needs for mobility, access and economic growth without compromising the ability of future generations to meet their needs and environment protection. there is a need for a holistic and balanced approach for achieving Environmentally Sustainable Transport. Strategies must account for short and long term needs for the sustainability environment, economic growth and equity.

**CONCLUSION :**

Require transport-related agencies to develop short-, medium-, and long-term detailed plans, policies, and methodologies for implementing their duties. Define indicators in the light of Kabul urban transport efficiency improvement to measure the performance of ministries and authorities involved in urban transport in order to appreciate the top performance and take corrective measures against poor performance. Require transport-related agencies to collect process and maintain accurate transport data in advanced databases. Require governmental agencies to launch research programs including programs related to policy and technology in order to develop local standards, guidelines, and provide sufficient information for decision-

makers as well as to find the best practices for transport problems. formulation and implementation of specific Area Plan in congested urban areas that propose appropriate mix of various modes of transports including exclusive zones for non-motorized transit. laying down a clear and time-bound schedule of progressively tighter emission norms, with adequate lead-time, to allow the auto and oil industry to make the required investments. Campaigns for public support for initiatives like greater use of public transport and non-motorized vehicles the proper maintenance of their vehicles, safer driving practices, etc. Encourage individuals, families, and communities to adopt "Green Travel Habits" that would make travel less polluting and damaging. to improve mobility within neighborhoods, so as to take care of intra-city and inter-city transportation needs. cities have to prepare Comprehensive Mobility Plan so as to access Government funds for Traffic and Transportation Projects. To make viable and reliable transportation options which aim at reducing dependence on automobiles with the widespread use of non-motorized modes and mass rapid transit system. This will require a comprehensive, long term program that encourages rapid transit systems.

**REFRENCES:**

1) Habibzai, A. (2015). Afghanistan green urban transport strategy. kabul.
2) IEA. (2013). A policy guide on how to transform cities by improving energy efficiency in urban transport systems. IEA.
3) JALAL, E. (2015). The short-term and long-term transportation planning policy in Kabul city. Graduated school of science and technology, kumamoto university.
4) license, P. b.-N.-N. (2014). Advance trip generation/ attraction models.
5) license, P. b.-N.-N. (2016). Management of road infrastructure safety. Science direct.
6) Management, T. (2017). Statistics of vehicle. kabul: trafific management.
7) R.K.Sharma, D. (2012). impact of transportation system on the environment. india: pp.72-136.
8) region, S. d. (2014). Kabul urban transport efficiency improvement PROJECT. document of the world bank.
9) Sutan P. Silitonga, D. o. (2011). Modal Split Model for Public Transport Development in Indonesia. Applied science research.
10) United Nations Economic and Social Commission for Asia and the Pacific and CITYNET, 2. (2012). Sustainable Urban Transportation System. United nations Economic and Commission for Asia and the Pasific (UNESCAP).