



Challenges of Low Carbon Public Transport Systems in the Arabian Gulf City: Case of Muscat, Oman

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Author's contribution

The sole author designed, analysed, interpreted and prepared the manuscript.

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ABSTRACT

The Arabian Gulf cities are growing. The gulf cooperation council states (GCCs) are among the richest and most urbanized in the world. As a major focus on sustainable development of cities, sustainable transportation acts to diminish the city's energy consumption by providing a public transport system that has greater ecological obligation and societal justice. The study's significance is to figure out the challenges in the sector of public transport in the city of Muscat. The wide spread of mass transportation plays a significant role in reducing the exhaustion of energy. Also, it contributes to make a better living experience. Provision of sustainable public transport will prevent the increasing number of motor cars and equally accompanied environmental pollution and traffic congestion. The study is based on an in-depth quantitative and qualitative research method to explore the hindrances that are encountered in the way of building sustainable infrastructure of public transport. The findings of the study revealed that public transport system face real challenges in Gulf region, particularly in Muscat. It indicated that for the well-being of Gulf society, the use of public transportation was encouraged and most of the population have their own cars. In addition to it, cultural and social preservations are raised, mainly by the people that act against the operation of public transport system. Due to the substantial effect of clean and sustainable transportation on energy consumption levels, recent years have been marked with a notable trend towards sustainable and low carbon systems, particularly the mass transportation ones.

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1. INTRODUCTION

Public transportation systems are becoming increasingly vital to modern societies. Overall, the world, communities need high operational public transport amenities for the commuters from the cross urban and rural entities. Public means of transportation are known as that service of transportation that pick and move passengers to a variety of destinations in communal way. It did not include certain type of transportation such as school vans and tourism transportation. Generally, the service is operated by several means such as buses, ground and underground metro, trams and monorails, etc. In contemporary highly urbanized cities, public transportation system has a very crucial significance and provides service that has to meet and satisfy all economic and social need of the community. The service is well-recognized occupation of highly competitive nature. Moreover, to maintain its recognition and efficiency, it must be safe, fast and process with highly accurate schedules. Along with, it must meet the higher standard of the quality of service. [1]. In order to enhance the sustainability and to reduce environmental hazards, the cities are making efforts for extending infrastructures and facilities of mobility towards various destinations within the growing urban fabric. These sustainable mobility facilities have to be affordable and accessible and must be adequate to meet the demands of different community sectors including people with special needs.

Sustainable mobility is concerned with reducing traffic congestion, limits emissions, and diminishes the exhaustion of exhaustible resources. While, sustainability deals with examining the concepts of sustainable development. A widely-adopted definition of sustainability is given by the report of Brundtland Commission, Our Common Future that describes "sustainable development is development that meets the needs of the present without scarifying the capability of future generations to meet their own needs" [2].

The study of Theis [3], Black [4], and Banister [5] propagated that transport has three-way bottom line, which make it important to address the hurdles of sustainable developments through using threefold magnitudes i.e. society, environment and economy. The service delivery through public transportation boosts the economic growth and brings about improvement

in the life of people while providing secure and lucrative transportation means. They also facilitate the individual mobility while providing affordable and effective means. The holistic approach of sustainability changes the role of transportation from distinct goal to a part of an integrated system. This approach propagates that sustainability is not related to provide technical issue but it is the key to the economic, financial, social and environmental issues among the communities [6].

Transportation systems provide trips to millions of passengers, daily in different countries. The developments in the public transportation services connect urban and suburban regions which led to a drastic change in people mobility from urban to suburban areas [7]. Additionally, the system has bridged the differences in land values and has assisted in decreasing concentrations and impediments [8].

In spite of the very obvious benefits of public transportation, and their contribution to the concept of sustainable cities, these systems are still not commonly used and accepted within the Gulf Cooperative Council (GCC) countries. The Sultanate of Oman located in the Gulf region, spreads over the total area of 310,000 square Km. The population accounts for 3.8 million, according to the last census of 2010. The Sultanate's location occupies the South-Eastern part of the region. When it comes to public transportation, it has far better situation as compared to its other states of GCC counterparts. The Sultanate enjoys a diverse modes of transport systems, particularly in Muscat Governorate, where wide range of public transport modes are available, which include buses, minibuses and taxis which are usually used in group. Despite it all, the majority of the populations are using private vehicles. Moreover, emission from motorization poses a real environmental threat as it is the major contributor to global climate change and causes air pollution that also has its negative health consequences.

Since public transport services has attracted significant attention from policy makers globally, the central concern of the study is to pinpoint the reasons for why policies to promote sustainable mobility are not adequately adopted and implemented in Muscat. In other words, it investigates and reveal challenges for sustainable public transport in Muscat and to identify facilitators and barriers. The adoption

and application of public transport hinges on variety of factors, where perception and attitude of community are few to name.

2. METHODOLOGY

The study employs a variety of research methods, including desk research, observations, and informal interviews with experts and professionals. The core objective is to measure and evaluate the situation and reach the solid conclusions. The major data collection method was a questionnaire which administered at the six wilayats of Muttrah, Bawshar, Seeb, Al-Amrat, Muscat and Qurayyat. Muscat is the capital of government, finance and business in the Sultanate of Oman, and the central region of the state. Both at the political, economic and administrative levels, it is the seat of government and has acquired the status of the administrative apparatus of the state. Moreover, according to the 2010 census the population of Muscat is 632,073 (NCSI, 2015). Also, Muscat plays a vital role in commercial and economic activities at all levels locally, regionally and internationally It is one of the most densely populated areas in Oman and ranked as the second biggest province in Oman, after Al Batinah, while comprising 27% of the total population of the country (Fig 2).

The quality of public transport systems has enormously been investigated through

observations using sample survey that investigate opinion of respondents and measure their level of satisfaction by scale. [9]. Such studies are widely used and accepted-methodology to evaluate the standards of Public Transportation service and to quantify service-user acknowledgement and acceptance [10]. The study participants were selected using a random accessibility sampling approach. Individuals from different areas and sectors were approached to confirm randomness. Lunneborg [11] claims that random sampling is entirely challenging and cost-ineffective. However, it is frequently adopted. He asserted that nonetheless non-randomness encompasses limitations, it does not entirely impede the likelihood of obtaining scientific knowledge by the data that is underwritten by a convenience sample. The survey comprised of demographic questions of a general nature, including age, gender, occupation and income level. Other questions consist of public transport attributes that are relevant to investigate user satisfaction. These attributes include availability, geographical coverage, convenience, schedules and others.

Tyrinopoulos and Antoniou [12] identified the satisfaction of users with respect to public transportation as (the overall level of fulfilment of the expectancy of customer's gauged in the form of percentage).

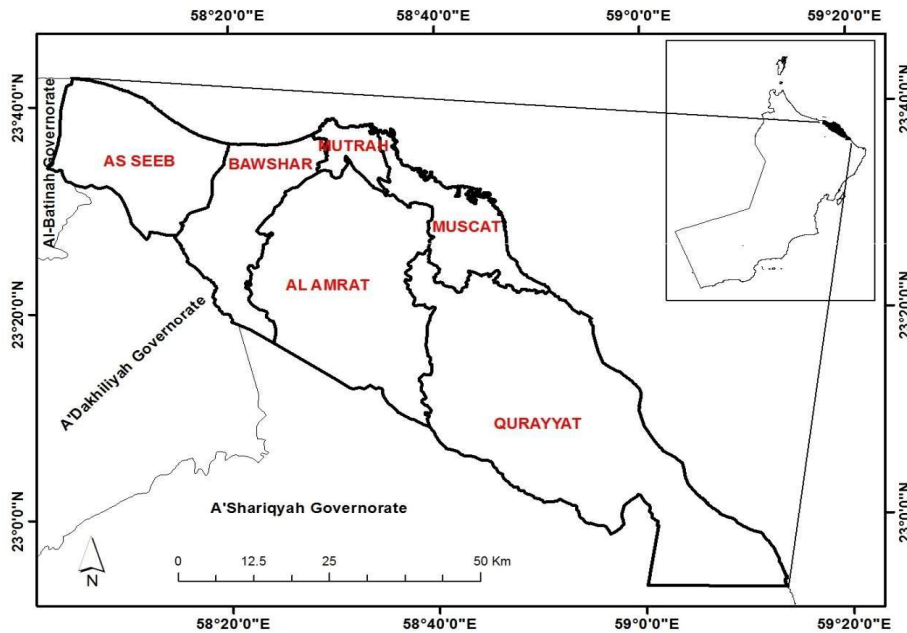


Fig. 1. The study area

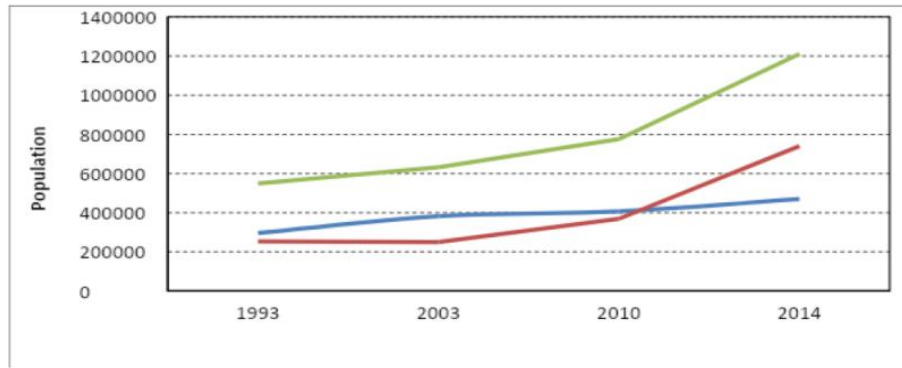


Fig. 2. Population growth in Muscat (1993 - 2014)

2.1 Public Transports in Oman

In 1972, the Oman National Transport Company was established. Initially, it was established to organize transportation in Muscat schools. In 1975, the company started to provide public transportation within the city as well as long distance bus services to major cities and the regions. The flights are beyond to Abu Dhabi and Dubai, but flights to Abu Dhabi were stopped. The number of buses in Muscat has been concentrated mainly in Muscat. Moreover, the increase in the per capita income that adds up the affordability of personal vehicle, the number of buses working within the city has been reduced to provide services only in Roy and Wadi Oday and Wadi Al-Kabeer. Presently, the company owns 200 buses and 230 employees at the company's main headquarters and the company's main station in Al-Azaiba. However, the main station for local and long-haul services is located in Ruwi.

In Muscat, the demand of taxi services by the passengers, have overwhelmed the demand of bus services in terms of preference. Taxicabs account for a half-measure of motorized transport by the public and private service providers. There is hike in the number of taxis as compared to bus service. Specifically, a major proportion of the intra-city travel is commuted through the group taxis (microbuses) and fleet of 30,000 taxis in the country. In Oman, there is gradual expansion of infrastructural development programs specifically the construction of roads. For instance, in the year of 1960, there was only 10 kilometres long built-road in Oman [13] whereas the number of roads in the year of 2009 had reached to not less than 25,000 (Mon, 2010). This was the colossal development in the form of using automobile and its proprietorship.

3. RESULTS AND DISCUSSION

The study results showed significant association between car possession and earning. The improvement in living conditions and economic prosperity that Oman has enjoyed since its Renaissance in the 1970s, have led the spike in private cars. A percentage of 84 of the sample surveyed, owned a private car. Majority of them earn median monthly income that range RO 500-1000. Most of these people were employed in both public and private sectors, while others include university students as well.

In addition to it, the remarkable population growth (Fig. 2) and the improvement in economic wellbeing of the population are the main factors behind the private vehicle ownership. The increasing number of registered vehicles is accompanied with increasing number of driving licenses for the same period. In due course of time, the number of certified vehicles expanded with a rate of 4.3% annually. This growth is primarily because of the rise in private vehicles and cars for rent. The number of private autos is growing annually by steady rate of 6%. While the number of rented cars is also expanding by 2.8% annually. Conversely, no increase in the number of taxi cars and cars owned and operated by government institutions which include ambulances and civil defence cars. The total number of private automobiles illustrate stable growth over the period of 2007-2008 which is marked as the highest rate. Furthermore, a hike is observed in the growth rate of private vehicle per 1000 persons from 130 in the year 2000 to 200 in 2009, which made Oman among the countries with high car ownership worldwide.

Considering the acceleratory urbanization and the accompanied socio-economic and

demographic transformation, urban development of gulf region, particularly in Oman, have been directed to extend road infrastructure. It aims to cope with the increasing pattern of private cars ownership. The region is thus characterized with high-standard road infrastructure that did not yet manage to accommodate and control the increasing number of motorizations.

People tend to use public transportation for a variety of reasons. Some take public

transportation to save the time they spent while driving. They used to commute for work and by then they can use the time in various activities. Another reason includes that private car ownership is costly in terms of fuel consumption and maintenance so using public transport can save much of these charges. Regardless of the above-mentioned facts and other benefits for the users of public transit, there are a number of drawbacks when using public transportation in Muscat as indicated by respondents.

Table 1. Registered vehicles in Oman (2006-2015)

2015	2014	2013	2012	2011	2010	2009	2008	2007	2006
971009	880214	799367	722934	638772	572829	530347	496784	431085	375972
223775	204753	196104	184018	172432	164564	156666	152931	13482	119120
20928	19387	17751	16109	12667	10816	9463	9310	6802	4754
33500	32162	30622	28599	28021	28137	28056	27417	26034	25518
21027	19670	18933	8533	5715	14121	13690	16170	15648	15056
730	711	689	4319	3618	633	611	645	627	589
4216	3877	3601	661	638	3217	3153	2851	2495	2294
1169	1114	1013	17950	15468	745	679	1312	1214	1171
6726	6072	5311	923	828	3300	3042	3227	3092	3076
14849	10815	9605	3308	3201	5871	10230	9669	7871	1358
1287	1025	0	0	0	0	0	0	0	0
3096	14	0	0	0	0	0	0	0	0
1302312	1179841	1082996	987354	881360	804233	755937	720316	629670	548908

Table 2. Causes of increasing private car ownership

Job * Cause of the increasing private car ownership Crosstabulation						
Count						
	Cause of the increasing private car ownership				Total	
	High-inco me	Difficulty to acquire public transport	Population growth	The ease of acquiring a driving license		
Government						
Employee		19	73	32	5	129
Employees in the private sector	16		21	32	7	76
Student	9		31	18	3	61
Unemployed	2		1	3	2	8
Job Freelancers	0		5	1	0	6
Other	3		8	1	8	20
Total	49		139	87	25	300

A primary consideration of respondents was the area coverage of public transportation to get to the places that they wish to visit via public transportation. Some of the routes in Muscat can be found very limited, which is considered as a major disadvantage for passengers who do not have an alternative means of getting around. The study's respondents have indicated the lack of maintenance and level of convenience in terms of service provision as other

disadvantages. Public transportation is usually working on fixed timetables. These schedules in most instances did correspond with trip demands of users. Consequently, this leads to wasting of time and delays of users. However, the most important disadvantage for Muscat respondents, particularly for citizens was related to the cultural belief and community perception i.e. privacy and personal space.

People of this part of the world are highly concerned about privacy and limits of socialization with others that public transportation permits. As it is acceptable globally that public transportation passengers are crowded in buses and have either very limited or even no personal rooms available which leads to all forms of privacy violations for people, since personal privacy is highly considered in Muscat and represents an important attribute for user satisfaction. As the issue of privacy remains an important factor behind reluctance of people from using public transportation, this is specifically applied to citizens who can obviously show their resentment being revealed to a variety of rude, impolite and anti-behaviors and practices. While some practices are illegal and regarded as forbidden behaviour. They may trigger criminal offences including harassment and ill-treatment. These malpractices include acts, verbal or corporal gestures that may prove as a catalyst for the causing disruption and uneasiness for others. The intolerable behaviour in society comprises a wide range of practises that threaten the safety and comfort of passengers, vehicles and work places.

In order to evaluate the major elements that affect the acceptance of public transportation by the passengers in the Muscat governorate, the study uses descriptive statistics. To point out the overall acceptance with public transport services in Muscat. It also includes other several factors that affect it via measuring on the Likert scale which comprises 1 to 5. The observations included that mostly, the passengers were not

satisfied with the existing services of public transportation. Only 3.3% respondents felt happy and strongly accepted the level of services. Conversely, 33.6% fairly accepted the services. The majority of the respondents is found to be highly unsatisfied 36.4% while 26.6% were unsatisfied. The statistical distribution of frequency regarding the perception of respondents in terms of overall acceptance of the service is attributed to the disadvantages of public transport in Muscat. Also, the figure unveils certain service quality features of public transport services that influence passengers' response.

Findings further revealed that the level of acceptance or discontent is connected with socioeconomic and demographic profiles of the respondents whether they are citizens or residents. When gender-based overall acceptance of public transport services is compared, findings reveal that there is more tendency of females to experience higher level of acceptance, specifically, the female citizens who rarely use the public transportation in Muscat. The claims of cultural preservation as indicated by interviewed females and as highlighted by other studies [14] emphasized that citizens' perceptions of public transport services have influence over their acceptance of public transport. Majority of the respondents that were the residents of Muscat (65%) and 50% respondents who have been living outside Muscat have agreed that private car mobility in Muscat is associated with the various disadvantages which mainly include stress and

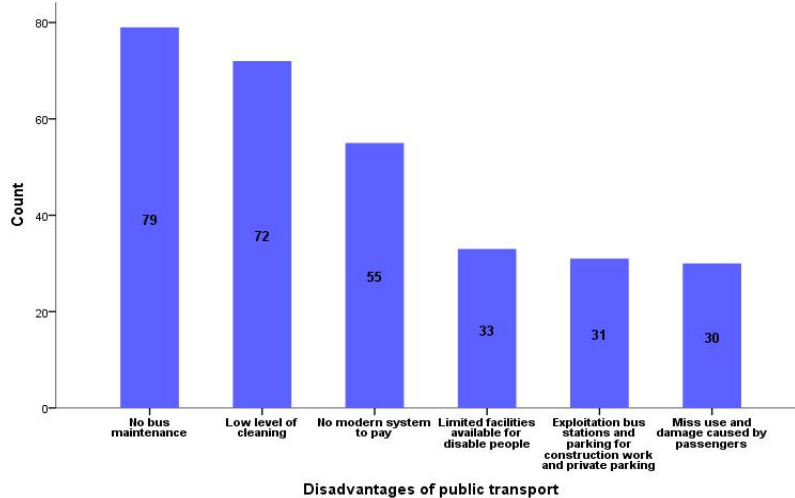


Fig. 3. Shows the disadvantages of public transportation as considered by the respondent

psychological pressure led by the traffic congestion. This is in comparison to small percentage who indicated that the high operating cost of the private car is one of the contrastive factors. The substantial growth of private vehicles ownership has accelerated the negative environmental menaces including pollution, congestion and other socio-economic and psychological drawbacks. Also, it causes global warming and associated extreme weather events. Using public transportation is more sustainable as far as energy saving is concerned, it produces less contamination than using private vehicles.

Kennedy [15] brings a deep and insightful investigation while comparing between private and public transportation. His comprehensive work has given coherent insight in the domain of sustainability. His analysis provides assessment of the advantages and disadvantages of private and public transportation. The comparable investigation between private and public transport has been thoroughly explored by several studies within the field of sustainability. Literature on this regard have revealed that private motorization is normally viewed as the main cause of environmental pollutions as a result of harmful discharges of the transport. Implementing clean public transportation leads lesser exhaustion through confining widespread motorization, enhancing the service quality of public transport, emboldening the culture of walking and pedalling, and through identifying the certain essentiality of diverse community members. Thus, it contributes to sustainability. It is seriously essential to recognize that the sustainability of public transport systems is not an ordinary issue. However, it is directly linked to several other dimensions of urban life. It is indispensable to confess that a cohesive method is highly required to accomplish a sustainable transportation network. [16,17].

Furthermore, the study findings indicated that private vehicles' ownership and usage in Muscat, provide high level of access to goods, services, and activities. Additionally, they bring comfortable choices and give access to the variety of tasks and activities. For many people, vehicles are also an emblem of social status and a secure additional revenue, along with a means of increasing productivity as well. However, the hike in the frequency of casualties related to the road accidents, the increasing operational cost, traffic congestion, and rise in

the price of transportation fuel could push people to travel in public transport. Regulating diverse modes and requirements including multi-modal arrangement will also improve acceptance for an efficient public transport network.

In Muscat as in other Gulf cites, the problem of congestion is usually attributed to a lack of sufficient road space and a need for better traffic flow, ignoring other additional multifaceted difficulties of travel demand management. The negative impacts of such policies have led to the development of solid infrastructure of roads along with the promotion of this vision as the solution to congestion and transport problems.

Transportation polices in Muscat is still largely in support of the development of road networks. Despite the great achievement on this regard, these strategies have not been succeeded to solve congestions and its associated impacts. The demand of devising the policies for more sustainable transport-oriented developments is higher. Public transportation represents a key area to implement sustainable urban transportation planning. This can be accomplished through the planning of systems that are sustainable. In addition, it can be achieved through multi-purpose connections that attempt to lessen trip distances and to build road infrastructures. Such urban development strategies and policies adopt mixed uses and land use density approaches along with the mass transit passages to maximize energy efficiency where public transport offers access to all nodes within urban structure.

Unfortunately, urban planners and in Gulf region are still reproducing the western style of development that suits the western cites. Despite the fact that even the western cities are now doing their best to get rid of the old patterns of development that no longer fit into modern time requirements. One of these old-fashioned development styles is a city with private cars. Public transportation and public transit have become essential parts of the modern western city, particularly in Europe. [18] and [19]

Muscat Municipality is recently concern about the situation of traffic and mobility within the city and working on all-encompassing strategy to address the requirements of traffic in the whole governorate until 2030. The strategy is based on a large number of information and field surveys.

In order to develop transportation strategy for the capital city and to develop a structural plan to accommodate the traffic need in Muscat governorate a multi-modal public transport model has been adopted to allow future traffic to be considered while taking into account the new developmental projects and population growth as well as future road plans.

4. CONCLUSION

Evidently, the public transportation sector in Oman is facing a variety of challenges. Despite recognising the indispensability of the transport sector for economic progression, it is contended that heavy reliance on vehicles is associated with environmental, financial and social hazards. In Oman, public transport service is not the preferred choice of transport for the citizens. These systems are often considered to be at a lower standard as compared to foreign means of transportation for the poor segments of society. Undeniably, people who do not own private vehicles, have no preferences towards public transport as the use of public transport is mostly associated with expatriates. More worryingly, women have lesser readiness to utilize public transport, and they are more inclined towards private automobiles. The global trend towards promoting public transit transportation and the replacement of motor vehicles in gulf countries to build more sustainable public transportation systems make it challenging on the basis of cultural values in spite of the realization of obvious drawbacks like congestion, prodigious vehicle emissions, and incessant accidents. Sustainability claims and campaigns are pushing to make cities more sustainable and communities fully involved, in order to build more convenient living environment. Public transportation help decreasing energy consumption that lead to hazardous carbon dioxide (CO₂) and other greenhouse gas emissions which deteriorate the environment. As far as energy saving is concerned, using public transportation is more sustainable since it produces less contamination than private vehicles. The authorities concerned to urban planning, has to endeavour for devising new strategies and practises to integrate urban transport development and planning within a comprehensive sustainable urban development in the future. Fashioning a sustainable transport system that is essential for an urbanized community, needs policy frameworks and integrated approaches that span all levels of administration.

DISCLAIMER

The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

CONSENT

As per international standard or university standard, respondents' written consent has been collected and preserved by the author(s).

COMPETING INTERESTS

Author has declared that no competing interests exist.

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