

Urban Transportation Conditions from the Metropolitan Area of Kuala Lumpur that will Impact and Endanger Putrajaya’s Sustainability Plan

Jorge Bonasif

E-mail: jbonasif@gmail.com (corresponding author)

Abstract. There is a growing demand for mobility and accessibility from the Klang Valley (The Greater Kuala Lumpur) into the city of Putrajaya. Putrajaya is the federal administrative Capital of Malaysia, conceived as the first sustainable intelligent city-garden. The public connectivity in Kuala Lumpur is mainly centralized with the RR (Rapid rail) integrated by the Light Rail Transit (LRT) and the MRT (Mass Rapid Transit) with connections by bus to the peripheral zones. However the primary mode of transportation is still private vehicles such as cars and motorcycles, with an increased use from 458,294 in 2006 to 628,239 in 2012. In 1990, these numbers increased from 247 vehicles per 1,000 persons to 546 and 994 vehicles per 1,000 persons in 1996 and 2002 respectively, beyond the national level per 1,000 population of 91 vehicles in 1990, 133 in 1996 and 210 vehicles in 2002 incrementing the heavily congested conditions existent in the traffic grid, thus also affecting the connection with Putrajaya (Kuala Lumpur Structured Plan 2020).

This paper highlights the necessity for a closer examination to some of the factors that exert influence on the motivation of the preference in the use of private transportation in detriment of the existent public urban network that will affect and endanger the sustainable nature of Putrajaya.

The primary methodology used is the consultation of available literature, newspapers, published reports, and interview with experts. A secondary source is the observation in situ to help support the conclusions. The constant growth on the demand for private transportation in the population is hypothesized to be directly positively correlated to a very ingrained tradition, unchangeable weather conditions and the unreliable connectivity. These factors directly affect the lack of incentives to improve existent public transportation from Klang Valley to Putrajaya.

Keywords: Putrajaya, mobility, sustainable, unchangeable, connectivity, endanger.

Conference topic: Sustainable urban development.

Introduction

The region of Malaysia (peninsula) known as the state of Selangor is compounded by two geographical zones, the federal territories of Kuala Lumpur that houses the Parliament, and the Federal territory of Putrajaya, base for the executive and judicial branches, together they give seat to the Federal government of Malaysia. Kuala Lumpur is the fastest growing metropolitan area of the country, it covers a 243 km squared with a population of approximately 1.6 million in the central federal territory and 5.5 million in the suburbs, which combined gives an urban concentration of 7.1 million inhabitants (Cox 2013).

The density by 2013 was calculated in 3,400 people per square kilometer. Positioning its urban space among the 70 world urban areas with more than 5,000,000 population, Kuala Lumpur itself ranks 56th in population density, and ranking in the 50th place in the largest build-up urban areas over 500,000 inhabitants (Demographia 2016).

Putrajaya was set to be the federal administrative center of Malaysia conceived as a sustainable garden city whose master plan was approved in 1995 on 4,900 ha site is demarcated into 17 precincts with 5 major designated as core areas separated by a large artificial wetlands designed to absorb the excessive amount of water occurred during the rainy season.

From its conception, Putrajaya has been planned as a Malaysian City, designed by Malaysian as the administrative capital of the country, it is based, next to the Multimedia Super Corridor (MSC), Cyberjaya. A formal 2.1km boulevard in the core area acts as a landmark axis (Smart City Business Institute 2015).

Designed as an “intelligent garden city” with wide roads and plenty of green areas, pleasing, environmentally friendly promoting community gardens for residents to grow their own fruit and vegetables, fomenting the sustainable self-cultivation.

Putrajaya is connected to Kuala Lumpur by highway and the Express Rail Link (ERL) connecting both to the international airport, located just to the south of the city. Thirty-seven percent of Putrajaya is dedicated to parks and open spaces and there are 200 hectares of man-made wetland and a 400 hectare man-made lake, which also harbor a space for 38 kilometers of waterfront (New cities Foundation 2014).

The connectivity and traffic conditions between the two urban nucleuses are endangering the sustainable condition of Putrajaya and some of the main factors of influence will be analyzed.

Methodology

The methodology adopted is to carry out the scope of works of the updated conditions of Selangor Federal State, related to the correlation between the Harvesting rain water system and the situation of the flooding occurrence. Bibliography will be revised in paper and through internet. An Interview as a substantial complement of the literature with Dr. Shahrizan Faiez (PhD in Sustainability, University of Cambridge) based on his experience as a Former Senior Sustainable Development Specialist of the World Bank. Also the incorporation of observations conducted in situ and from the SPAD website.

Urban Kuala Lumpur

By 2016 the estimated population is to be closer to 1.76 million people (federal territory), or in other words within the last 3 years to an increasing ratio near to the 7%. With a rapid growth that lead to a very high population density number of 6,890 people per square kilometer. At the same time the last years the amount of residents from abroad has increased, now accounting for about 9% of the total population.

With regard of the population, Kuala Lumpur is an aging city with birth rate fallen in the last decade or two. This has led to a lower percentage of young people under 15, a group that has fallen from 33% in 1980 to under 27% in 2000. The working age group between 15 and 59 has increased from 63% in 1980 to 67% in 2000 as more people move to the city for opportunities. Rapid development in the city has led to an immigration of foreign workers from a variety of countries from the neighborhood like Thailand, India, Bangladesh, Nepal, Burma, Sri Lanka, Philippines and Vietnam. By 2020, Kuala Lumpur city is projected to have a population of 2.2 million.

According to the 2010 census, the dominant ethnic groups in Kuala Lumpur are: Malay/Bumiputera: 45.9% Chinese: 43.2%, Indians: 10.3%, other: 1.6% (World Population Review 2016).

Nowadays its economic activity encircle the entire country, and its big concentration of governmental and non-governmental institutions, added to the fact it is the most industrialized and economically fastest growing territory in Malaysia. The vibrant life in the city is also the hub of the international city center competing with other big markets like Bangkok and Singapore (Economic Base and Population 2016).

As for an efficient transportation network, it presents an issue currently and in the near future is set to play a major role when meeting the requirements of the economic transformations of a highly populated city demands.

At this respect Kuala Lumpur suffered and still is, the process of a rapid urban expansion, becoming more prone to be involved in new competitive markets. When a vibrant developed economy exert an attraction of a large expat community, importations and foreign investment thus a better level of connectivity, infrastructure, and the consequent need of improvement in mobility are needed. Where there is an increasing population growth ratio, the demand for transportation is positively correlated to that process and the cities must respond to this new scenario. In large urban areas human mobility usually happens over a multimode public transportation network.

At this respect, citizens tend to use more than one way of transportation to arrive at a particular destination as not always all the needs are located in the nearing, and this fact is even more notorious in the urban settlements whose expansion sprawled in multiple directions as a resultant of a lack of a concise and structured urban plan. Accordingly, when analyzing and utilizing integrated transportation systems people regularly do not conceive them as a multi-mode transportation with an coordinated and synchronized grid, the tendency is to understand them as a set of separate elements, this is a known phenomenon when the system is new and the public has no education and information about of what an advanced platform for more flexible, efficient, sustainable and reliable transportation can offer. And this perception, makes an impact by the time to decide and choose what to use.

Due to the nature of the expansion of Kuala Lumpur and in order to fulfill the current demands, latest improvements in addition to the grid enlargement of the existent network created, as a resultant, a more complex densified urban commute trajectory. Now as a part of the transportation features that include multi-layer highways and major roads with a big amount of intersections, all the connectivity is hubbed in Kuala Lumpur Sentral, (Kuala Lumpur Sentral 2016), Malaysia's largest axis of transit (Layout as shown in Fig. 1).

An integrated rail transportation interconnected and flowingly linking a big portion of urban and suburban residential, commercial, recreational, green and industrial areas. It is also directly linked to Kuala Lumpur International Airport, Putrajaya, and Cyberjaya. Last one, town with a science park conceived as a core of the Multimedia Super Corridor in Malaysia with direct access to six rail systems and links to major highways (Cyberview 2017).

The rail urban for public transportation grid comprehends the Light Rapid Transit (LRT), Keretapi Tanah Melayu (KTM) Komuter, Express Rail Link (ERL), and Monorail. Currently, public transportation that operates within Klang Valley area is managed by different companies, Rapid operates on LRT which consist of two lines namely Kelana Jaya Line and Ampang Line.

RapidKL is also in charge of the KL Monorail. Keretapi Tanah Melayu Berhad (KTMB) on the other hand operates on KTM Komuter. The other company, Express Rail Link Sdn Bhd operates on ERL. The complexity of the this platform is that none of these network lines are linked up in the same platform, for example KL Monorail line is not connected physically with any other line (Ismail, Said 2014).



Fig. 1. Kuala Lumpur Sentral layout Transit Concourse, **Level 1**: Urban public transit services such as the KTM Komuter, KLIA Transit and the Kelana Jaya Line light rail transit. Transit Concourse, **Level 2**: KTM intercity trains. KL City Air Terminal (KLCAT): KLIA Ekspres, and the high-speed rail service to Kuala Lumpur International Airport (KLIA). (KL Sentral Station 2016)

When the grid extends its reach to a broader surface, the number of people that will gain access to the service will suffer a substantial increase endorsing to the integrated connectivity a major role in terms of quality of service that includes optimal paths, effectiveness in the interconnections and a timely response to the accurate schedules set. Situation is more complex during rush hours and the connectivity should meet the expectations of the users as in routes with more than one connection, one desynchronization is enough to trigger a chain effect where the entire flow could collapse.

In the same context, the road network plays a critical role in the effectiveness of the railroad integrated system as the current grid doesn't reach important suburban areas leaving a big portion of the population with one more connection to take in order to connect with the railroad.

One of the characteristics of the road system in Kuala Lumpur is that has been developed in a gradual way, and therefore, linkages between major and minor roads clearly present interrupted interconnections and lack of fluidity. Similarly, this gradual process of development has adversely affected the quality and the effectiveness of streetscapes, which in the actual state of conditions of the streets in the current grid.

Sustainable Putrajaya

In June 1993, Putrajaya was nominated as the new Federal Government Administrative Centre. By April 1994, the city had its first urban plan approved, a revolutionary urban sketch conceiving the space as a Garden City Concept, to turn Putrajaya into a sustainable and a “-city-in-a-garden-“. This decisions included to incorporate high green technology features during development and management stages, as well as to ensure the city's integration with the existing natural environment. Putrajaya is the first city panned entirely from the urban, ecological and social aspects, located 25 km south of Kuala Lumpur, helped to decentralized the federal administrative of Malaysia, this way the government was shifted in 1999 from Kuala Lumpur to Putrajaya, due to overcrowding and congestion in the Kuala Lumpur area. Nevertheless, Kuala Lumpur remains Malaysia's national capital, where the King and Parliament function are physically located. The economic power also has its headquarters in the center of the capital (Chowdhury 2015).

The city is divided into 20 precincts, and the designation of 40% of the entire city area as open space as an exclusive use. As a part of the program, the plantation of 1.6 million shaded trees was contemplated, as well as the creation of 400 hectares of artificial lake and 200 hectares of wetlands.

These areas perform the function of carbon sinks; the wetlands in particular have the function to filter the entire lake system water in replacement of a conventional system and the consequent energy saving. On the lake, a manmade island is the nucleus of the central business precinct while the housing follow the neighborhood ring type of arrangement (New cities Foundation 2014).

The entire water, neighboring and transit system was set to be a self-sustainable balanced ecosystem with interdependence of the surrounding environments (Roberts, Kanaley 2006). At the beginning, Putrajaya was set to have a Monorail which now it is an incomplete network system having in consideration at first the construction of a tunneled connectivity, but at the end a monorail plan was selected. It calls for two lines; Line 1, which is 12 km monorail route with 17 stations and Line 2, which is 6 km monorail route with 6 stations. Construction stopped in 2004, due to budgets constraints. The monorail would include the suspension Bridge, (currently incomplete) and the

Putra Bridge. The line would allow transfers to KLIA Transit (Kuala Lumpur International airport), connecting to Kuala Lumpur and Kuala Lumpur ERL station.

Putrajaya was awarded the "Sustainable City Status" in the Malaysia Urban Indicators Network (MURNInet 2010) in addition to the Asean Environmentally Sustainable City Awards 2011 by the ASEAN Working Group on Environmentally Sustainable Cities (AWGESC), Putrajaya Lake and all the Wetlands have been categorized as an Eco hydrological Operational Site by the UNESCO in the International Hydrological Program (IHP) (Yim 2013).

The master plan locates the administrative jobs concentrated in the city center, the commuting patterns of the trip makers tend to be more convergent at morning, midday and evening hours and this has led to a three peak moments of congestion in the day in some of the major highways, leading in and out of the city and as we will see, it is becoming a problem to be taking care of as it will potentially endanger the very nature of the sustainability of the city garden.

This phenomena is not new to Malaysia in general as a country as it is not in the whole Asia region, the new numbers in the GNP of the countries and in special Malaysia (The World Bank 2015) as shown in Fig. 2. In the region have created a strong and steady demand for products and goods, mainly in the automobile industry.

As the mobility is increasing correlated to the population and the expansion of the urban soil, Malaysia has a public transportation that is not responding to this necessity, and availability of the private car is immediate due to the a variety of factors, among others the low cost of the domestic industrial production, the cheap, available and extensive oil production and the existence of an ingrained tradition between Malaysian families. The main factor of incidence is the recovery of the region in terms of emergent economy after the big crisis in 2008 readable in the table of GDP growth (annual %). As shown in Fig. 3.

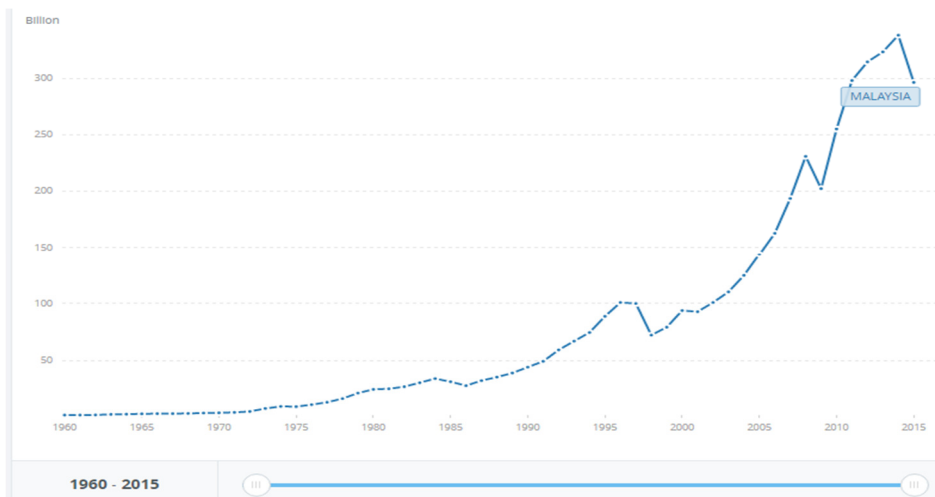


Fig. 2. GNP (Source: The World Bank 2015)

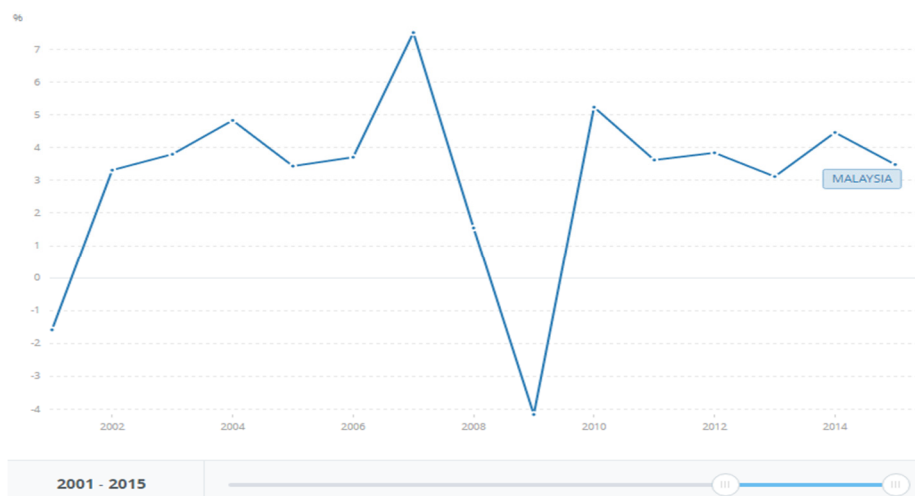


Fig. 3. GDP growth (annual %) (Source: The World Bank 2015)

Rapid motorization became one of the most active features of many East Asian cities such as Bangkok, Manila, Seoul, Jakarta and Kuala Lumpur (Dimitrou, Gakenheimer 2011). Over the 1980–1990 period, the spectacular economic growth of the East Asian and the so called miracle economies such as South Korea, Taiwan, Hong Kong, Singapore, Thailand, Indonesia and Malaysia created numerous employment opportunities, increased incomes and reduced poverty, generating the perfect conditions for the car ownership explosion.

The immigration to the Klang valley was due to the rapid recovery in the economy and played one of the most important factor of incidence in the increase of demanding for mobility in the federal territory. The total population of Kuala Lumpur increased from 1.21 million in 1990 to about 1.42 million in year 2000. It has a total employment of about 0.84 million in 2000 of which 83 per cent is in the tertiary sector.

During the tenth Malaysia Plan, the Malaysian economy expanded at a GDP of 5.3 % annually and between 2009 and 2015, the average monthly household also income expanded at the faster rate of 8.8% while employment was at low as 2.9 % (Eleventh Malaysia Plan 2020).

The natural consequence of these numbers can be translated into a spectacular increase in growth rates of motor vehicle registered (With a notorious recession during the crisis periods such as 1986–1988) and 1997. Numbers show the positive correlation between the rapidly-expanding car market in the Federal Territory of Kuala Lumpur and other parts of the Klang Valley and the economic performance with a huge economic role in all areas of the economy, being the urban expansion, the affluent of immigrants and foreign investments the articulators of the rapid demand.

This way, the number of vehicles registered in Malaysia has passed the 21.3 million units with Kuala Lumpur Federal Territory as the highest number of registrations with 4,914,992, as it is shown in Fig. 4. (Motor Trader 2011).

Out of this number, the industrialization process in Malaysia brought the automobile national plant (National Automobile Enterprise Co Ltd) or internationally known as Proton. By 1985 initially designed to produce 21.3 units per hour with a volume of 40,000 units per year on a single shift, or 120,000 cars a year over three shift (Chee 1995).

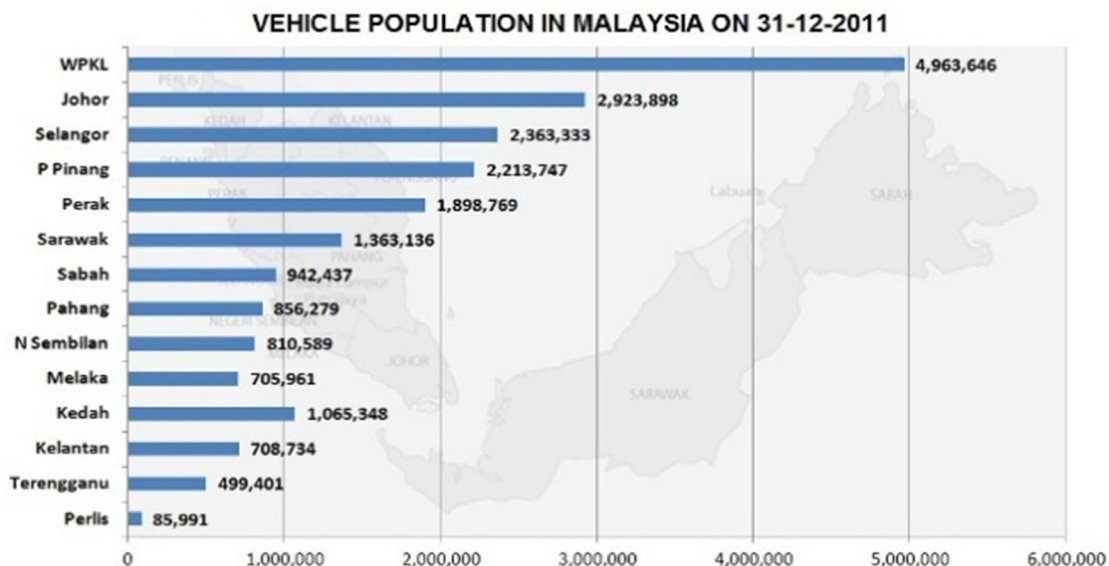


Fig. 4. Vehicle population in Malaysia (Source: Motor trader 2012)

In 1993, the Malaysian Government established another national car manufacturing company, Perodua (Perusahaan Otomobil Kedua Sdn Bhd) to absorb the increasing demand of the labor forces, and to strengthen its local auto industry with a better position before arriving at the ASEAN (The Association of Southeast Asian Nations) Free Trade Area (AFTA).

This way, with a growing and robust automobile market and the relocation of the Federal administrative center of Malaysia into Putrajaya added to a deficient and asynchronized integrated public transportation, the affluent of private cars inside the sustainable city during the day has suffered an increase as all the public administrative affairs including the expat, was located in the center.

The commuting to and from Putrajaya with this effects, plus the increasing numbers of employees that live in the city and in the vicinity satellites towns has generated an unsustainable traffic condition and a new source of pollutants. Important is to highlight the fact that the number of single occupancy vehicles has risen in a positive correlated pace with the number of cars in circulation, it is very frequent to observe one single occupant per car in a traffic jam and the kilometers of roads have not increase to fulfill the demand for space. Malaysia as a whole experienced a 15 per cent decrease in kilometers of road per 10,000 vehicles. This decrease is due to a higher rate of increase in vehicles, which grew by 41 per cent compared to 19 per cent for roads (Seventh Malaysia Plan 1996–2000).

Traffic is increasing therefore congestion is unavoidable being this one a major urban problem in many cities both in the developed and developing world, in the case of the increasing commuting between Putrajaya and Kuala Lumpur, congestion is a direct result of increased traffic flow as all the administrative matters are located in an specific urban center and there is no diversification of the paperwork to avoid the access to the core of the city.

In this specific case, the volume consists of a series of vehicles, in many occasions with a single driver of which each want to minimize their own journey of time on the road, and to benefit from the shortest time as the public transportation is inefficient on this aspect due to the many transfers to be make and the intricate access to the main central station from the periphery.

The increasing travel demand has been met in large part by private transportation. As a consequence, congestion and a serious deterioration of travel speed has become part of a daily situation on major roads in many parts of Kuala Lumpur, especially in the City Centre as well as in the east and south, and it is a new phenomenon in the frequency of the connection between the two urban centers, due to major traffic routes operating above capacity during peak hours. Low vehicle occupancy has further aggravated the problem and it seems to be an increasing factor.

Nonetheless, various measures have been successfully implemented, worth to mention one of the most important, the new traffic control in the City presently comprises a computer based area traffic signal coordination system SCATS/ITACA that are currently operating with 130 intersections. Extension of the existing traffic control system, together with an upgrading of the system's capability, though it is currently being implemented in phases but the system does not take in consideration as a decisive factor the road conditions and the Malay tradition of car ownership (Kuala Lumpur Structured Plan 2020).

Consulted about this topic Dr. Shahridan Faiez (PhD Cambridge, and Former Senior Sustainable Development Specialist of the World Bank) responded – “There is an ingrained tradition in among the Malay population about car ownership, when the older son reach 18 years old he will inherit a car as a new member of the family as adults.”

To this respect the vehicle is likely to be a motorcycle or a car, being the car the more usual one as the son receive the old one and the family buy a new one, creating the chain reaction of two and even 3 vehicles per family in every house in Malaysia.

When asked about what would be an effective and immediate solution in order to solve the huge traffic congestion in KL? Dr. Faiez answered “There is no immediate solution that will not create hardship to the citizens, especially the poor. KL needs an integrated approach that will involve the following elements:

- More efficient bus transportation and a greater coverage and connected to LRT/MRT system having in consideration to the adverse weather conditions in Malaysia. (Hot and humid seasons all year around).
- More efficient train system to bring passengers into and out of the city form the outskirts such as Klang, Nilai, Seremban, Tanjung Malim, etc.
- With the right financial model, expand existing MRT system-Provide dis-incentives for car driving into urban centers aggressive policing, high parking fees, limited parking, among others.”

Right now Bus service is provided from 6:30AM until 10PM to and from Cyberjaya, Putrajaya, Pasar Seni LRT station in Kuala Lumpur. The bus takes about 30 minutes-one hour, depends on the traffic flow. Usually, on non-working days the time the buses take to arrive at Putrajaya will be much faster, but the frequency of the buses will be accordingly reduced, however the alternative is not attractive to the Malay people due to the intricate access from the outskirts, making the private mobilization the preferred one.

“To make it even more complicated, the private sector involvement in transport infrastructure has expanded from the original role of bus and taxi operations to toll road construction, an important factor, and the implementation, operation, maintenance of the light rapid transit (LRT) and people mover rapid transit (PRT) systems.

Underutilization of bus services; and Unreliable and poor quality of interconnected services is the obvious aftermath of these policies”. Added Dr. Faiez.

As it is well known, cars make a significant contribution to overall emissions of CO₂ in the planet, a very important factor to be consider when planning a sustainable urban space as road transportation is also one of the major sources of emissions which are harmful to human health. Climate Change, is considered to be one of the greatest environmental threats facing the World today. When petrol or diesel are burnt for energy in an engine the main by-products are water and Carbon Dioxide (CO₂). Although it is proven to be not directly harmful to human health in a short term, is the most significant of the greenhouse gases contributing to Climate Change.

The approximated amount of cars entering Putrajaya can be calculated over an estimated number approximately 20,000 crossing the bridges daily (SPAD 2014) and the results can give an idea of how many CO₂ is expelled to the atmosphere and then precipitate to the wetlands and the gardens, over an estimated of 20,000 cars the amount of CO₂ emitted on an everyday trip to Putrajaya basis (taking in consideration the average extension of the urban grid as 16 km in an normal extension in a driving day inside the city) at an average of 160 CO₂ g/km, (ETA 2010) could reach daily 51,200,000 g of Carbon dioxide which is highly likely to precipitate into the wetlands water tanks, water treatment plants and gardens.

Discussion and Conclusion

The increasing surface of populated areas in the urban geography of Kuala Lumpur has proven to be a factor that triggers the necessity for mobility and accessibility to a different sectors of the city and their peripheral areas. The road connectivity plays an important role as Putrajaya as the administrative center of the nation is constantly acceded due to the nature of the functions allocated there. To fulfill this purpose, Kuala Lumpur does not possess an adequate integrated public transportation system to offer, this issue in concomitance with the fact of the existence of a profound ingrained tradition of legacy of the used cars to the older sons when they reach the majority of age are creating the conditions for a congestion and jammed condition of traffic between the cities.

One of the earliest options adopted to solve the situation, has been the policy of the construction of new motorways and toll expressways. However the strategy has somewhat failed to achieve its intended objective of curbing traffic congestion in Kuala Lumpur as many major roads leading to the city center are still experiencing traffic congestion especially during peak hours. Climate with a very hot weather condition during the whole year which makes the outdoor life very harsh on the commuters, plus two months of heavy rain due to the monsoon season, the lack of a synchronized connectivity, cheap access to vehicles and gas prices, makes the private car ownership the primary choice of the population to commute inside and between urban centers. Highway construction in Kuala Lumpur has not only proved to be too costly but also environmentally and socially inimical (Abd. Rahim Md. Nor, Nor Ghani MN Nor 2016).

The increasing demand for mobility had prompted builders to build the highways traversing densely-populated areas, without providing a proper and effective solution to the access to that part of the population to a public transportation deficiently interconnected to the existent grid.

The sustainability nature of Putrajaya is in an endangered situation as traffic continues to increase, as a result of the implementation of the administrative center of the country in its nucleus without the appropriate provisions of an adequate infrastructure to allow a synchronized accessibility and connectivity from the peripheries and surroundings of Kuala Lumpur.

The importance of the Putrajaya's experiment is essential when planning the design, implementation and the construction of a sustainable city, the rescued value of this experience is the precedent given, as an urban nucleus cannot be planned and executed without the analysis and study of the characteristics of the population, their traditions, values, education and their preferences as individuals, important as well is the functionality and the destination of the urban center in terms of purpose and services offered to the population, as Putrajaya reunite and concentrates all the governments administrative tasks which makes it vulnerable to a daily massive access from the Great Kuala Lumpur without the necessary provisions to detour the accessibility of a massive fossil fuel mobilization.

The sustainable city cannot be conceived without an exhaustive and comprehensive investigation and analysis of the surrounding urban nucleus and all the relationships in terms of connectivity and interactions they will have in the near future, in order to plan accordingly as the city is in a current ongoing and sustainably progressive and endangered situation.

A synchronized public transportation from and to Putrajaya and an effective connectivity to nearest neighborhoods is part of the solution at the same time of the prohibition of the entrance to fossil fuel combustion cars to the urban center, providing as an alternative an efficient monorail integrated to a bus service electrically powered and with a coverage to all the precincts inside Putrajaya, giving as an incentive the integrated form of payment, this is, one ticket from Kuala Lumpur is valid to all the connections and all the modalities of transportation.

Acknowledgements

Dr. Shahridan Faiez (PhD in Sustainability. University of Cambridge) for facilitating his valuable time to concede an interview and walking me through the most present matters in the topic subject. SPAD for valuable information available on its website.

Disclosure Statement

The author of the paper states that he doesn't have any competing financial, professional, or personal interests from other parties.

References

- Abd. Rahim Md. Nor; Nor Ghani M Nor. 2016. Empowering Public transport for urban environmental management, *Malaysian Journal of Environmental Management* 7(2006): 93–111 [online], [cited 02 January 2017]. Available from Internet: http://journalarticle.ukm.my/2241/1/2006_7_Rahim.pdf
- Chowdhury, S. 2015. *Green, smart and connected Putrajaya* [online], [cited 04 March 2017]. Smart City Business Institute. Available from Internet: <http://www.smartcbi.org/index.php/en/city-halls/65-asia/535-green-smart-and-connected-putrajaya>

- Chee, K. C. 1995. *A study on the national car industry and its impact on the Malaysian economy*: Unpublished M.A. Thesis, University of Malaya.
- Cox, W. 2013. The evolving urban form: Kuala Lumpur [online], [cited 08 February 2017], *New Geography*. Available from Internet: <http://www.newgeography.com/content/003395-the-evolving-urban-form-kuala-lumpur>
- Cyberview. 2017. *Sdn Bhd, Government-owned company* [online], [cited 10 February 2017]. Available from Internet: <http://cyberview.com.my/>
- Demographia. 2016. *Demographia World Urban Areas. 12th Annual Edition* [online], [cited 18 February 2017]. Available from Internet: <http://www.demographia.com/db-worldua.pdf>
- Dimitrou, H. T.; Gakenheimer, R. 2011. *Urban transport in the developing world: a handbook of policy and practice*. Edward Elgar Publishing, 20–23.
- Economic base and population. 2016. *Kuala Lumpur Structure Plan 2020* [online], [cited 20 February 2017]. Available from Internet: http://www.dbkl.gov.my/pskl2020/english/economic_base_and_population/index.htm
- Eleventh Malaysia Plan 2020. *Economic Planning Unit, Prime Minister's Department pp 2.1 / 2–3* [online], [cited 22 February 2017]. Available from Internet: <http://rmk11.epu.gov.my/book/eng/Eleventh-Malaysia-Plan/index.html>
- ETA. 2010. *Calculating a car's CO2 emissions from its mpg* [online], [cited 22 February 2017]. Available from Internet: <https://www.eta.co.uk/2010/02/22/calculating-a-cars-co2-emissions-from-its-mpg/>
- Ismail, M. A.; Said, M. N. 2014. Integration of geospatial multi-mode transportation systems in Kuala Lumpur, in *7th IGRSM International Remote Sensing & GIS Conference and Exhibition*, 21–22 April 2014, Kuala Lumpur, Malaysia. <https://doi.org/10.1088/1755-1315/20/1/012027>
- KL Sentral Station [online]. 2016 [cited 02 March 2017]. Available from Internet: <http://www.lcct.com.my/others/places/kl-sentral-station>
- Kuala Lumpur Structured Plan 2020 [online], [cited 02 March 2017]. Available from internet: <http://www.dbkl.gov.my/pskl2020/english/index.htm>
- Motor trader. 2011. *21, 25 million vehicles on Malaysian roads* [online], [cited 02 March 2017]. Available from Internet: <http://www.motortrader.com.my/news/21-25-million-vehicles-on-malaysian-roads/>
- Motor trader. 2012. *Malaysia's vehicle population* [online], [cited 02 March 2017]. Available from Internet: <http://www.motortrader.com.my/news/malaysia-s-vehicle-population/>
- New cities Foundation. 2014. *Putrajaya, Malaysia: designed as an intelligent garden city* [online], [cited 10 March 2017]. Available from Internet: <http://www.newcitiesfoundation.org/cityquest-putrajaya-malaysia-designed-intelligent-garden-city/>
- Roberts, B.; Kanaley, T. (Eds.) 2006. *Urbanization and sustainability in Asia, case studies of good Practice*: Asia Development Bank, 232–235.
- Seventh Malaysia Plan 1996–2000. *Economic Planning Unit, Prime Minister Department* [online], [cited 19 March 2017]. Available from Internet: <http://www.epu.gov.my/en/rmk/seventh-malaysia-plan-1996-2000>
- Smart City Business Institute [online]. 2015 [cited 12 March 2017]. Available from Internet: <http://smartcbi.org/index.php/en/>
- SPAD (Land Public Transportation Commission). 2014. *Annual Report 2014* [online], [cited 10 March 2017]. Available from Internet: <http://www.spad.gov.my/sites/default/files/Annual-Report-2014.pdf>
- The World Bank. 2015. *Malaysia* [online], [cited 16 March 2017]. Available from Internet: <http://data.worldbank.org/country/malaysia>
- Yim, L. A. 2013. *Putrajaya into green growth city* [online], [cited 16 March 2017]. Economic Social Commission for Asia Pacific UNESCAP. Available from Internet: <https://sustdev.unescap.org/Files/Malaysia%20Putrajaya-into-Green-Growth-City.pdf>
- World Population Review. 2016. *Kuala Lumpur Population 2016* [online], [cited 16 March 2017]. Available from Internet: <http://worldpopulationreview.com/world-cities/kuala-lumpur-population/>