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Literature Review

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What sustainable urban transportation solutions could be suitable for developing countries?

Sustainable transportation refers to a system involving a range of different aspects such as affordability, availability, efficiency, safety, self-sufficiency, reliability, and being environmentally friendly. Cities in developing countries are under severe pressure due to increased motorization, urbanization, and population growth. The United Nations projects that 66% of the world's population will live in urban cities by 2050 (UNESA, 2014). Therefore, it is essential to work on transportation systems, which will have a significant contributing factor to the quality of life of the majority of the people on the planet. Roads are the backbone of an economy, while a sound transportation system is the beating heart of a city. If the system clogs up, the heart stops, and the entire economy dies. Roads link people, build markets and facilitate trade. Developing countries can take many different routes that lead to sustainable transportation, such as road-based public transport, road infrastructure, rail-based public transport, and non-motorized travel modes. According to Oxford Languages, developing countries are poor agricultural countries that are seeking to become more advanced economically and socially. This literature review targets policymakers (politicians) working towards a sustainable transportation system, researchers working in the transport domain of development economics, and the residents of developing countries. This review provides the widely known solutions that can be implemented in urban cities of developing countries.

A good road infrastructure can minimize travel time, accidents, and emissions. More important transportation systems such as road-based public transport are built on roads, making them a core necessity. People from all social and economic backgrounds have access to similar services. Roads link people, build markets, and facilitate trade. Contrary to popular belief, increasing the size and

number of roads (including flyovers) does not efficiently address the problem of traffic congestion; however, it leads to "induced travel." Induced Travel occurs when the increased capacity leads to a great demand for the new and improved roads, which eventually leads to pre-expansion levels of congestion. Moreover, wider roads cut down economic activity as they occupy sidewalks, leading to no space for entertainment hubs.

Roads need to be safer for the system to be sustainable. Therefore, strict driving courses should be made compulsory to earn a driver's license. Traffic education should be provided in schools to be well-informed about behaving in such an environment. Stricter traffic laws with heavier fines must be enforced to disincentive reckless behavior and penalize any damages. Prohibition of cargo traffic during peak hours to release pressure on existing traffic. Awareness of apps such as google maps that inform drivers to take alternate routes to avoid traffic jams.

Creative and cost-effective solutions such as Urban freight consolidation centers in the United Kingdom can be implemented in developing countries to relieve traffic congestion. As the population in urban cities grows, their demand for goods also grows. Instead of delivering each parcel to a designated location, the parcels are collected in city freight consolidation centers to be dispatched collectively, reducing energy consumption. In theory, the policy relies on effective coordination between freight delivery companies, local businesses/retailers, and city councils. They can transport goods during off-peak traffic hours while also avoiding double trips to a nearby location through their communication. Case studies conclude that urban consolidation centers reduce business costs, increase the load balance of transport, and cut down urban traffic and emissions (Triantafyllou et al., 2014).

An efficacious road-based public transportation system is key to the economic growth of developing cities. The majority populous have access to employment, education, and public services through road-based transport. Regrettably, the current state of road-based transport in many developing countries does not serve the mobility needs of the residents. In recent years, bus lane marking on existing roads has been a common low-cost approach, improving the quality of bus systems worldwide. The latest technologies provide a further advantage to vehicles in bus lanes by preferring to pass first through an intersection. However, temporary parking in bus lanes, delivery vehicles, and no respect for traffic laws have made the system redundant as they lead to a state of gridlock. The solution is to physically isolate bus lanes using physical barriers.

Bus Rapid Transit (BRT) is a fully developed bus-based mass transit, which provides the full services of rail-based transit.

BRT systems reduce energy consumption and emissions tremendously by providing an alternative to private transport. Instead of fifty cars with fifty passengers, only one bus caters to all the individual passengers while also reducing the space occupied by the fifty cars on the road. Comparative assessments of BRTs around the globe have concluded that most systems have improved their local travel conditions by reducing travel time and enhanced reliability (Pojani & Stead, 2015).

“BRT can be developed at substantially lower costs than rail transit. BRT systems typically cost between \$1 m and \$8 m per kilometer depending on the complexity and size of the project (the need for overpasses or underpasses and the need for property acquisition). Even in developed cities with higher labor costs, BRT costs less than \$10 m per kilometer. If properly designed, BRT can operate at affordable fares (\$1/ride) without subsidies” (Pojani & Stead, 2015).

Rea Vaya, Bus Rapid Transit System in Johannesburg, is a success story that motivates other countries to adopt BRTs. The total cost of construction for the project was estimated to be US\$749 million in net present value, while the economic returns (including more comprehensive benefits) are estimated to be US\$900 million in net present value (*MOBILIZING SUSTAINABLE TRANSPORT for DEVELOPMENT*, 2016). BRT can be developed at relatively lower costs than rail transit, as developing countries have limited funds to allocate for transportation.

Non-motorized modes of transport such as cycling and walking are healthy for the passenger and the environment as they lead to zero emissions. Moreover, research has supported that the likelihood of collision between a pedestrian or cyclist and a motor vehicle is inversely related to the amount of foot or bicycle traffic (Jacobsen, 2003). It is a fact that non-motorized trips would increase travel time, but residents in developing countries would prefer a higher time cost relative to a higher financial cost (Dimitriou & Gakenheimer, 2012).

Car-free zones in city centers could eliminate the problems of traffic congestion. An extensive network of bicycle lanes, bicycle parking, and integration with public transport (public busses with bicycle holders) would incentive the population to move to a healthier and cheaper transportation medium.

For some cities, it is not possible to eliminate motorized vehicles due to climate change. The temperature in certain cities becomes unbearable, and it is not humanly possible for people to cycle to work under such harsh conditions; therefore, switching to mass transit systems is a more efficient and long-term approach to making Travel more sustainable.

Metro systems are generally one of the most expensive forms of public transport to construct and operate. They are designed for an enormous capacity of passengers (30,000 to 40,000) and usually operate in densely populated cities.

Delhi metro is an example of low carbon and sustainable urban transport solution. "Dehli metro carries 2.8 million passengers a day, replacing 400,000 vehicles on the road, saving 300,000 tons of oil import per year, and preventing 70 tons of pollutants being let into the air every day. Each commuter saves 32 minutes in his/her journey, and about 135 road fatalities are avoided per annum" (*MOBILIZING SUSTAINABLE TRANSPORT for DEVELOPMENT*, 2016).

Developing countries could adopt such systems, which are very beneficial in the long term. After WWII, The Japanese government implemented policies that discouraged automobiles use and incentivized public transport. Their urban transportation system led to rapid economic growth as the aggregate transportation costs were minimized while also limiting the use of private vehicles. Today, Japan has one of the most efficient railways systems and is well known for its punctuality. Due to their high capital requirement and operation cost, they are not feasible in medium-sized cities and would be effective in megacities. Moreover, it is not feasible to build a railways system in unplanned and existing cities as it would lead to population displacement and unproductive routes.

In upcoming years, boring tunnels could potentially be the solution to the problem of population displacement and climate change. The boring company is a venture by Elon Musk that aims at creating underground weather-proof tunnels throughout cities. Eventually, existing developing cities can make their tunnels to support the increase in demand for transportation by providing underground railways and roads. Further research is needed to confirm if it is feasible to construct such tunnels in different developing countries.

The governments of the developing countries should disincentivize private transport through intelligent policies. The governments in developing countries could impose fuel taxes based on

emissions and further taxes on vehicle purchases to decrease the demand for private transport. Through price controls and quantity restrictions, fuel prices are artificially kept low in developing countries which cascades to much more significant economic problems such as booming black markets, smuggling, and fuel shortages.

“The availability of free or underpriced parking also fuels car ownership and use and increases “search-for-parking” traffic” (Shoup, 1997). Russia was struggling with similar issues that led to frequent gridlocks in the city; they introduced 67,000 paid parking spaces that generated EUR 90 million in revenue by 2012, the sum was later invested in neighborhood improvements, as well as the development of public transport (*MOBILIZING SUSTAINABLE TRANSPORT for DEVELOPMENT*, 2016).

Other countries should adopt similar policies as it has proven effective in resolving the issue and has generated funds. Allocating parking space in a city might incentivize car sales to increase, but an expensive parking fee would turn private transport into a luxury product in the long term and discourage private transport ultimately. In the meantime, the governments should subsidize electric vehicles, encouraging everyone (especially celebrities) to switch to electric vehicles, encouraging others to switch to more eco-friendly modes of transport. A wide range of vehicles such as garbage trucks, cargo trucks, and busses can run on alternative fuel sources such as electricity and biofuels, which would relieve pressure off fossil fuels and eliminate emissions. Pricing mechanisms are more efficient than regulatory approaches since they offer private transport users more choice, raise funds, and can be altered according to the situation at hand (Anas & Lindsey, 2011).

Sustainable urban transportation is necessary for developing countries as it fuels the growth of their important cities. Every place is unique with its own set of circumstances; any densely populated urban city can have its sustainable transportation system with the right set of policies. Some cities can focus on non-motorized modes of transport while others can plan road-based bus systems to accommodate the population. Each policy has its positives and negatives, such as rail-based public transport is one of the most efficient and fastest modes of transport able to accommodate the majority of the population, but it is not economically feasible to construct in developing countries. Therefore, developing countries would afford BRTs instead as they are relatively cheaper and cost-effective. There are many ways to move existing systems towards sustainability, such as exclusive lanes for bicycles and busses, pedestrian-only zones, especially in

areas with markets and reasonable parking fees. It is not necessarily essential to develop unique solutions to solve the existing problems in the countries; developing countries can take the example of successful policies in other cities across the globe and implement similar policies to address their issues.

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