TRANSPORT AND ENVIRONMENT FOR SUSTAINABLE DEVELOPMENT OF THE THIRD WORLD: STRATEGIES FOR NIGERIA

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Abstract
Non-polluting transportation systems that provide high level of amenities and are at the same time low in energy use are needed in both developed and developing countries, including Nigerian cities. Honest pricing of different means of transport (for both passengers and freight) and the introduction of more efficient and rational vehicles are among the most important steps that need to be taken. This study examines the strategies open to Nigeria to attain these objectives.

Introduction

Less than a hundred years ago, human and animal transport of people and goods was common. This is now largely replaced by transport involving petroleum burning engines on land, water and air. Transport infrastructure and provision have grown to immense proportions. Civil aircraft flew 1.7 trillion passenger kilometers in 1990. Over 400 million tonnes of freight are transported annually. And, there are now more than 500 million motor vehicles in the world (Banister *et al*, 1994)

The growth of transport has undoubtedly brought many economic and health benefits. But it has brought problems too, leading to environmental crises of energy, air pollution and congestion. It is not only the transport industry's current size that makes it so

environmentally crucial, its continued rapid growth. Developed countries already have extensive transport infrastructure – roads, railways, airports, bus systems and others, yet many are still planning further expansion (WHO, 2002; CEC, 2002).

In developing countries, the level of transportation provision is much lower, but is expanding at an extremely rapid pace. For example, car sales in Malaysia rose by more than 70% annually at the end of the 1980s. Globally, the car population is growing even faster than the human one. Today's half a billion vehicles are expected to increase to one billion or more early in the next century.

The air has been severely polluted in the villages, towns and cities, where most of the world's population lives. Though the word 'smog' was coined in the United States, photochemical smog due to vehicle emission is now turning many megalopolises both in developed and the developing world into virtual disaster areas. Population in an increasing number of areas is regularly exposed to air pollution levels above the limits set by the World Health Organization (WHO, 2002; Borzel, 2002; Robinson, 2004).

The hallmark of the policy thrust in the relationship between transport and environment is a clear need for sustainable transportation and environmental development. This is the focus of this paper with specific reference to the Nigerian cities.

Literature Review

Following world conferences on the environment held in Stockholm in 1972, Rio de Janeiro in 1992 and Istanbul in 1996, there has been greater concern for the global development process to seek for integration of exploitation of resources and economic growth and physical development. The need to improve the quality of life of city inhabitants through their production and consumption activities, without compromising the ability of future generations to meet their economic, social, cultural, health and political needs, remains the focus of sustainable urban development (Mitlin and Satterhwaite, 1998). Mobility, which is perhaps the most fundamental human need in the

process of urban life, requires the consumption of non renewable resources. Sustainable mobility development, therefore, implies that consumption activities should be able to take into consideration effective utilization of available resources and develop environmentally friendly system for the mobility of the people that would not damage the natural resources, but rather have some positive effects on the same environment (Ogu and Adeniji, 1998).

In addition, car emissions also cause significant air quality problems. Hydrocarbons, nitrogen oxides and carbon monoxide undergo reactions in the atmosphere to produce ozone. Sixteen kilometers up in the stratosphere, ozone acts as a vital shield against the sun's ultraviolet radiation; but in the lower atmosphere it is a pollutant. Nitrogen dioxide also causes direct health risks and its level in many big cities and the Nigerian cities in particular often exceed international health norms.

Government around the world have instituted vehicle emission limits to try and control transport air pollution.

Table 1.1 shows selected countries legal limits for nitrogen oxides, hydrocarbons, carbon monoxide and particulates. Limits are being made still tighter in many countries.

Table 1.1: ***Legal exhaust emission limits for cars in selected countries***

Country	Year	NOX	Hydrocarbons	CO	Particulates
Australia	1986	1.93	0.93	9.3	
Brazil	1990 1992 1997	2.0 1.4 0.6	2.1 1.2 0.3	24.0 12.0 2.0	
EC Countries	1993	-	1.11	3.16	0.18
EFTA Countries	-	0.62	0.25	2.1	0.124
Hong Kong	1992	0.63	0.26	2.1	
Japan	1978	0.25	0.25	2.1	
Mexico	1990 1991 1993	2.0 1.4 0.62	1.8 0.7 0.25	18.0 7.0 2.11	
South Korea	1987	0.62	0.25	2.11	
Taiwan	1990	0.02	0.75	2.11	
USA	1987 1994-6	0.62 0.25	0.25 0.24	2.1 2.1	

Source: Enviro 13, Swedish Environment Protection Agency (May, 1992)

Noise is another serious environmental problem caused by transport. Road traffic, high-speed trains and planes all cause a nuisance and harm to growing numbers of people. Over 100 million people in the OECD countries are exposed to road traffic noise in excess of 65dBA. One measure of the seriousness of the problem is that the European community recently passed a law to cut maximum allowable vehicle noise by 50% from 1996 (OECD 1995).

Transport generated waste is an under-recognized but growing environmental problem, especially waste from road vehicles. In regions where vehicle density has been high for some time, millions of vehicles are scrapped every year. Traditionally, the high steel content in vehicle scrap has been recycled and other components land-filled. Changing patterns of materials use, especially the growing proportion of plastic components in cars, has led to a disposal crisis in some countries (Mackenzie and Walsh, 1990)

Energy and the regulation of air pollution remain the biggest areas of research activity. Though, numerous companies and research institutions are experimenting with petrol additives or substitutes designed to cut air pollution or to take transport beyond its dependence on fossil carbon fuels (see Table 1.2), some of the new technologies are more experimental than others. In Brazil, cars have been running on a petrol/ethanol blend since 1975. Liquified petroleum gas is used routinely in Italy, Japan and other countries. Fuel oxygenate petrol additives are in widespread in the United States (UNEP, 1993; Chapman and Hall, 1992).

Table 1.2: ***Comparison of Alternative Transport Fuels***

Fuel	Adequate resource Base	Manageable fuel properties	Green house gas and other emissions	Feasible hard ware modifications	Cost comparative (currently)	Available (market ready)	Effect of existing regulations
Compressed natural gas	+	+	+	+	+	+/-	-
Liquefied natural gas	-	-	+/-	+	+	+	-
Methanol	-	-	+/-	+	-	-	+
Ethanol (Maize)	-	+	+/-	+	-	-	-
Ethanol (Woody biomas)n	+	+	+/-	+	+/-	-	-
Reformulated gasoline	+/-	-	+/-	+	+	-	+
Oxygenated (MTEB/ETBE)	+	-	+/-	+	-	+	+
Electricity	+/-	+/-	+/-	-	-	+/-	+
Hydrogen	+	+/-	+/-	-	--	-	-
Solar energy	+	+/-	+	-	-	-	+/-
Fuel cells	+	+	+	-	-	-	+

+ Advantageous - Disadvantageous

+/- Both advantageous and disadvantageous

Source: steering & new course, union of concerned scientists (1991)

Cities as Environmental Hazards

Almost all the major human induced affronts on the physical environment appear to be the direct or indirect result of cities (Boyce, 1982). In fact, cities are the catalysts of change for the physical environment. They are the centres from which landscape degradation emanates. Thus, cities are the focal points for all manner of physical inputs and the places from which all manner of manufactured and outcast materials are distributed.

It is clear that urban sustainability policy required operational insight into environmental quality conditions measured by means of indicators. In our discussion of urban environmental problems we will make a distinction between impacts on the natural and on the social environment of a city (Camagni, Capello and Nijkamp, 1995).

a. **Environmental Problems with an Impact on the Natural Environment**

Atmospheric Pollution

All pollutants discharged to the atmosphere are beyond critical concentrations – harmful to plants, animals and humans. Some are harmless in typical ambient concentrations; others have indirect effects that may be harmful. Some have effects that are local or regional, and some have global effects. The air pollution in many urban areas causes severe problems. We can distinguish between emissions which pollute the urban atmosphere.

Carbon Dioxide (CO_2)

Carbon dioxide emissions stem from the combustion of fossil fuels. They are seen as the main contributors to the green house effect. Even relatively high amounts of carbon dioxide have no direct known detrimental effect on personal health. The problem of carbon dioxide is that it represents heat escaping from the planet, which may generate climate changes. Climate modelling is indicating that by the year 2030 the atmospheric CO_2 concentration may result in an average

temperature rise of the earth climate between 1.5 and 4.5 centigrade. The result of global warming include a rise in the sea level, caused mainly by the thermal expansion of the oceans, with the risk of coastal area floods. When we keep in mind that a large number of big cities is located near coastal areas, the CO_2 emissions are not only a global threat but also a local threat.

Nitrogen Oxide Emissions ($N0_x$)
At trans-boundary levels, nitrogen oxide emission converted to nitric acid and combined with sulphur dioxide, form a significant component of acid rain which has serious detrimental effects on many ecosystems.

Sulphur Dioxide
Sulphur dioxide can cause bronchitis and other diseases of the respiration system, and it is the main contributor to acid rain. The consequences of acid rain include damage to aquatic life, forest and crop fields, and corrosion of structures and materials. Clouds beeting acids may travel hundreds or even thousands of kilometers across several borders to produce acid rain in regions other than the one producing the original emissions.

Carbon Monoxide (CO)
Carbon monoxide is especially a problem in urban areas where synergistic effects with other pollutants contribute to photochemical smog and surface ozone (O_3).

Particulate Matter
Particulate matter contributes significantly to visibility reduction and, as a carrier of toxic metals and other toxic substances, exerts pressures on human health.

Depletion of Energy Resources
Due to the high use of energy in the city by transport, houses and industry, many energy resources are over-exploited. Excessive

exploitation of carbon-based fuels is often seen as the major problem. Although the exploitation of the resources causes only little environmental problems in itself, the effects of over-exploitation cause severe negative effects on future generations. In this context, renewable energy plays a potentially important role in sustainable city initiatives.

b. Environmental Problems with an Impact on the Social Environment

Noise

In urban area especially, the noise caused by the different economic activities is a big problem. It has been estimated that about 110 million people in the industrialized world are exposed to noise levels in excess of 65dB(A), a level considered as unacceptable in OECD countries (Camagni *et al*, 1995). Noise has several different effects on health and well-being. These effects further induce psychological and physiological disorders, such as stress, tiredness and sleep disturbance.

Negative Feedbacks of Transport Activities: Mobility versus Accessibility

The negative feedback of transport activities is not irrelevant in modern societies, and risks to become even greater if efficient intervention policies in favour of environmental protection are not put in place. The list of cost is a long one: air and water pollution noise and vibration and road casualties are just some of the examples. According to Swedish studies, urban air pollution causes between 300 to 2000 new cases of cancer annually (Capello and Gillespie, 1990). Traffic accounts for 70% of the emission of carcinogenic substances that may affect the genes of people living in urban areas.

As far as cities in developing countries are concerned, the virtuous circle does not look the same as before (Table 1.3). Also in this case, the mechanism is activated by supply driven policies which develop transport infrastructures in cities. The first impact on

accessibility is the same as in the case of developing countries, but then:

More accessibility generates more development, as new activities are attracted or generated (transport infrastructures is a direct precondition for development); more development has two kinds of effects: from one side it acts on sustainability through more investments in the quality of social services, sewerage systems and sanitary infrastructures, at present very low in developing cities. All these have a positive impact on the quality of life in urban areas, and thus on sustainability. From the other side, economic and social development have a positive effect of per capital income growth in developing countries and have underlined the fast rise by the consumption of non-durable goods, such as cars and electric appliances, usually second-hand, high energy-consuming ones. What is even more worrisome is the fact that forecasts on the number of car ownership in developing countries estimate a substantial increase by the year 2025 (Houghton and Hunter, 1994).

As is the case in developed cities, in the long run more mobility generates more congestion and thus less accessibility. Most of developing cities are in fact already affected by congestion on urban roads, which is the result of an increase in car trips and very poor quality of transport infrastructures (roads and public transport services). Bangkok is a clear example of a highly congested city, with severe traffic problems: overall, Bangkok's public transport carries only 33 percent of total annual passenger kilometers in the city, compared to an average of 64 percent in Singapore, Tokyo and Hong Kong. At the same time, Bangkok has 51 percent of daily trips by private transport, and is recognized to be the most severely congested city in the world (Paboon and Kenworthy, 1995).

Table 1.3: ***Social cost in relation to transport modalities (By percentage)***

Social costs	Air	Rail	Inland water ways	Road	Total
Air pollution	2	4	3	91	100
Noise pollution	26	10	0	64	100
Land coverage	1	7	1	91	100
Construction/ maintenance	2	37	5	56	100
Accidents/ causalities	1	1	0	98	100
Total in billion DM/year	2	14	2	68-77	86-95

Source: Whitelegg, 1988

Transportation Scene in the Cities

The discourse on the transportation in the cities cannot be differentiated from the basic issues in the development and growth of the urban centres and cities. Two major factors continue to explain the pattern of growth of the cities in Nigeria: rapid rate of urban growth, in terms of the population and numbers of the settlements that are urban; and widening gap between demand for, and supply of infrastructure and services, including transportation (Oyesiku, 2005). The consequences of the rapid rate of growth and slow growth in the overall socio economic development include; shortages of infrastructure and services; fragmented city management structure; slow rate of response to urban problems; poor living standard; and mobility and accessibility difficulties (World Bank, 1996; Oyesiku 2001a, 2001b; Atubi and Onokala, 2004a, 2004b)

In the Nigerian metropolitan and intermediate cities that are experiencing chronic city transportation problems, sustainable transportation development requires direct government interest for environment, safety and improved health of the people. It may be argued that in an environment that there is inadequate transportation infrastructure, poor network, complete absence of bus-stops,

inadequate vehicles for public transportation system, that the issue of balancing production and consumption or transportation services may be meaningless. The argument goes further: that the level of the transport sector in Nigeria and in Africa in general has not reached that of Europeans or the Americans and therefore should not be of concern to the government and researchers; and that the transport sector being heavier polluter of the environment and also a contributory factor to landscape deterioration and climatic change, has no corresponding impact on the environment in the developing countries (Oyesiku, 2005).

The gap in this thought is that people need to wait till they experience the problem caused by transportation development in the developed countries before thinking of what to do. More fundamentally is the fact that fatality resulting from transportation and congestion in the third world countries is higher per capita than in the developed country. Thus, with recently experienced rapid rise in car ownership and mobility, the fatality rate is expected to increase. Similarly, the nature and type of congestion in many Nigerian cities show that an average resident traveling to work spend longer time than an average resident in any other part of the world. The cost and time implication of this is becoming unbearable, particularly as it is affecting work productivity and health of the residents.

The import of the foregoing is that living and working in the cities that are dependent on the use of private cars and motorcycles (that have no capacity restraint for accident) is increasingly at odds with sustainable development and the negative consequences of the effect of mobility must be addressed.

Sustainable Transport Systems Policy Measures

The conventional strategies of policy perspective of sustainable transport are in two directions:

a. Road pricing in form of tolls to finance improvement in the technology, roads infrastructure and reduce congestion to a tolerable limit; and

b. User charges to cover investment in new public transport and to compensate for external cost of use of transport.

The extent to which these policy strategies have worked even in the developed country is still being debated. Lack of consensus on the effectiveness of this policy thrust is to the extent that external costs are difficult to measure and the impact of the use of transport affects everybody. Nevertheless, the extent to which various modes of transport impact the environment and the population is not in doubt. Table 4 shows that rail network has the smallest impact on the two significant aspects of the use of transport, which are the soil and health of the people.

Table 1.4: ***Impact of the Environment by the Modes of Transport***

	Air pollution	Water pollution	Soil pollution	Health and safety
Road	***	*	***	***
Rail	*		**	*
Inland water ways		**	*	
Sea	*	**	*	
Air	*		*	*

* Small impact ** Significant impact *** Great impact
Source: Nijkamp, 1994

In the light of the impact of different modes of transport in the immediate environment of the population, policy strategies should be geared towards harnessing the mode that holds a lot of potential for easing city transportation problems, that does not pollute as such, takes limited space and provides a great deal of flexibility. Such a mode of transportation that improves the energy performance of transportation systems and moves the mass of the people in several directions at the same time should be the focus for sustainable development in the intermediate cities. Two of such environmentally sustainable related

policies are: to encourage the use of bicycles rather than automobiles, and revitalization of the rail system and development of rapid and light rail system in the intermediate cities. The policy strategies aiming at sustainable modes of city transportation are less dependent on fuel, have a short run effect on the environment and have long range mobility sustainability (Oyesiku, 2005).

Complementary Policy Measures

A complementary policy strategy must comprise a broad set of measures that will improve the qualities and quality of the public transport system. Better co-ordination and management of the existing transportation modes as part of the development of the public transport should be a major focus of government attention. The public service approach to management of public transportation has failed as the operating costs are never covered and buses continue to depreciate, yet government operators charge the same fares as those of private operators (Oyesiku, 2005; Atubi and Onokala, 2006).

In addition, effective maintenance of the existing road network to improve the surface condition and connectivity is imperative. This policy measures must also be complemented by some user charges, such as regulator or prohibitive measure of parking within the commercial areas, higher taxes for vehicle licenses and renewal of the existing fleet and co-ordination of user charges (Wallace, 2000; Willoughby, 2001; Atubi and Onokala, 2005).

An often-neglected aspect of causes of traffic congestion and associated transport problems in the cities is lack of control of spatial location of activities. This particular deficiency in the overall physical planning of the cities has caused long hours of journey to work. To ensure good co-ordination between transport and land use, physical development policy must be designed to fully enforce land-use and physical planning regulations and effective development control of various land uses (without exception of the government agencies and religious organizations). The development guidelines should ensure redistribution of human activities and provision of guidelines for

emerging urban settlement that are sprawling in all direction of the cities (Atubi and Onokala 2004a).

Conclusion

The discussion of transport and environment in developing countries has given a number of conclusions and indications of conclusions which need further examination. It is also worthy to note that developed countries are attempting to reduce environmental problems caused by transport technology while Nigeria is encouraging the importation of used vehicles imported to the country and which aid the degradation of the environment.

The observed and discussed urban transport crisis is to pave way for a detailed discourse on sustainable transport development uses, with a view of ensuring a balance between modern transportation systems and achieving the objectives of mobility of the majority of the urban population viz. safety, comfort, effectiveness, efficiency moderate cost and just in time. The existing urban transport policy measures have not focused on sustainable transportation approaches that can meet the challenges of contemporary Nigeria's development and at the same time ensure minimal mobility and accessibility crisis.

Nigerian government should avoid cumulative negative impacts of transport on urban environment. Therefore, environmental policy needs to be broadened and intensified. This is because, further transport development is inescapable. However, it must be done in a way that meets the needs of the present without compromising the ability of future generation to meet their own needs.

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