An Assessment of Traffic Congestion and Its Effect on Productivity in Urban Ghana

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Abstract

Whereas traffic congestion disrupts business activities and reduces productivity level, research has shown that it may also be a symbol of growth in an economy. As the economy grows and real income of household increases, vehicle population surges up, contributing to traffic congestion, particularly within cities. Given the critical importance of productivity on the Gross Domestic Product (GDP) growth, it is economically worthwhile, and of policy importance to recognize the deleterious effect of traffic congestion on productivity. This study attempts to assess the extent to which congestion affects worker productivity. The study focuses on the transportation system in Kumasi Metropolis, Ghana. Kumasi was chosen for the research due to its strategic location as a transit point to the north, south, central and western parts of Ghana, which makes it prone to traffic congestion. The study adopted survey strategy on five major road links in the metropolis. Primary data was collected using questionnaire instrument. Descriptive statistics was used to analyse the data with the aid of Statistical Package for Social Sciences (SPSS). The results from the analysis indicated that mobility in Kumasi Metropolis is restricted due to congestion, causing excessive travel delays, particularly, during peak hours and negatively affecting productivity. Therefore, expanding transport infrastructure as well as improvement in the traffic management and control system should be given attention to improve the transportation system in the metropolis. This would enhance worker productivity and ultimately increase GDP.

Key words: Transportation system, Traffic congestion, worker productivity.

1. Introduction

Improving the social and economic wellbeing of the citizenry is the aim of every nation. The long-term goal of government is to raise the standard of living of all Ghanaians to a level consistent with that of middle income economy. One basic economic and social necessity that comes into focus when discussing economic and social development is transportation. Transportation is an activity of life processes and seeks to provide access to various activities that satisfy mobility needs of humankind (Arasan 2012).

According to Eddington (2006), an effective transportation system is significantly important in sustaining economic growth in contemporary economies since it provides linkages between different parts of the country and the global world. It links to work, deliver products to market, underpins logistics and supply chain, and support local and international trade. A good-established transportation system is not only key to national growth but also serves as catalyst for economic development of a country. Thus, there is a relationship between transportation and productivity (Lu *et al.* 2009).

Economic and social activities of human kind revolve around transportation. It is a link to almost all sectors of an economy. Virtually everything we do relies on transportation. Trade within and between different regions is vital to economic development and directly depends on transportation (Kulash 1999, World Bank 2002). Thus the importance of transportation to societal growth cannot be underestimated. Broadstock (2011) and Pacione (2005), state that increasing wealth and high population, and availability of vehicle loan facility result in more car ownership than current transportation network can handle. It could be inferred from the above statement that there is a relationship between income level and car ownership and that the dominance of private car usage, particularly within cities, is likely to increase even further as a result of rise in household income with its attendant traffic congestion and high consumption of fuel.

Again in Kumasi, cars and taxis dominate the transportation system within the Metropolis. The Central Business District, (CBD) is characterized by too many cars and taxis. Cars and taxis form about 77% of the traffic mix yet account for less than 30% of all person trips (Urban Roads 2004). This situation has contributed to excessive traffic congestion within the Metropolis, especially at the CBD and thus affects the logistics system and business activities in the metropolis. The aim of this paper is to examine the traffic congestion situation in the Kumasi metropolis and how it affects worker productivity.

2. Urban Transportation

Urban transportation refers to the system of transportation that provides access and mobility for people and goods within cities. Elements of urban transportation include public transit (collective transport); non-motorised transport (pedestrians, cyclists) and freight. Effective urban transport systems are essential to economic activity and quality of life. Urban transportation opens up opportunities to access essential services as well as social activities (Arasan 2012, Rodrigue *et al*. 2009, Lu *et al*. 2009). Business activities depend on urban transportation systems to ensure the mobility of its customers, employees and suppliers. The urban transport services cover a range of important social and economic services such as leisure trips business journeys; commuting; shopping; trips to places of education and freight distribution. Effective urban transport fulfills the demand for accessibility within cities (Okoko 2006). Arasan, (2012,) and Rodrique et al (2009), further report that transportation infrastructure is one of the key factors that directly affect urban transportation effectiveness and capacity within the metropolis. Transportation infrastructure mainly includes roads, parking lots, vehicles and transportation terminals. Urban traffic management system is also an important component which can properly control and guide the distribution of traffic flows on roads.

3. Factors of Effective and Efficient Transportation System

Eddington (2006) cites adequate transport network, traffic management and control system and effective, efficient and reliable mass transit as key factors that affect urban transportation system. Nadiri (1998) postulates that investment in adequate transport infrastructure improves transport efficiency in terms of increased productivity and continue that transportation infrastructure involves good road network, adequate bus stops, parking areas with traffic signals. Shapiro et al, (2002) assert that mass transit is prerequisite for ensuring efficient and effective transportation system in urban areas in terms of energy conservation reduced traffic congestion and environmental preservation. They argue that effective mass transit system is underpinned by availability, accessibility, and reliability of buses. Effective traffic management and control system is key to ensuring effective transportation system in the urban areas. This involves management and control of road signals, road space, parking space and road users (Arasan 2012; Jones 1999).

4. The Impact of Transportation on Productivity

Productivity has to deal with the ratio of volume measure of output to the volume measure of input. It measures the extent to which production input is utilized to produce output in the production process. Economic growth and business competitiveness is underpinned by productivity growth (Organization for Economic Co-operation and Development (OECD) 2006; Nadiri 1996). Nadiri (1996) argues that the input of productivity is a state or national investment in transportation whilst the output is gross domestic product (GDP) growth. An effective transportation system is therefore key in sustaining economic growth in the contemporary economies by its capacity to link people to job, deliver products to markets where there is demand, drives supply chain and logistics and enabling domestic and international trade.

Again improvement in transportation efficiency can influence cost of doing business, travel time, forecast reliability, comfort, safety and security of commuters. The direct benefit of an efficient and effective transportation system reflects in the reduced travel time, which translates into cost saving, increase in output and ultimately GDP (Kulash 1999, World Bank 2002). Eddington added that travel reliability is critical to some business sectors, especially those that deal with perishable goods as well as those that rely on just- in- time (JIT) deliveries. That is, to some businesses, productivity growth is underpinned by what they termed as predictable and time- critical deliveries. This view is further shared by Weisbrod and Reno (2009), when they state that effective transportation system increases productivity in terms of job creation, reduction in business operation cost, improved output, expanded market and increase in economic competitiveness.

They continue to suggest that effective transportation system contributes to productivity by improving business ability to provide goods and services, improving people's ability to access education and health services, create employment and reduce vehicle operation cost as well as emission and safety benefits. Thus effective transportation system improves productivity which is a key determinant of economic growth and living standards.

5. Traffic Congestion

Rodrique *et al*, (2009) states that congestion can be perceived as unavoidable consequences of scarce transport facilities such as road space, parking area, road signals and effective traffic management. They argue that urban congestion mainly concerns two domains of circulation, passengers and freight which share the same infrastructure. Thus, traffic congestion condition on road networks occurs as a result of excessive use of road infrastructure beyond capacity, and it is characterised by slower speeds, longer trip hours and increased vehicular queuing.

Downie (2008) also opines that traffic congestion occurs when the volume of vehicular traffic is greater than the available road capacity, a point commonly referred to as saturation. He describes a number of specific circumstances which cause or aggravate congestion. Most of such circumstances are concerned with reduction in the capacity of road at a given point or over a certain length, or increase in the number of vehicles required for the movement of people and goods. Downie (2008) further argues that economic surge in various economies has resulted in a massive increase in the number of vehicles that overwhelms transport infrastructure, thus causing congestion on roads in cities. Rodnique *et al.* (2009), note that congestion in urban areas is dominantly caused by commuting patterns and little by truck movement. They further attributed the causes of congestion to rise in population densities, road incidents and broken vehicles on the roads which restrict capacity of roads and impair smooth traffic flows.

Another contributing factor to congestion as suggested by Herman (2001), cited Downie (2008) is parking. He is of the view that road parking, which consumes large amount of space has become a land issue that greatly inflates the demand for urban land, causing congestion in cities. He adds that high urban mobility rate also contributes to the congestion menace. The massive use of cars does not only have an impact on traffic congestion but also leads to decline in public transit efficiency, thereby creating commuting difficulties in cities. Indeed the over-dependence on cars has tremendously increased the demand for transport infrastructure. Unfortunately the supply of transport infrastructure has never been commensurate with the growth of mobility needs. Consequently, several vehicles spend most of the time in traffic as a result of traffic space limitation (Yan and Crooks 2010).

Furthermore, Urban Roads (2004) Report that traffic congestion in Kumasi is attributable to limited road capacity, parking space, dysfunctional road signals, drivers' behavior, vehicle breakdown on roads and too many cars within the city. Rodnique *et al.* (2009) outline some measures that could help deal with the congestion menace. They mention traffic signal synchronization, incident management, congestion pricing and the use of public transit as possible effective strategies available in dealing with congestion situation, although not without their associated challenges.

6. Traffic Congestion and Productivity

Any city that is economically dynamic and vibrant will rarely be free from traffic congestion. Congestion has become an inevitable part of everyday life and that it is the city authorities that have to devise policies to help manage congestion on affordable basis to relief commuters of the difficulties imposed upon them by traffic congestion (May and Marsden 2007, Yildirim 2001).

According to them, there is little consensus on the type of policies that can be used to trade congestion in cities, and that it is unsure that congestion has any clear cut solution. Indeed people living in cities have come to accept traffic congestion as part of city dynamics and therefore have become used to getting along with it. They continue to argue that traffic congestion in cities is a symbol of a successful socio economic development – improved business activities, increase in employment and improved culture. These are factors that motivate firms to operate in cities to benefit from economic gains.

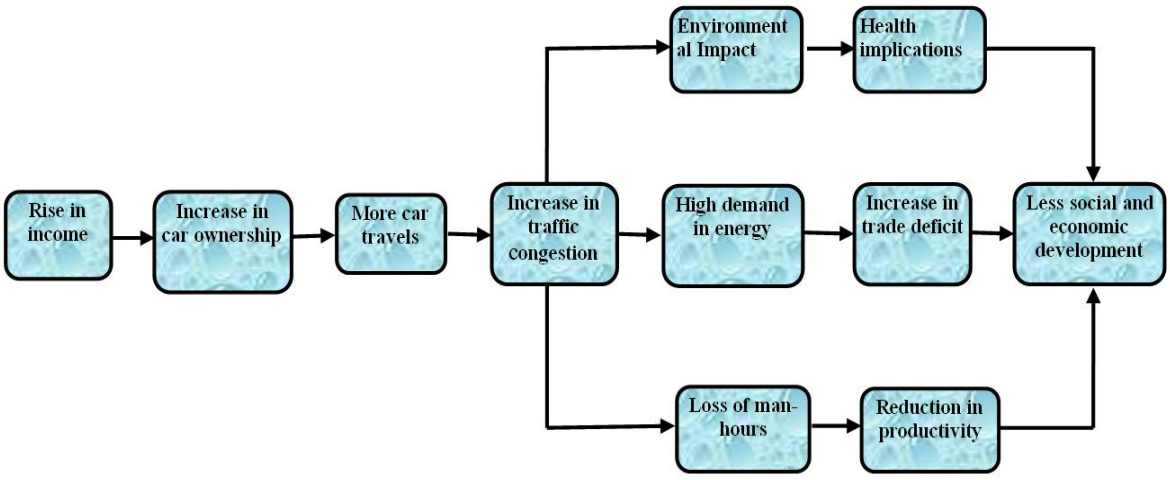
May and Marsden (2007), however argue that congestion impairs us from moving freely and that it disrupts business activities in cities and reduces productivity. Congestion affects speed and smooth traffic flow. This affects a wide range of activities, services, goods, markets opportunities in the cities which can best be delivered through transport mobility. The report continues that congestion also reduces productivity through increased inventory holding by manufacturers and retailers as a result of unreliable travel conditions within cities. Business activities depend on timely delivery of logistics. However, freight movement in cities is impaired by traffic congestion, thus making productivity suffer.

Weisbrod *et al*. (2003) reinforce this assertion by saying that increased traffic congestion imposes cost upon commuters and affect business operations. They further affirm that businesses that have high needs for incoming deliveries are mostly affected by traffic congestion and thus reduce productivity. Thus traffic congestion increases the cost of businesses operations. For instance delay in delivering time-sensitive logistics can impose additional inventory and logistics cost. Indeed, congestion affects lean management system like just-in-time, making businesses less responsive.

Weisbod *et al*. (2003) conclude that congestion leads to reduced productivity through reduced worker access to job and shopper access to stores as a result of excessive delay in traffic. According to Crowther et al (1963), cutting traffic congestion by half will bring huge economic benefit to economies. This statement lends credence to the fact that traffic congestion has negative impact on productivity. Indeed in August 2010, Habee, one of the provinces of China experienced what is considered the world worst traffic jam ever, as traffic congestion stretched more than 100km from August 14 to 26 (Hickman 2010) . Such situation has obvious implication on productivity and the socio economic development at large.

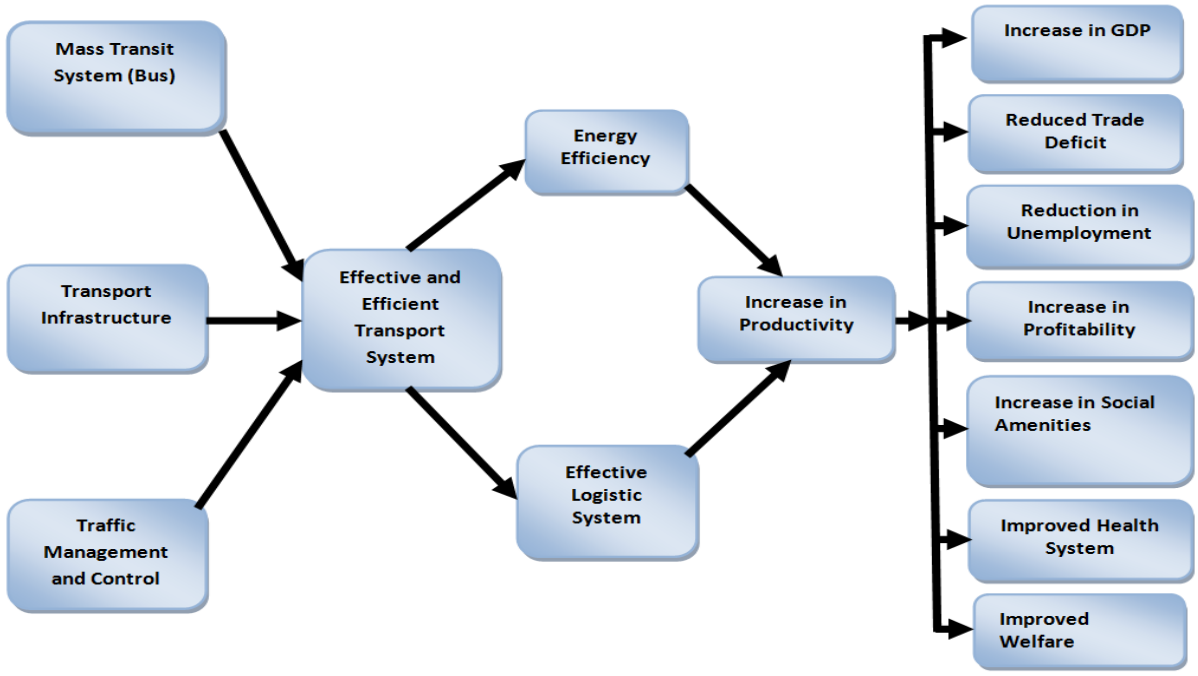
Lewis (2008) and Downie, (2008) further delineate that although the digital revolution enables twenty 21st Century industries to adopt just-in-time production, distribution and inventory management system, the challenges in the transportation system such as congestion, makes it difficult for them to be up to the task of ensuring reliable just-in-time deliveries for enhanced productivity and competitiveness. Poole (1998), and Eddington, (2006) argue that economic cost of congestion takes the form of time wasted through travel delays and unreliable transportation conditions, extra fuel, the environmental damage and related cost to human health.

Figure 1- The conceptual framework



Source: Adopted and modified from Pacione, (2005)

Figure 2- The conceptual framework



Source: Adopted and modified from Karlsson et al., (2007)

The conceptual framework in figures 1 and 2 give graphical model of transportation situation in Ghana and its potential outcome. It seeks to explain that rise in income leads to increase in automobile ownership which will culminate in increased traffic congestion. The potential results of this situation are high energy demand, environmental implication and reduction in productivity, a situation that adversely affects the national socio-economic development. However, adequate infrastructure, effective traffic management and effective public transportation as key factors in place, will lead to effective transportation system. This will improve energy efficiency, effective logistics system and increase productivity at both individual and national level.

7. Methodology

Deduction approach was used for this study. The study used survey with multiple cases of road links. Primary data was collected using questionnaire instrument. Commuters working in the formal sector within Kumasi Metropolis and drivers that use passenger vehicles constituted the study population

7.1 The Study Population, Sample size and sampling techniques

The population for this study included drivers that use passenger vehicles (taxis and mini-buses) that ply the roads within Kumasi and commuters. These groups were purposively targeted with the view that they could provide relevant information in relation to the research question since they constitute major stakeholders in passenger transportation within the city. There are twenty-one selected key road links in the metropolis with their respective levels of congestion records (Urban Roads 2004).

It was realised that using all the twenty-one key road links for the study would present practical challenges. In the light of this, the researcher sampled the first five out of the twenty-one (21) key road links. Purposive sampling was used in this selection to enable the researchers select road links with high traffic congestion records. The five key roads understudy is presented in table 1. Since the number of various vehicles plying the five road links understudy has not been fully established, it was impossible to construct a sample frame for the drivers and commuters. For this reason the researchers used quota sampling techniques. The average traffic volume of the five road links understudy, as has been established by Urban Roads Department (2004), was 63.46 vehicles per minute. This is presented in table 2.

Based on this, and the fact that the five road links bore similar characteristics in terms of the vehicles that ply them, a quota of sixty (60) drivers of passenger vehicles was allocated to each of the five roads to make a sample size of 300 for the drivers. The quota distribution rate for each road comprised of forty-one (41) taxi drivers and nineteen (19) mini bus (trotro) drivers. This was based on the distribution rate of traffic mix in the metropolis as established by urban Roads, Kumasi. This is presented in table 3. The respondents from each category were selected using systematic random sampling based on every third driver met at the terminals. The drivers were given higher quota than the commuters due to the technical information required which could best be provided by them.

Again a hundred and fifty (150) commuters working in the formal sector were involved in the study with a quota of thirty (30) from each road. The 30 respondents from each road were also selected randomly so that each has an equal chance of being selected. Thus making for a total respondent of four hundred and fifty-five (450).

Table 1-Volume of Traffic Flow Analysis

Road Link	Peak Total Volume Per Hour	Peak Total Volume Per Minute
Manpong Road	5,394	89.9
Sunyani Road	4,219	70.3
Antoah Road	3,860	64.3
24th Feb. Road	3,202	53.4
Harper Road	2,148	35.8
Wtd. Average	3,764	63.46

Source: modified from Urban Roads Report(2004)

Table 2 - Key Roads in Order of Congestion Level

Rank	Name of Road	Functional Class	Study Length (km)	Congestion Index (CI)
1	Mampong Road	Principal Arterial	5.0	13.8
2	Suyani Road	Principal Arterial	3.3	8.9
3	Antoa Road	Pricipal Arterial	5.5	6.0
4	24th Feb. Road	Principal Arterial	5.4	5.8
5	Harper Road	Principal Arterial	2.5	5.6

Source: Urban Roads Report(2004), Kumasi.

Table 3- Distribution of traffic mix

Type of Vehicle	Number of Vehicles
Private vehicle	33 %
Taxi	44 %
MinBus(Trotro)	19 %
Large Bus	4 %
TOTAL	100 %

Source: Urban Roads Report. (2004)

Table 4- Category of Respondents

CATEGORY	SAMPLE SIZE
Driver	300
Commuter	150
Total	450

Source: Researcher's field work (2012)

Table 5- Sample and Response Rate

Respondents	Sample Size	Response Rate
Drivers	300	300(100%)
Commuters	150	135(90%)
Total	450	435(96.7%)

Source: field data (2012)

8. Method of Data Collection and Analysis

Primary data used for the study was obtained from the researcher's field data where four hundred and thirty-five (435) out of four hundred fifty (450) drivers and commuters from the five key road links under the study gave responses from sets of questionnaire. Both self-administered and interviewer-administered questionnaires were used for the study. This allowed for responses from the respondents with varying characteristics, some of whom required further assistance in providing responses.

The questionnaires used were closed ended with five point likert scale, ranging from 1= Strongly Disagree to 5= Strongly Agree. Respondents were given the chance to tick or rank the most appropriate response(s). The researchers used two different sets of questionnaires. The first was used to collect information from taxi and 'trotro' drivers whilst the other was used to collect responses from commuters. The questionnaires were delivered to the respondents by the researchers. Where necessary, the researchers read out and explained the questions to the respondents whose literacy level were low and were unable to read and understand for relevant responses. The researchers used descriptive statistics of simple averages to analyse the field data with the aid of statistical package for social sciences (SPSS) and Microsoft Excel Software.

9. Results and Discussions

9.1 The Effect of the Transportation System in Kumasi Metropolis on Worker Productivity (mini-bus Drivers)

Table 6 - Effect of the transportation system in Kumasi on Driver's Productivity

Variables/categories	Expected no. of trips (Off Peak Traffic Hrs.) (%)	Actual No. of trips (Peak Traffic Hrs.) (%)	Expected Income (Gh¢) (Off Peak Traffic Hrs.)(%)	Actual Income (Gh¢) (Peak Traffic Hrs.)(%)
10- 15 trips		81		
16- 20 trips	82.6	19		
More than 20 trips	17.4	-		
TOTAL	100	100		
35-40				78.8
41– 45			79.3	21.2
46 – 50			20.7	
51 – 55				
TOTAL			100	100

Source: Researchers field work, 2012

Table 6 shows the average number of trips and income generated by mini-bus (Trotro) drivers based on in the situation where there is less or no traffic and in situation of intense traffic. The respondents were asked the number of journey trips and income they were able to make on the normal day based on the current transportation situation in the Kumasi metropolis and what they were expected to make. 81% of the trotro drivers indicated that on the average, they made a maximum of about 15 journey trips instead of 20 trips expected as a result of the traffic situation in Kumasi metropolis.

With respect to income, 78.8% indicated that, on the average they made a maximum of between GH¢35 and GH¢ 40 instead of between GH¢46- GH¢50 expected due to the traffic situation in Kumasi metropolis. The drastic decrease in expected income of the mini-bus (trotro) drivers shows the magnitude of loss they incur due to the traffic congestion situations in the Kumasi metropolis.

Table 7 - Effect of the transportation system in Kumasi on Driver's Productivity (Taxi Drivers)

Variables/categories	Expected no. of trips (No Traffic) (%)	Actual No. of trips (During Traffic) (%)	Expected Income (Gh¢) (No Traffic)(%)	Actual Income (Gh¢) (During Traffic)(%)
10- 15 trips		86.2		
16- 20 trips	82.5	13.8		
More than 20 trips	17.5	-		
TOTAL	100	100		
20 – 25				88.6
26 – 30			83.8	11.4
31 – 35			16.2	
TOTAL			100	100

Source: Researchers field work, 2012

Table 7 shows the average number of journey trips and income generated by taxi drivers based on in the situation where there was less or no traffic and in situation of intense traffic. The respondents were asked the number of trips they were able to make on the normal day as well as the income level based on the current transportation situation in the Kumasi metropolis and what they were expected to make. 86.2% of the taxi drivers indicated that on the average, they made a maximum of about 15 journey trips instead of 20 trips expected as a result of the traffic situation in Kumasi metropolis. With respect to income, 88.6% indicated that, on the average they made a maximum of between GH¢20 and GH¢ 25 instead of between GH¢30- GH¢35 expected due to the traffic situation in Kumasi metropolis. This represents an average income loss of 14.3% to the taxi drivers captured. The drastic decrease in expected income of the taxi drivers shows the magnitude of loss they incur due to the traffic congestion situations in the Kumasi metropolis.

Table 8- the effect of transportation system in Kumasi on productivity (Formal Sector Workers)

Descriptive Statistics	N	Minimum	Maximum	Mean	Std. Deviation
Mandated hours of work	135	7.30	12.00	9.34	1.21
Report late	135	.25	1.00	.88	.22

Source: Researchers field work, 2012

0.8759 x 100 = 9.4%
9.3422 hours.

Table 8 shows the average mandated number of working hours public and private workers (Commuters) surveyed by the researcher. It was identified that workers work for an average of nine (9) hours and thirty-four (34) minutes. But they waste an average of fifty-two minutes and eight seconds (52.8) because they report late for work. This represents an average of 9.4% of work time per day. This is identified as a significant productive period wasted because of late arrival to work due to the transportation situation in the Kumasi metropolis. This corroborated the findings from the observation and the key informants about how the transportation system in Kumasi Metropolis affects worker productivity.

10. Conclusion

10.1 The informal Sector Productivity (TroTro and Taxi Drivers)

The main objective of the study was to assess the extent to which congestion affects worker productivity. The analysis of the study revealed that congestion in the Kumasi Metropolis has negative effect on worker productivity in the informal sector. More than78% of the mini-bus drivers indicated that, on the average they made a maximum of between GH¢35 and GH¢ 40 instead of between GH¢46- GH¢50 expected representing an average income loss of 21.9% due to the traffic situation in the Kumasi metropolis.

The case of taxi drivers was no different. More than 88% of the taxi drivers contacted indicated that, on the average they made a maximum of between GH¢20 and GH¢ 25 instead of between GH¢30- GH¢35 expected due to the traffic situation in the Kumasi metropolis. This represents an average income loss of 14.3% to the taxi drivers captured.

10.2 The Formal Sector Productivity

In the formal sectors, the negative effect of the transportation system in the metropolis on worker productivity was evident. The study revealed that the average mandated number of hours of about 9 hours a day was reduced by 0.88 of an hour (52.8 minutes) a day, which represents an average of 9% loss of productive hours a day and loss of over two working days in a month. This has obvious implications on the economy. Thus the traffic congestion in the Kumasi metropolis is negatively affecting worker productivity, confirming the existing theory by researchers like Eddington, (2006), Weisbrod (2010), May and Marsden, (2007) and Nadiri (1996) that traffic congestion has negative effect on productivity.

11. Recommendations

Based on the findings and the conclusions drawn from the study, the following recommendations are made by the researchers:

1. The authorities of urban road transport in the metropolis should embark on regular education campaign to sensitise the road users on effective utilization of roads.
2. They should also construct additional bus stops and expand those with narrow lay-byes to prevent packing and stopping at unapproved places.
3. Again, they should fix all dysfunctional road signals at various intersections and ensure regular maintenance to check effective traffic flows.
4. Policy makers of the road transport management should initiate the provision of well equipped quick traffic response unit to deal with frequent vehicle breakdowns on the road.
5. The metropolitan authority must be improved upon the satellite markets in various sub-metros and communities within the metropolis and new ones constructed in order to decentralise the economic activities in the metropolis and to ultimately reduce the volume of vehicular inflow to the CBD.
6. Further studies into the mass transit system and how it can reduce traffic congestion is recommended

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