

## **THE GREEN EVOLUTION OF GHANA'S MARITIME PORTS - IMPACTS FROM ROAD HAULAGE TRUCK EMISSIONS**

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**ABSTRACT:** -The research was to estimate the level of gaseous emissions from haulage vehicles that do business at the Port of Tema in Ghana, which is a critical component in its quest to be recognized as a green port. The work considered the vehicle related factor of age distribution; and travel related factors of engine operating mode, speed level and speed variation that significantly influence the quantity of pollutants emitted from vehicles. Sixty percent of the population of vehicles doing business in the port were sampled and their ages determined based on their format of vehicle registration numbers. To estimate the travel related factors, focus group discussions were conducted with haulage vehicle operators to assess their views about haulage on the Harbour Road. The study highlighted that the mode age of the sampled trucks was one year whilst the mean was eight years. Comparing this to international standards, the Port of Tema was found not doing badly in its efforts to be recognized as a green port. It was also found out that in either case of heavy traffic or less traffic, the truck operators' conduct amounted to considerable exhaust emission. As such, the research pointed out the need for the Port Authorities to calve a niche objective relating to further reduction of pollution from haulage vehicles that would inspire collaboration with Road Authorities to put in place suitable mechanisms or regulations on the use of overage vehicles and the prevention of over-speeding.

**Keywords:** - Green port, evolution, haulage vehicle emissions.

### **Introduction**

The general commitment to promoting sustainable green ports is nicely evidenced in the slogan of the 'Greenport', an online magazine, which is; 'Balancing environmental challenges with economic demands' (Greenport, 2011). This slogan, from many perspectives, summarizes the reality which the whole world must come to terms with, as there seem to be a genuine desire to ensure the sustenance of the Earth for posterity. Ports of the world and for that matter those in developing world economies are known widely to be establishments whose activities contribute to the degradation of the environment. Borrowing contemporary views from the United Nations Conference on Trade and Development, Geneva (UNCTAD), ports *are geographic and economic entities, located on the seaside, a river or a lakeside, serving ships, and where transfer of goods and passengers takes place from water to land transport and where facilities could be found on land and water to render complementary services required by the ships, goods and for developing*

*international trade, industry and more generally the economy of the countries under the zone of influence of the port*(UNCTAD, 2009).A thorough examination of this concept indicates clearly that marine, terrestrial and atmospheric ecosystems all stand the risk of irreparable damage due to activities that take place in ports.

It is no news globally when mention is made of the effects of shipping on the marine environment, especially those in and around ports. Researches continue to be conducted worldwide and many international conventions, for example the International Convention for the Prevention of Pollution from Ships, 1973 as modified by the Protocol of 1978 (MARPOL 73/78),have been adopted and ratified by states to reduce environmental degradation. Issues of interest as far as developing economies are concerned are firstly, whether there is individual organizational awareness of the unique effects of this very important economic activity on their environment and secondly, whether they have the where-with-all to manage the effects for the sake of posterity.

### **Literature review:**

It is not easy to come across a standard definition for ‘green-ports’ though research and collaborations are underway to establish that. However, mention of the word turns attention to dealing with sustainable seaports in the midst of challenges with regards to climate changes and rising sea levels, as well as promoting future sustainability for social and natural environmental conditions.

Core operations in ports include receiving ships, cargo handling and cargo transfer to and from port hinterlands. The risk of irreparable damage to the ecosystems stems from the nature of the equipments, technologies and other resources that congregate in the ports. Harbour basins and berths, rivers, and approach channels often need regular dredging to keep them open for shipping. The dredged materials are often said to contain anoxic materials (Clarke, 2001) which can destroy life and therefore marine ecosystems. If a port and its facilities are located in industrial areas, the dredged materials may contain metals, pesticides and persistent oils. The dredged materials have to be dumped somewhere and these can have negative effects on other ecosystems as well if not handled carefully.

Clarke, 2001 mentioned some measures that were taken by some ports to manage contaminated dredged materials. He stated that ports in Florida and Hong Kong deposited contaminated dredged materials in deep excavations offshore and covered them with uncontaminated sediments; whilst materials dredged from the Port of Rotterdam, the Elbe and the Rhine Rivers were deposited on artificial islands.

With regards to the atmosphere, it is interesting to note some findings on the effects of exhaust emissions from ships on the environment. Pearce, F. 2009, is quoted as stating that “the most staggering statistic of all is that just 16 of the world’s largest ships can produce as much lung-clogging sulphur pollution as all the world’s cars”. Pearce’s analogy may yield the impression that emissions from other modes of transport are not so much an environmental issue. But the interventions put in place by some ports suggest the contrary that emissions from other modes, especially road, are worth preventing or minimizing. This may be reiterated when we read (for instance)of the Clean Trucks Program which was put in place by the Port of Los Angeles in the United States of America. The intervention program was aimed at reducing air pollution from harbour trucks by 90 percent. One of their targets by the end of 2012 was to ensure that drayage trucks

servicing the Port terminals were 2007 or newer models. With the industry replacing vehicles much sooner than expected, the result may be a major reduction in air pollution.

Another intervention is the quality of fuel used to run road and rail vehicles in some parts of the world. In some economies, port hinterlands are connected by road and rail engines that rarely run on fossil fuels, but when they do, the fuels have insignificant quantities of sulphur and other environment polluting substances. Some analysis of data gathered in 2011 by the Clearing-House for the Partnership for Clean Fuels and Vehicles (PCFV) indicated varying sulphur content in fuels used in some of the world countries. This is summarized in the Table 1.

**Table 1: Diesel-Sulphur contents of world countries**

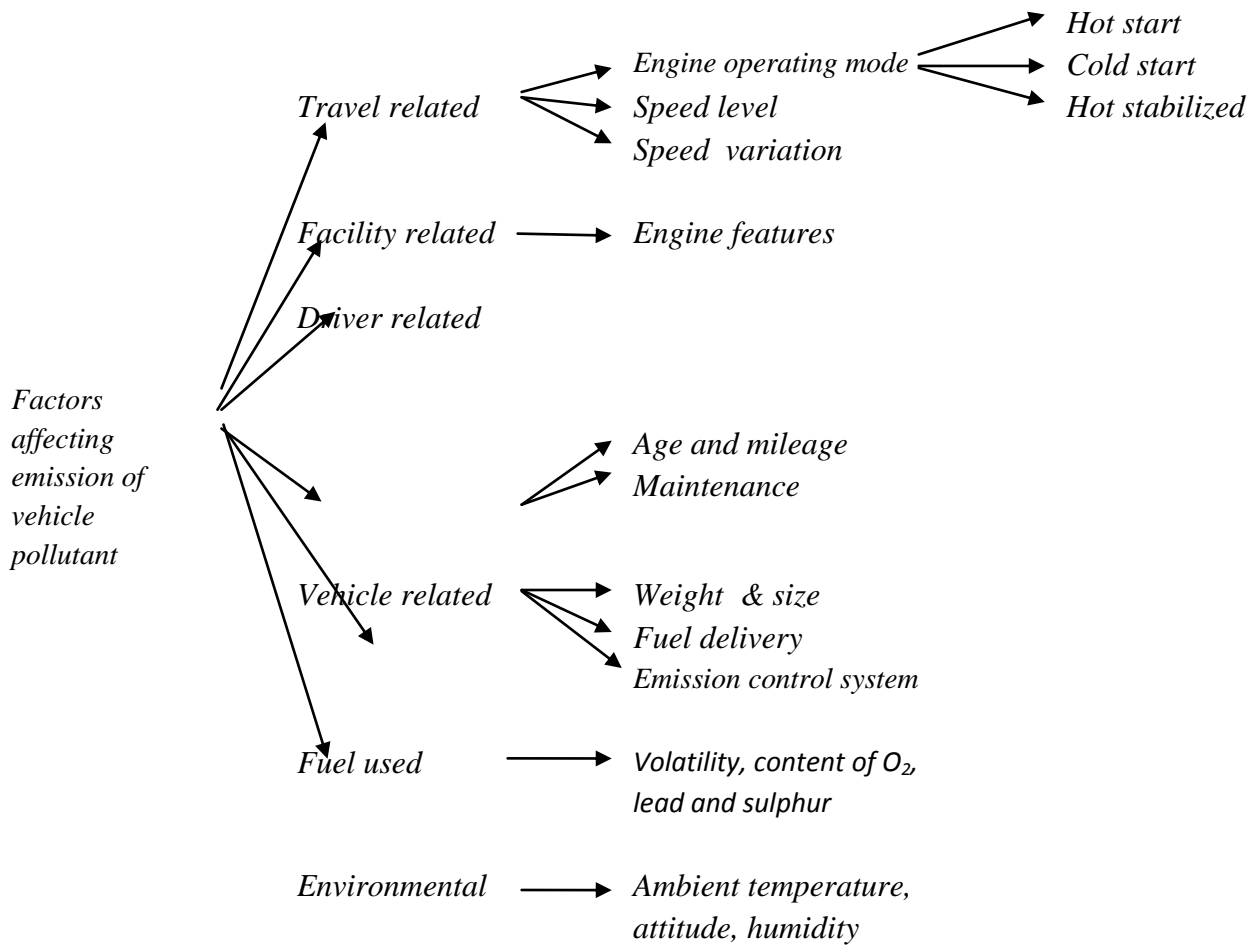
Country	Diesel sulphur content (ppm)
Japan, South Korea, Bulgaria, Romania, Canada etc	$\geq 15 - 50$
South Africa, Namibia, Botswana, Australia, India	$\geq 50 - 500$
Nigeria, Brazil, Azerbaijan, Russia, Ukraine	$\geq 500 - 2000$
Ghana, Togo, Liberia, Peru, Bolivia	$\geq 2000 - 5000$

*\*ppm means part per million.*

Ghana's maritime ports are currently connected to their hinterlands mostly by road transport and it is pretty obvious that the sulphur content of fuel used for running the engines is high compared to other countries. Apart from sulphur, fuel emissions from road vehicles in Ghana are said to contain Carbon monoxide (CO), Nitrogen dioxide (NO<sub>2</sub>), Lead (Pb), Manganese (Mn) and other heavy metals (Armah, Yawson & Pappoe, 2010). Armah, *et al* (2010) found that emissions from road vehicles affect the quality of air and have been the cause of many respiratory tract infections, coughing, and itchy eyes cases in the capital of Ghana. By these disclosures, one question that was to be answered was the extent to which emissions from road transport affect the port environment of the country.

#### **Measurement of emissions from road vehicles:**

Sinha, K. C. and Labi, S. (2007) generally classified the major factors that influence the quantity of pollutants emitted from vehicles as illustrated in figure 1.



**Figure 1: Factors affecting vehicle emissions**

With ‘fuel quality’ in Ghana already been discussed, other factors of interest in this paper were travel related, vehicle related and driver related. Work by Sinha and Labi (2007) indicated that sharp acceleration of vehicles and high loads on vehicle engines caused high emission of pollutants. They also indicated that emissions of hydrocarbons; nitrogen oxides and carbon monoxide were highest when vehicles moved at low speeds. Lack of smoothness or varying speeds resulting from inconsistent traffic conditions also were causes of high emission of pollutants. Furthermore, aggressive drivers, who have the habit of frequently accelerating and decelerating, created abrupt changes in vehicle velocity, imposing heavy loads on the engines and caused high levels of emissions. Sinha and Labi also established that older vehicles emitted more pollutants than newer ones whilst heavier and larger vehicles emitted more pollutants than lighter vehicles.

**Research statement:**

The dangers of environmental pollution from ship emissions at the Port of Tema may not be the only issue to be concerned about in its mission to gain or sustain international recognition as being green. Another area of concern could be road truck operations and must be monitored.

## **Objectives:**

Modalities with regards to road haulage and its effects on the levels of gaseous emissions into the atmosphere (environment) is a subject of interest to the Ghana ports in the bid to have world recognition as being green. The main objectives of the research were to estimate the level of gaseous emission from haulage vehicles that do business at the Port of Tema by considering the vehicle related factor i.e. age distribution; travel related factors of engine operating mode, speed level and speed variation of vehicles operating within the boundaries of the Port of Tema.

## **METHODS**

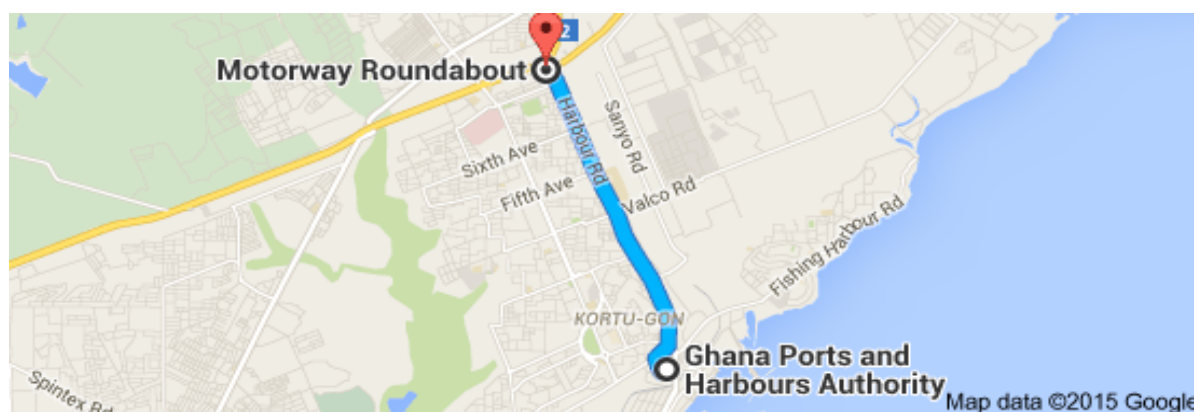
### **Estimation of vehicle related factors impacting environmental pollution:**

The ages of haulage vehicles doing business in the Port of Tema was used. To estimate the ages, samples of vehicles were drawn from the populations of trucks registered to do business in the port of Tema from January 2011 - June 2012. Data from the GHPA indicated that the population of vehicles registered to do business in the Port of Tema in the stated period was 4947 and mostly originated from Ghana, Niger, Burkina Faso and Mali. From this population, the purposive sampling technique was used to draw a sample of 3022 vehicles, which were the vehicles registered in Ghana by the DVLA. The choice of sample was based on facts that it forms a significant sample size i.e. 60% of the population of vehicles doing business in the port and also because of the ease of estimation of the years of operation of the vehicles in Ghana based on the policy/principle/format for vehicle registration numbers provided by the DVLA.

### **Estimation of travel related factors impacting environmental pollution:**

The experiences of drivers as they hauled cargo from the main exit point of the Port of Tema to the Tema motorway roundabout via the harbour road (6.6km) which can be considered as the outskirts of Tema as shown in figure 2 below.

### **Figure 2: The Tema Harbour Road**



**Source: (Google Maps, 2015)**

The specific indicators that were measured were: - time spent by queuing trucks, the number of times vehicle have to start and stop and finally speed variation as they went about their operations. Furthermore

focus group discussions were conducted with 15 haulage vehicle operators to assess their views about haulage on the targeted stretch of road as mentioned above. The reason for the group discussion was to enable the participants to openly exchange and collectively agree or disagree on their operational situations. The researchers view were that a larger number for the discussion would create challenges for drawing of consensus and therefore reduces the validity of the findings of the research.

**Analysis methods:**

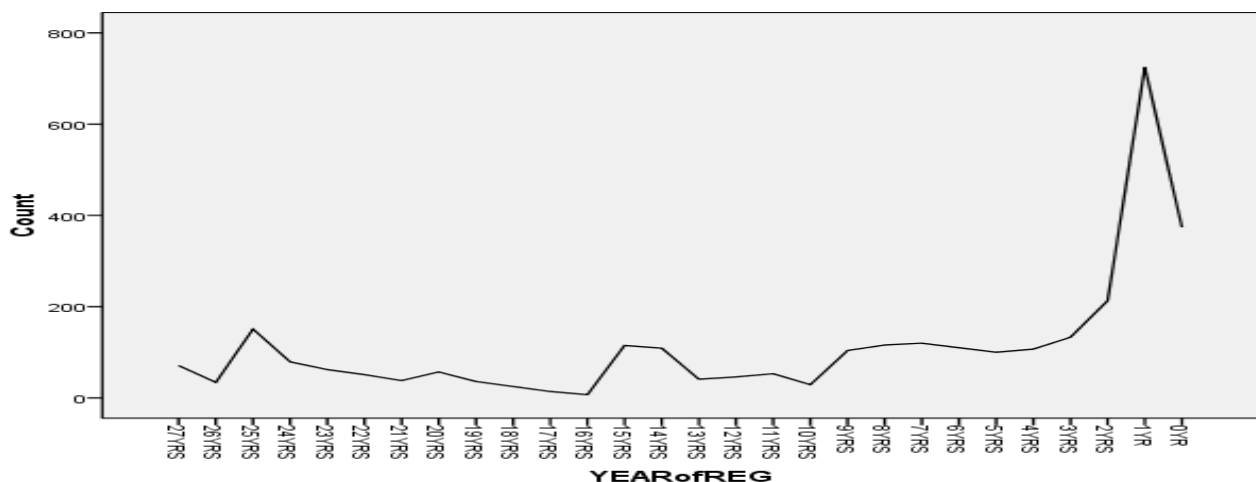
Data collected in the areas mentioned were analyzed using central tendency measurements, specifically mean and mode. Such measurements have been found to provide useful and practical ways of reducing a large size univariate data to get ‘central values’. Therefore the central values of the indicators measured provided a fair summary of the entire picture of the situation in the Port of Tema, for which comparative study with Dublin Port, Ireland and the Long Beach Port in United States was done. Central tendency analysis methods was used also because they provide simple, straight forward analysis that can be understood by most categories of managers and decision makers.

**RESULTS**

***Vehicle age distribution:***

An analysis of data collected indicated that the ages of haulage vehicles registered to operate in the Tema Port from the year 2011 to 2012 were in the range of zero (0) to twenty-seven (27) years, the mode age was one year (1) and mean age was eight (8) years. Comparing to the standards that was set by the Long Beach Port, which worked towards operating with haulage vehicles which were not more than five (5) years in operation, it could be said that Ghana’s Tema port, being in a developing economy was not doing badly in growing to become a green port if the average age of haulage vehicles in operation on that corridor was estimated at eight years. *(It may be noted however that researchers acknowledged the fact that not all haulage vehicles imported into the country were new. Some were used-vehicles. So with the assistance of the Customs and Excise Service of Ghana, and estimated average age of ± 5 year is looked at as the degree of error).* Figure 3 below is a graph showing the age distribution of haulage vehicles based on year of registered in the Port of Tema.

**Figure 3: Age distribution of haulage vehicles registered in the Port of Tema**





***Travel related factors:***

The findings from the focus group discussions indicated that 5 minutes is the fastest possible time to transit the road connecting the Port of Tema to the Tema Motorway Roundabout via the harbour road which is 6.6km, when there are no constraints of heavy traffic. Ideally, according to Google Maps (2015), driving under the required speed limit of 50km/hr., it should take about 12 minutes instead. This 6 minutes difference between the ideal transit time and the truck operators' unusual transit time (fastest transit time) is obviously indicative that they travel on higher speed limit and so prone to more gas pollution.

However, plying the same road during heavy traffic can take a minimum of one hour, and this has become the norm and predominant experience. The truck operators indicated that they mostly do not vary their speed level because of the necessity to keep to their first gear with uncountable need for *hot starting* under the constraint of the usual traffic.

However, the findings indicated that even proceeding under the first gear with the uncountable *hot starts*, they are compelled to press hard on the accelerator given that fact that their loads are heavy and yet plying on a hilly road. Obviously, this also results in producing more exhaust.

## **DISCUSSIONS**

Though findings from work done by Armah et al (2010) on the level of pollutants from fuels used by vehicles in Ghana portray a gloomy picture of a dream of the country's Tema Port to be internationally recognized as a green port, the age of haulage vehicles used on the corridor i.e. eight (8) years brings some hope for future recognition. Therefore the ban on importation of over aged vehicles into the country is commended and may be reviewed periodically to reduce further the age limit of vehicles in the country to be at par with international standards.

Besides the import restriction on the age of vehicles imported into the country, an effective and efficient mechanism could also be established for use by both road authorities and the port authorities to track the age and operations of haulage trucks that would help enforce any ban on the use of over-aged haulage trucks especially within the port environs.

Meanwhile, it stands out for recommendation that the authorities of the Port of Tema need to consciously and specifically set objectives about green port that directly relate to the operations of haulage trucks to cause the existence of an appropriate partnership with road authorities towards building suitable regulations on pollution from haulage trucks.

As measures are being put in place to expand the road connecting the Port of Tema to the Tema Motorway Roundabout via the harbour road to ease the traffic, much attention must be drawn to the need to enforce speed limits in order to prevent over-speeding and more gas exhaust. The installation of security cameras would help to easily track the speed of vehicles and should be considered as part of the road construction.

