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Statistical Analysis of Flow of Charcoal through Trunk Road A7 and B2 Using Traffic Count Data into Dar Es Salaam, Tanzania

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Abstract:
Charcoal is considered to be the primary source of fuel for ages. Even in the current scenario charcoal is widely been used as a primary fuel both in rural and urban areas. The economic and financial policies of most of the African countries show that the demand for use of charcoal as a fuel source is not going to reduce in the near future. There is no regulation in practice to regularize the production, transport and use of charcoal in Tanzania. The practice of sustainable and efficient charcoal production is also way behind. The use of charcoal in urban areas is estimated to be around 62.2% and the use of wood in rural areas is estimated to be around 92.4% (TDHS, 2013). Tanzania ranks 7th among the largest charcoal producing nations at a global production of about 1.6 million tons (3%, World Bank 2011). The charcoal industry in Tanzania contributes to about USD 650 – 780 million to the country's economy. A study on the flow of charcoal into the commercial city Dar Es Salaam based on the traffic count on the two major trunk roads A7 and B2 that connect Dar Es Salaam to other parts of the world is conducted and the results are analyzed to suggest suitable solutions to reduce the deforestation rate in Tanzania for charcoal production.

Keywords: *Charcoal, environment, traffic count, efficiency, trunk road A7 and B2*

1. Introduction

Charcoal is considered to be the primary source of fuel for household usage in Tanzania. The economical lag has forced its people to go for cheaper and available source of energy like charcoal and wood for their domestic usages. The continuous usage of charcoal has caused a serious impact on the environment and the ecological balance in the country.

1.1. Deforestation

Deforestation is the only way to produce charcoal in a cheaper way. It is estimated that 30% of the worlds' forest has been destroyed in the last 45 years. About 39.9% (35,257,000 ha) of Tanzania is forested. The rate of deforestation is seen to be very high, especially in developing countries like Tanzania. World Bank estimates that Tanzania has been losing about 400,000 ha of forest land on an average every year at a rate of about 0.5%. Almost 40% of the trees cut are for producing charcoal and for firewood. Deforestation is done in an alarming rate that it is estimated Tanzania will lose its forest reserves by 2050. The fact that population growth is also at a high rate in the country, which will also make way for a faster destruction of the forest.

1.2. Problems in Charcoal Making

The usage of charcoal in Tanzania is more when compared to other African countries. The commercial capital Dar Es Salaam alone consumes about 1.3 million tones of charcoal per annum at a rate of 3561 tons/day. It is estimated that 40,000 bags of charcoal enter into Dar Es Salaam every day. The same rate of charcoal is used in other cities of Tanzania as well. These statistics demands for a study on the methods used in producing charcoal. It is seen that charcoal is produced in rural villages far from cities in earth mounded traditional kilns and transported to bigger cities. The analysis of different kilns used in Tanzania show that the efficiency ranges between 12% to 27 %, for 1 m^3 of wood produce 2.6 bags of charcoal each weighing about 53kg. Traditional kilns are commonly used in producing charcoal with an efficiency rate of not more than 12%, improved kilns at 18%, semi improved kilns at 24% and industrial kilns at 27%. Almost 80% of the wood energy is lost in the process of making charcoal. Due to such low efficiency rates the emission

of green house gases are also causing a serious risk to the environment. The green house gases produced in these kilns are also very high. It is estimated that these kilns may produce about 49.7 million tons of CO_2, 9.8 million tons of NO_2, 1.2 million tons of SO_2 and 12.4 million tons of CH_4 by 2030 that will cause serious environmental problems globally.

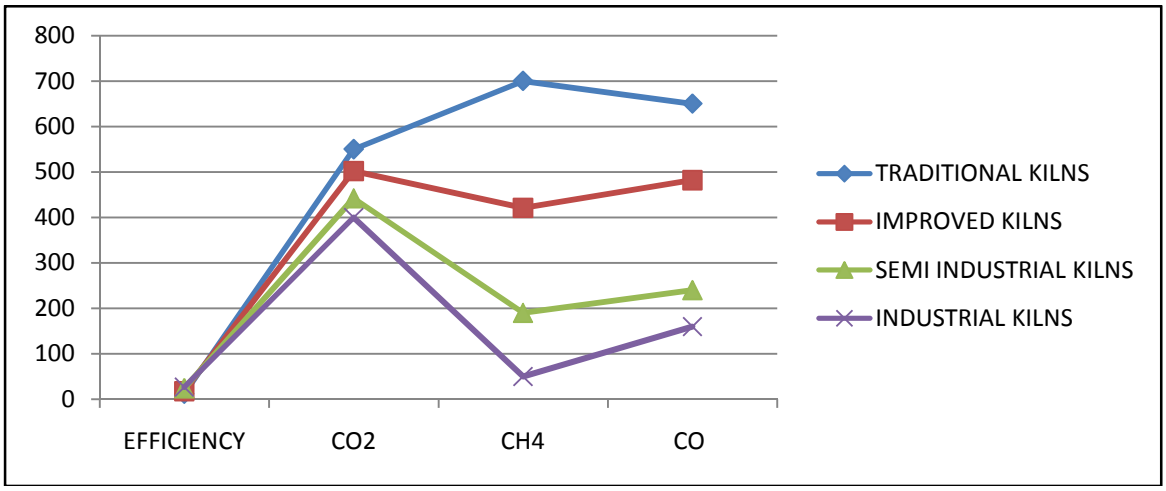

Figure 1: Analysis of kilns used to produce charcoal in Tanzania.

1.3. Economic Evaluation of Charcoal Production

The annual demand growth rate of charcoal is 8% per annum. The increase of population and urbanization is likely to increase the demand by 12% in 2020. Over 85% of household in Tanzania use charcoal as the fuel source for cooking. Almost all the hotels and restaurants in Dar Es Salaam use charcoal for cooking. Almost 40,000 bags of charcoal enter into Dar Es Salaam alone every day. The cost per kilogram of charcoal in local market is around Tsh 1000 to Tsh 1500 and in the supermarket it is sold at Tsh 3000. Each bag holds around 25-30 kg and sold at Tsh 35,000 to Tsh 40,000. This shows that the per day business of buying and selling charcoal in Dar Es Salaam alone is about Tsh 1.4 billion. The data collected from sellers and suppliers of charcoal reveal that the price is continuously increasing due to the demand. Studies reveal that the need for charcoal will not stop in the foreseeable future. This is the reason why most people are attracted towards charcoal making business. If this scenario continues it will certainly affect the forest reserves in Tanzania and may end up in losing its environmental wealth.

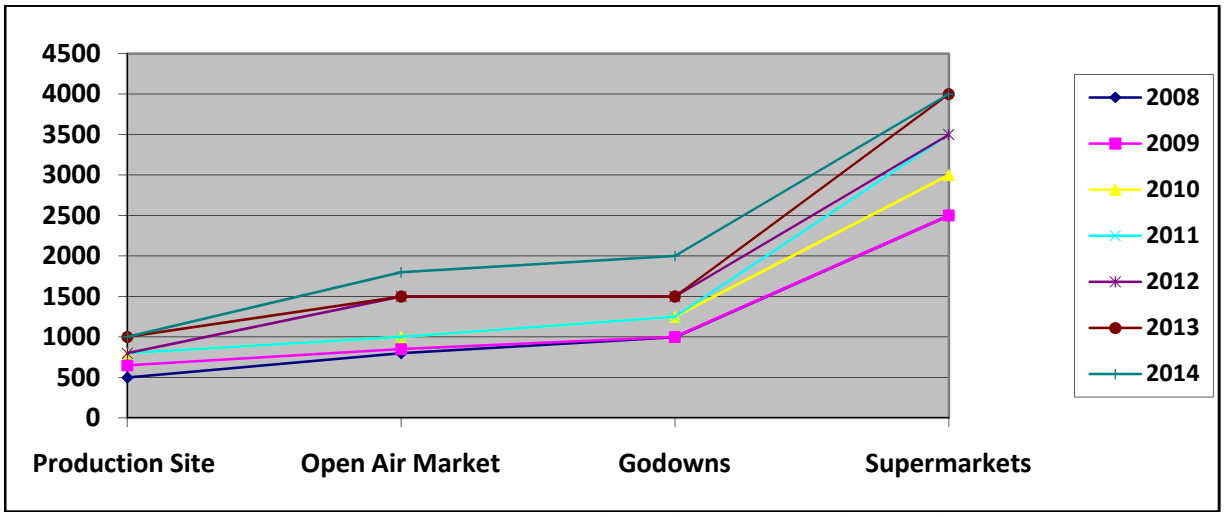

Figure 2: Price Variation of Charcoal in various Outlets in Tsh.

2. Materials and Methods

Survey and data collection where done in Dar Es Salam and checked for the inflow of Charcoal into the city to assess and analyze the use and the impact caused by it throughout the country. Traffic count on the amount of vehicles carrying charcoal on the two major roads entering Dar Es Salam is the major data collected. These data where used to interpret the amount of charcoal entering the city.

2.1. Traffic Count Method

In order to collect the data accurately, the place suitable for counting is carefully selected. After the selection of the places for counting, the method of counting is chosen. The traffic data is collected with the help of battery operated, hand held electric counting board. The data from the electric counting board is downloaded into the system and the data is analyzed.

2.2. Traffic Count on Dar Es Salaam Morogoro Trunk Road A7

Dar Es Salaam- Morogoro trunk road (A7) is the most important road connecting all the major cities of Tanzania spanning about 451 km. Traffic count on this road is a vital information that explains the inflow of charcoal into the city. Data were collected at Kimara junction which is situated at the outskirts of the city on trunk road A7 for the whole day of a week.

APROACH FROM	Light Truck	MGV 2Axle	HGV 3Axle	VHGV 4 Axle & Above	Tractor with Trailer	Cycle	ADV / Cart	Total Traffic
MONDAY	844	1352	1032	692	40	347	168	4475
TUESDAY	1940	852	1196	1020	48	296	212	5564
WEDNESDAY	2044	868	1184	1024	16	380	176	5692
THURSDAY	1221	556	981	776	24	362	176	4096
FRIDAY	1164	724	988	860	48	336	100	4220
SATURDAY	2268	692	788	693	22	284	112	4859
SUNDAY	1188	588	548	460	18	350	43	3195
TOTAL	10669	5632	6717	5525	216	2355	987	32101

Table 1: Traffic count data of load carriers for a week from 03-08-2015 to 09-08-2015

The traffic count data collected for a week clearly show that there are a lot of vehicles flowing into the city through trunk road A7 every week. It has been observed that most of the load carriers plying into the city carry charcoal bags. The load carriers carry charcoal illegally into the city and there is no investigation on the source of wood or charcoal. There is no regulation on the entry of charcoal into the city and so more people gets into this business which is more profitable with less investment. It has been observed that the heavy vehicle drivers help a lot in trading of charcoal for transporting and selling it in the black market.

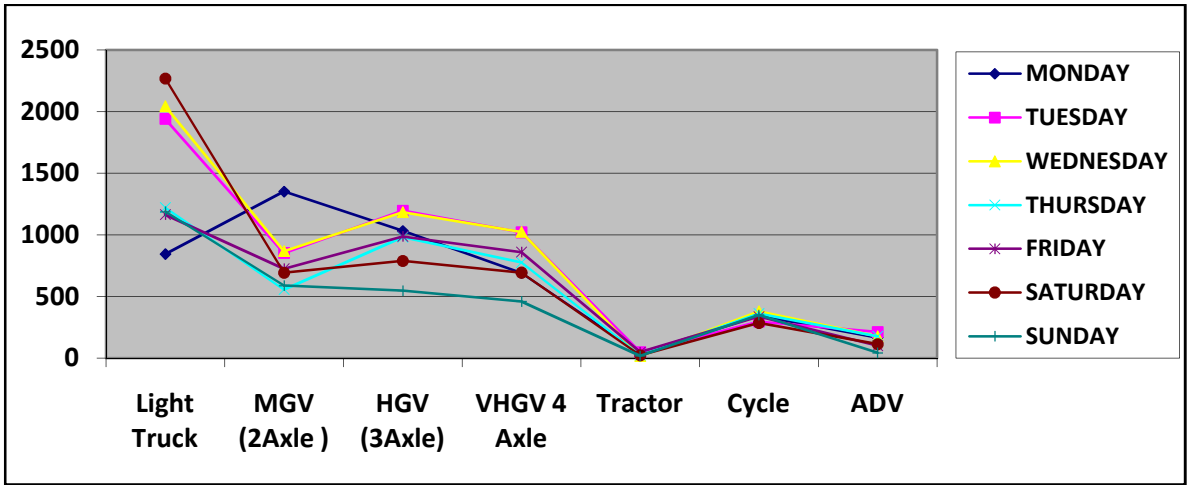

Figure 3: Traffic count data for trunk road (A7)

2.3. Traffic Count on Dar Es Salaam Mtwara Trunk Road B2

Dar es Salaam- Mtwara trunk road B2 is the next important road entering Dar es Salaam spanning a length of about 559 km. This road is also used by many people to bring goods and commodities into the city. The flow of charcoal through this road is also more and traffic count on this road is collected at Vikindu junction which is situated at the outskirts of the city and collected for whole day of a week.

APROACH FROM	Light Truck	MGV 2Axle	HGV 3Axle	VHGV 4 Axle & Above	Tractor with Trailer	Cycle	ADV / Cart	Total Traffic
MONDAY	623	1254	913	637	46	114	155	3742
TUESDAY	924	926	986	967	52	216	187	4258
WEDNESDAY	1116	883	1023	1016	25	226	177	4466
THURSDAY	1008	824	889	837	21	359	146	4084
FRIDAY	968	692	939	822	35	493	122	4071
SATURDAY	1564	669	768	683	34	342	144	4204
SUNDAY	1122	523	608	354	27	324	62	3020
TOTAL	7325	5771	6126	5316	240	2074	993	27845

Table 2: Traffic count data of load carriers for a week from 10-08-2015 to 16-08-2015

The traffic flow of heavy vehicles through the Dar es Salaam Mtwara road is seen to be less when compared to Morogoro road. But still a large number of vehicles seem to carry charcoal that are supplied to users and suppliers in the city.

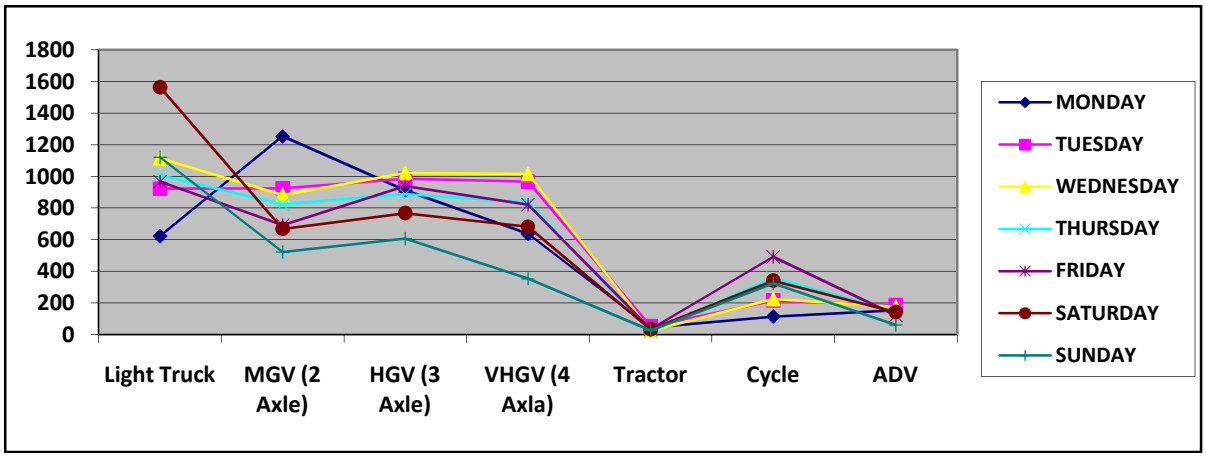

Figure 4: Traffic count data for trunk road (B2)

2.4. Traffic Data on Charcoal Inflow through Trunk Road A7 & B2

The traffic count on the amount of vehicles carrying charcoal into the city through the two major roads where studied and it is found out that the flow of charcoal into the city in indeed high at an alarming rate.

APROACH FROM	Light Truck	MGV 2Axle	HGV 3Axle	VHGV 4 Axle & Above	Tractor with Trailer	Cycle	ADV / Cart	Total Traffic
MONDAY	223	318	246	196	24	36	54	1097
TUESDAY	248	334	259	294	26	54	52	1267
WEDNESDAY	257	289	276	236	11	63	68	1200
THURSDAY	204	253	259	270	6	80	34	1106
FRIDAY	284	184	234	261	13	93	28	1097
SATURDAY	266	173	204	223	18	58	39	981
SUNDAY	156	96	136	83	9	67	17	564
TOTAL	1638	1647	1614	1563	107	451	292	7312

Table 3: Charcoal carrying vehicles through trunk road A7 for a week from 10-08-2015 to 16-08-2015

The investigation proves that most of the vehicles that enter into the city through these roads carry huge bags of charcoal weighing about 150 kg on an average. There are even bigger vehicles that carry upto 1.5 tons and above charcoal to the city. A little knowledge is available on the source of this unaccounted charcoal. At an average about 875000 kg of charcoal enters into Dar es Salaam through trunk road A7 which is a very high value. The flow of charcoal through trunk road B2 is less but competitive with trunk road A7 at an average rate of about 525000 kg of charcoal entering the city.

APROACH FROM	Light Truck	MGV 2Axle	HGV 3Axle	VHGV 4 Axle & Above	Tractor with Trailer	Cycle	ADV / Cart	Total Traffic
MONDAY	188	280	180	179	11	47	37	922
TUESDAY	133	290	185	197	15	69	44	933
WEDNESDAY	146	263	176	183	20	35	33	856
THURSDAY	163	241	166	177	7	58	24	836
FRIDAY	152	174	147	165	14	63	27	742
SATURDAY	134	187	193	143	9	57	39	762
SUNDAY	92	107	76	72	6	29	15	397
TOTAL	1008	1542	1123	1116	82	358	219	5448

Table 4: Charcoal carrying vehicles through trunk road B2 for a week from 10-08-2015 to 16-08-2015

2.5. Data Analysis

The data collected from the traffic count are carefully analysed to find out the maximum flow of charcoal into the city. Computer software like Microsoft excel is used to summarize the data so that it is available in a readable form. The results of the data analysis are presented in the following topics.

3. Result and Discussion

3.1 Analysis of Charcoal Flow through Trunk Road A7

It is clearly seen from the analysis reports that the flow of charcoal through the trunk road A7 is more when compared to trunk road B2. From the analysis, it is understood that the medium grade vehicles, very heavy grade vehicles and light trucks contribute more in the inflow of charcoal in sequential order. The reason why medium grade vehicle contributes more in the transport of charcoal is that these type of vehicles count for almost 18% of the total traffic and contribute to about 22% of traffic which transport charcoal to the city. The light vehicles are not monitored for illegal transport and the quantity these trucks carry is less and so they are not noticed. The taxes imposed on the medium grade trucks are also very less when compared to other vehicles which attracts more people to use these type of vehicles for transportation. The very heavy grade vehicles show a greater contribution in transportation of charcoal because of the fact that the local illegal traders use these tructs which come into the city to carry huge quantity of charcoal at a cheap cost. Almost 70% of very heavy grade vehicles entering the city carry charcoal. There is no regulation currently available to monitor or regulate these kinds of illegal transport into the city. The medium grade vehicle also stand first in quantity aspect of charcoal brought into the city doing it as their primary business, whereas the other type of vehicles contribute less in quantity since these vehicles bring charcoal into the city only on a part time basis. The observation proves that almost 23% of the load carriers in trunk road A7 helps in bringing charcoal into the city and most of it illegally.

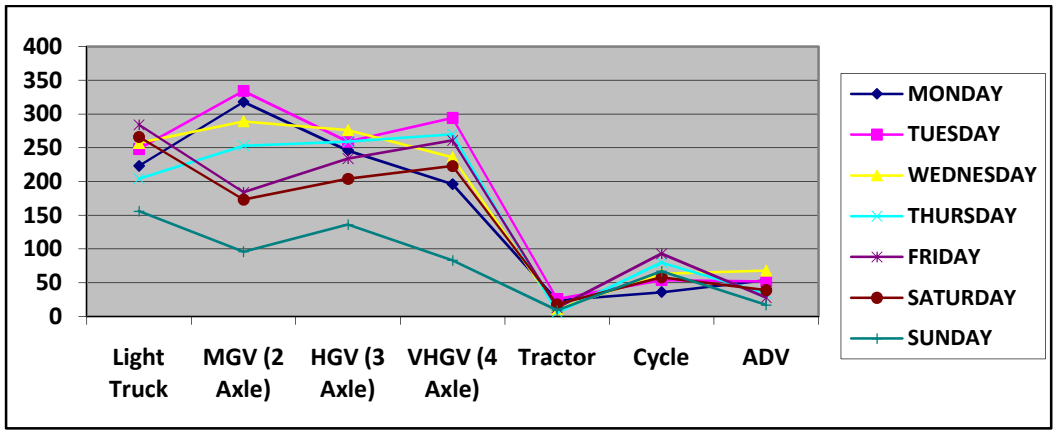

Figure 5: Vehicles carrying charcoal in trunk road (A7)

3.2 Analysis of Charcoal Flow through Trunk Road B2

Trunk road B2 is found to have a traffic volume less than trunk road A7. But the flow of charcoal is as similar as trunk road A7. From the analysis it is understood that Medium grade vehicles, Very heavy grade vehicles and heavy grade vehicles contribute more in the transport of charcoal to the city in the sequential order. The trunk road B2 also shows the same characteristics possed by trunk road A7. Investigation show that 21% of the load carriers moving into the city through this road are medium grade vehicles and almost 19.5% of the vehicles contribute in transporting charcoal into the city.

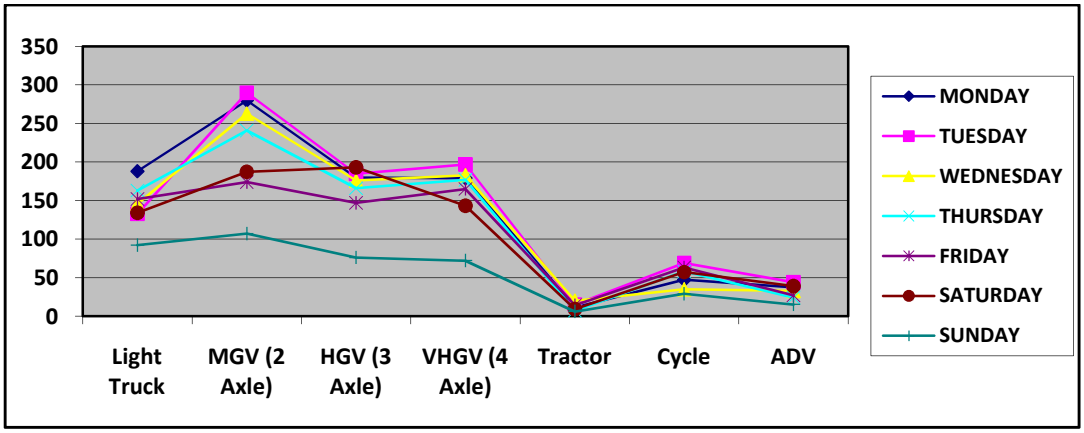

Figure 6: Vehicles carrying charcoal in trunk road B2

4. Conclusion

Dar es Salaam in one of the cities in Tanzania which consume charcoal in large quantity. There are other cities in the country like Dodoma, Arusha etc. which consume almost the same quantity of charcoal. The rate of consumption of charcoal is in such an alarming rate that Tanzania will end up in losing its forest reserves in a few years. It is much more important to have a regularised system of operation of production, transport, business and use of charcoal in the country. The concept of sustainable charcoal production has to be implemented. Detailed study on the charcoal production kilns in the country has to be conducted. All the kilns that produce charcoal at very less efficiency rate should be identified and decommissioned. The transport of charcoal should be regularised. Only licensed dealers should be allowed to transport charcoal. Illegal transport of charcoal should be dealt with seriously. People should be given awareness about the efficient use of charcoal and other methods for cooking. The inflow of charcoal into cities like Dar es Salaam should be reduced to save the forest reserves of the country.

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