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Original Article

## Behavioural Dumping and Drainage Channels.

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Dumping is one of the inevitable societal behaviours because waste can only be controlled but not eliminated completely. The rapidly growing developing countries have cities, towns and trading centres emerging daily coupled with increasing populations can be well related to poor drainage and irresponsible dumping in water channels. The aim of this study was to scrutinize drainage dumping behaviours in relation to water channels in some selected cities in Uganda. In this study, observational and analytical experiments on dumping were done in selected towns and cities, along some major highways connecting them. The findings showed that a lot of illegal dumping is happening at a rate of 63% on average on roads and even near the legal dumping places. Most of the refuse that is erroneously dumped ends up in drainage channels leading to serious flooding and other environmental consequences. The study recommends other better models in addition to improving drainage design, construction and maintenance patterns. Strict laws and sensitization are crucial in this regard and can help in saving and improving the lives of the people by at least 11%.

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## INTRODUCTION

Water channels globally have been endpoints for the dumping process (Semwogerere *et al.*, 2014). The process begins with irresponsible and managed dumping near or on the roads and drainage channels, and finally to the water channels. Officially, dumping is arranged for when managers provide waste bins on town or city streets but not done on highways. Irresponsible dumping is done on streets and on highways through vehicle windows, business vendors working along the streets, street residents and pedestrians. These finally end up in drainage channels which carry them to further destinations. Yet, there is still a need for necessary sanitation through proper management of drainage channels in relation to the increasing population (Banerjee & Morella, 2011). They are also intended for regulating surface water runoff and enhancing water quality through protecting the natural flow regimes in water courses (Banerjee & Morella, 2011) (Geldof & Stahre, 2006) (WHO/UNICEF, 2012). However, surfaces and drainage channels are eventually filled with refuse which is irresponsibly dumped. Therefore, the main focus of this study was to analyse the dumping behaviours and the consequential effects.

The illegal dumping activity is one of the major effects on our drainage channels, which eventually causes serious environmental challenges like floods, especially in the urban areas. So, it is an unlawful activity with several environmental and engineering effects. Overflows in the drainage channels are caused by many reasons, notably the construction of houses along or directly on them eventually blocking them and allowing the reckless dumping. It should be noted that urban drainage networks are a large structured system comprising open drainage, manholes and pipes among others targeting the collection and transportation of wastewater which includes dumped materials (Moeini & Afshar, 2017). Whereas hydraulic regimes within given drainages is a function of different design parameters like diameter and gradients, unplanned dumping is normally ignored. This study aims at considering this parameter of dumping in analysis.

Such dumping is coupled with some drainage channels that do not meet modern requirements and therefore result in blockages (Swamee & Sharma, 2013). Most cities have combined sew systems to capture both sanitary and stormwater (Chen *et al.*, 2013).

## METHODS AND MATERIALS

The study was basically experimental based on blocks considered from town streets of length at most 50 meters and parts of highway roads of at most 150,000 meters (150 kilometres). The researcher observed the dumping behaviours for a period not exceeding nine weeks from morning to evening. The average number of times of both responsible and irresponsible dumping were recorded for each block. A total of 12 blocks from the towns and cities selected was considered. The highway experiments were monitored for only six days for each of the roads to/from Kampala up to experiment areas in each region. The study was guided by several research questions including among others: Who does the dumping responsibly and the otherwise in towns, cities and on the roads? Which parts along the experiment blocks are most affected and why? What next after dumping? What is the content in drainage channels? Who is responsible for removing the contents? How long does it take to clean up the wastes from channels and from the sides? Are there any effects like sicknesses related to the drainage content?

The research questions were administered directly to respondents and physically through experiments, responses were recorded and analysed. Most of them required detailed explanations that were captured in the findings. Several drainage channels were selected from the Eastern (Tororo (Tor)), Northwestern (Arua (Ar)), Central (Kampala (Kam) and Mpigi (Mp)) and Western regions (Kabale (Kab)) of Uganda. The dumping behaviours were followed physically in these areas and in real time with events recorded. Several materials like cameras were used to capture some parts of the experiments. Observations and simple discussions with stakeholders like drivers, business persons and

residents were also made and recorded and used for further analysis. Other sources of information included books, journals and conference proceedings materials about the study arena.

## FINDINGS AND DISCUSSION

Analysing irresponsible dumping in the cities or towns and along the highways was the theme behind this study. Waste dumped affects the flow characteristics of the drainage contents which eventually end in massive floods or other ecological and environmental effects. Proper management for sustainable drainage systems in many parts of developing countries like Uganda is therefore necessary. Some people in these selected areas dump irresponsibly or authorities take long to clear up garbage which ends up in drainage channels. In some establishments, residents regularly dump their waste in the channels (gutters), and this clogs and overflows them when it rains (Falade, 2001). The research study answered all the research questions that were staged. It is no doubt that most of the garbage content is determined by the kind of activity dumpers do, their status and that of their vehicles. For instance, the study found out that in business areas like shops/markets, residential areas and along the highways, most garbage content is polyethylene materials. It was also noted that city and town authorities are responsible for collecting and removing the garbage. They take long to collect it because of insufficient and delayed funding which

also slows the collection intervals (Jimoh, 2008). There are several effects related to the contents especially those related to health hazards like cholera (Offiong, *et al.*, 2008). The study took a deeper analysis on the following:

### Dumping in Cities and Towns

Urban dumping arises from pedestrians, motorists, business vendors and street residents. It is also coupled with delayed removal of garbage from the official points leading to the overflow. It is true that most cities and towns have dumping challenges arising from irresponsible dumping to delayed removal of the refuse. Normally there are gazetted places with large collection bins where residents and other street users are supposed to put garbage. The users normally dispose garbage off or outside the bins because they are either irresponsible or they have nowhere to step to use the bin because of scattered litter. More so, the contracted agencies take long to pick the bins to finally dispose the garbage in the 'secured' places. Whereas these are supposed to be 'secured' places, for some cities and towns, they are neglected for some time and this causes havoc in the surrounding areas. It was observed from the experiment that the ratio of wrong to proper dumping is rather high for all the experiments done as observed in *Table 1*. It is observed also in *Table 2* that the ratio of wrong to proper dumping is 0.63 for this analysis done in only few urban settings.

**Table 1: Experiment Blocks for the Towns Considered for the Wrong (w) to Proper (p) Dumping Ratios**

Block No. and Area	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8	Week 9
B1 (Kab)	12w/2p	11w/4p	13w/8p	8w/7p	6w/2p	11w/13p	3w/3p	6w/7p	5w/4p
B2 (Kab)	15w/7p	8w/7p	13w/8p	9w/11p	6w/7p	8w/10p	14w/7p	7w/4p	5w/5p
B3 (Ar)	5w/3p	10w/7p	10w/9p	6w/8p	7w/3p	13w/10p	7w/4p	9w/3p	8w/7p
B4 (Ar)	10w/11p	9w/3p	9w/8p	8w/6p	12w/4p	6w/10p	13w/9p	7w/7p	6w/4p
B5 (Tor)	16w/7p	12w/6p	11w/9p	4w/7p	11w/4p	15w/13p	7w/9p	12w/4p	6w/7p
B6 (Tor)	11w/3p	14w/8p	12w/10p	5w/6p	13w/4p	12w/13p	5w/6p	9w/5p	7w/5p
B7 (Kam)	17w/6p	15w/7p	14w/8p	10w/7p	5w/7p	13w/12p	7w/2p	9w/2p	7w/3p
B8 (Kam)	15w/4p	13w/3p	15w/6p	13w/9p	8w/4p	15w/9p	4w/7p	5w/3p	9w/7p
B9 (Mp)	13w/4p	10w/8p	11w/6p	9w/3p	9w/8p	14w/7p	4w/7p	6w/2p	8w/3p
B10 (Mp)	17w/11p	8w/7p	10w/5p	10w/6p	7w/3p	12w/14p	10w/6p	9w/6p	9w/6p

**Table 2: Summary Average Values for the Wrong (w) to Proper (p) Dumping**

Blocks	B1	B2	B3	B4	B5	B6	B7	B8	B9	B10	Average Number
Average (w)	78.3	9.4	8.3	8.9	10.4	9.8	10.8	10.8	9.3	10.2	10.7
Average (p)	5.7	7.3	6.0	6.9	7.3	6.7	6.0	5.8	5.3	7.1	7.1

**Dumping in Drainage Channels and Gutters**

This basically arises from businesses that are established along the channels besides the roads like markets and shops. It also arises from the construction developments done near or in wetland parts of the country in some towns. It was noted here that businesses like markets do a lot of damage directly onto the channels in two ways. One is where the vendors create evening businesses very near or even on top of these ditches covered but with outlets and therefore drop directly in them. On the other hand, vendors create their own garbage heaps which eventually are eroded by water or wind to the channels. Such dumping is coupled with inadequate waste collection systems. This further leads to poor sanitation and can often result in blockages of drains. More so, increased population, as it is the

trend in towns and cities, increases human activities and more inflow of materials. It also generates larger volumes of waste, coupled with the irrepressible location of physical infrastructures such as markets and residential structures due to poor planning (Jimoh, 2008; Semwogerere, *et al.*, 2017).

**Dumping on Highways**

This is normally done by all vehicles and individuals spotted dumping irresponsibly. It was noted that the experiment was done within six days selected randomly and respectively for the selected highway roads. It was noted that dumping had a normal curve as observed in Figure 1, maximizing at town or areas with refreshments for the road travellers along the roads.

**Figure 1: Dumping on Highways as a Normal Distribution curve for a Given Commercial Area.**



This implies that dumping on roads is done mostly by passengers and refreshments vendors. Dumping is high near towns or commercial areas and reduces

as you move away from towns. From Table 2, it was observed that the number of live dumping is rather high on highways and yet simply taken for granted.

For the selected days, findings show an average of 13 times of irresponsible dumping through the windows of vehicles on highways. The average highs are on Kampala – Kabale highway and Kampala – Arua highway with averages of 15 and 14 times respectively. This can be attributed to the high number of dumping from passenger buses than

minibuses (taxis) and some few other vehicles on the respective roads. These are fewer on the Kampala – Tororo road. The high dumping rate can also be attributed to the bigger length of the road under experimentation respectively as observed in *Table 3*.

**Table 3: Number of Live Dumping on Highways**

Highway Experiment Blocks	Days						Average Value
	1	2	3	4	5	6	
Highway 1 (Kampala –Tororo)	09	11	05	08	12	11	09.3
Highway 2 (Kampala – Kabale)	16	22	13	12	17	08	14.5
Highway 3 (Kampala – Arua)	13	17	18	14	13	10	14.2

Results from Table 2 also reveal that there is current live dumping on our roads to a minimum average of 9 people for the few hours one can be on the road in a given day. In a month or year, we can have a minimum average number of live dumping of 270 or 3,240 times respectively. A good quantity of this garbage is eroded to drainage channels, the blockage is really evident. Many highways in developing countries have this characteristic and therefore require a special move on managing such dumping which litters and eventually blocks drainages along roads leading to floods and consequently loss of lives and property (Offiong, *et al.*, 2008) (Semwogerere *et al.*, 2013). Sometimes, wastes dumped directly in ditches and drainage channels remain unattended to for quite some time. It is also true that some drainage challenges are caused by poor maintenance strategies or erroneous implementation of the plans. The study also discovered that some people drop garbage collected from home on these roads as well.

There is also lack of community involvement in sanitation measures. This is coupled with the wide gap in the socio-economic status within the community (Silveira, *et al.*, 2001). Silveira and others confirm that poor people who live in areas with poor public services continuously pay no or little attention to these utilities like roads and gazetted garbage bins (Silveira, *et al.*, 2001). Therefore, environmental education programmes are necessary but not adequate in eradicating urban and highway drainage problems irrespective of the dumping syndrome.

Managing some of these problems requires proper and regular cleaning of channels to manage the possible accumulation and clogging of garbage and the repercussions. Also, more refuse dumps (collection points) be provided in these areas under study and be visited by the authorities regularly. The study also recommends dumping responsibly in the vehicles until the vehicle reaches a cleaning point like washing bays.

There are several considerations that were focused on in this study like the common locations of illegal dumping activity, the dumpers’ profile and reasons behind such dumping. The locations considered here are towns, cities, roads and drainage channels. The profile is indeed wide but the study discovered that it is a cross-section of all subgroups excluding a small percentage of people who are aware of illegal dumping. The waste collection system has various drawbacks like high fees charged (CNT, 2013) versus the collection intervals. In fact, some towns that gained city status in the year 2020, have changed their collection status to free collection services. The services are managed by the government through collected taxes from the business services. Noted also was that dumpers tend to fear the high fees and try to dump irresponsibly in a bid to reduce or avoid paying such fees. However, sometimes, the waste collectors violate the collection intervals because of late funding systems. This also allows overflows around waste bins thus accelerating the poor dumping activity. More so, the proportion of garbage collected to what quantity is available at the collection centre is always far much below. For example, in Kampala

city, it is estimated that only 61% is collected of the waste generated per day (Flavia, 2013). There are other noted factors towards illegal dumping that include among others: Laziness and resistance to dumping necessarily (these wish to dump in drainages), accessing some areas especially the slums around the towns and cities because of the poor urban planning, the working class cannot timely bring garbage to the trucks since they are always off for work (Asoegwu, 2009) and yet it is one of the collection systems. There is also an issue of having false hopes that of rain washing it away than paying for its collection.

The study found out that the garbage bins are also grossly misused when users dump faecal waste and other inappropriate materials. This puts off collectors and eventually end up with overflows which end up in drainage channels. Illegal dumping has several other notable effects away from drainage effects that may include water, land and air pollution from chemicals, faeces, burning and decomposition effects; wildfires from irresponsible burning to curb the smell; possible risks on safety and health of the people around the collection centres and affected drainages as a result of toxic substances, breeding grounds and decomposition point; and effects on tourism for littered areas.

## CONCLUSION

There are many issues that are still worth considering in this fight against illegal dumping. This ranges from the recycling of wastes to community awareness and involvement. Recycling can only be effective with good collection methods.

Illegal dumping control programs focus on community involvement and targeted enforcement to eliminate or reduce illegal dumping practices. The key to successfully using this BMP is increasing public awareness of the problem and its implications. Illegal dumping control programs use a combination of public education, citizen participation, site maintenance, and authorized enforcement measures (Walski, 2011).

There is a need to sign a Transaction Advisory Services Agreement (TASA) in order to provide advisory services with respect to contracting private operators to implement an Integrated Solid Waste Management system for several cities and towns.

This was done in 2012 with Kampala with regard to collection, recycling and composting of waste and landfill operations (Flavia, 2013). Construction and operation of new landfills and beneficial use of landfill methane for the generation of electricity and potential generation of CDM carbon credits.

There is need for law enforcement solutions on irresponsible dumping on roads, garbage areas and drainage channels. This should go hand in hand with collective responsibility and community awareness of the several effects of such dumping especially to the drainage channels as is the fact with this study. Cities and town authorities must therefore enforce strict illegal dumping laws and fixed camera systems especially within and on roads to and from them, by clearly outlining the penalties and consequences if found guilty.

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