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Urban flooding and waste disposal nexus: Challenges and implication for property ownership in third world nations

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ABSTRACT

The study examined the indiscriminate disposal of waste in Ghana relative to the flooding and devaluation of properties in urban Kumasi and Tamale. Adopting the waste management theory coupled with survey design, the study investigated the types of waste produced in these cities. Using SPSS, the regression was utilized to analyse the relationship between proximity to flooding and flood prone areas and residential rental values. In both Kumasi and Tamale no tenant was willing to pay higher rent for a house located at a flooding or flood prone area irrespective of the architectural designs. An R of 0.54 and a P value 0.0000 at 0.5 significant level indicating a fairly strong relationship between the two variables tested. The study found it dangerous for an emerging city like Ghana to have higher percentage (82%) of households practicing open dumping as the favourite method of waste disposal and treatment.

Keywords: Approach, Waste Management, Flooding, Rent, Disaster, Reuse

1. INTRODUCTION

Waste is an inevitable product in man's life since it is produced at the quest of consuming a product either for biological purpose or anthropogenic satisfaction. The production of waste in itself is not a burden but it becomes a curse or blessing at the manner, ways and processes by which it is been disposed. This is because each and every one wish to keep waste far and away from home but due to the Not At My Backyard (NAMBY) syndrome, these wastes end up been deposited at open lots and spaces meant. This was not a major issue when the human population was comparatively small and itinerant, but became a serious problem with urbanization and the growth of large conurbations (Bogoro et al., 2013). However, indiscriminate disposal of solid waste has hostile effects on live and the environment in general.

In medieval times, epidemics associated with water contaminated with pathogens devastated the population of Europe and even more recently (19th century), cholera was a collective manifestation (Bogoro et al., 2013). Some of the direct health impacts of the maladministration of waste are well acknowledged and can be pragmatic especially in emerging countries (Giusti, 2009). UNCHS,

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(1996) documented that the proportion of solid waste evacuated and disposed is less than 25% in Dares Salaam (Tanzania) and about 40% and about 40% to 60% respectively for Karachi (Pakistan) and Jakarta (Indonesia). It is believed that in the poorest communities (many of which are in sub–Saharan Africa), 80 to 90% of wastes generated are ill collected for safe disposal (Ogu, 2000). Recently, however, most of the emerging cities in Ghana have been experiencing tragic flooding resulting from indiscriminate disposal of waste that choke gutters. In 2015, 154 people perished with several thousand incapacitated together with millions of Cedis of properties destroyed by flooding (Joynews.com). This was the tenth flood that slammed Accra (Asumadu-Sarkodie et al., 2015). Several natural disasters have occurred since the time of biblical Noah up until now in the form of flooding, earthquake, volcanic eruption tsunamis, tornadoes, landslides, hurricane, among others (Asumadu-Sarkodie et al., 2015).

Pertaining to the Global Facility for Disaster Reduction and Recovery, flooding is a serious development challenge, which causes widespread devastation, economic damages, and loss of lives. Flooding is a conjoint environmental disaster after disease and accidents. Annual data shows that, flood claims 20,000 lives and adversely claims 20 million lives worldwide (Smith et al., 2014). Flooding can have devastating impacts which may cause major interference to energy, water, communication, transport, restriction of public services, have significant impact on the environment, cultural heritage, cause pollution, cause changes to habitats, causes migration and reducing economic rent of residential properties. Effects of flooding on residential property values have been enormous when it occurs and these impacts are becoming a global tragedy as those in advanced countries are not spared of the canker. For instance, the upsurge in incidence and relentlessness of flood events in the UK has emphasised the question of the impact of flooding on the value of property (Lamond et al., 2010). Erstwhile research in the UK and worldwide have quantified an extensive assortment of impacts from no impact to concessions of more than 40% of property price (Lamond et al., 2010). In most of the developing nations and Ghana for instance, tradable dimensions have not earlier been tried in the country's property market owing to inadequate handiness of data; a phenomenon common to the real estate industry.

In order to improving and providing evidence base, statistics, this study investigated the causes and sources of flooding in 5 emerging cities in Ghana. It intends ascertaining whether or not the rampant flooding events in these cities are influenced by the rate at which waste is indiscriminately disposed in the cities? The research would explore further to establish if residential properties in such cities have their rental values affected by this flooding disasters and if so how are the vulnerable property owners adapting to the disaster and getting evidence to backing this questions is the rationale behind this paper.

Literature Review

The safe disposal of solid waste is precarious for public health and is especially true during an emergency (WHO, 2013). These pressures are felt the most acutely in informal settlements in developing cities, where spontaneous residences often expand into flood-prone, low-lying areas or existing drainage channels (World Bank, 2017). The world is however, becoming more urbanized than it used to be where especially every continent is experiencing rapid population growth.

In accordance with the World Bank, (2017), the year 2008 was noticed for a year where half of the world's 6.8 billion people became urban residents. It emphasized that if this trend lingers, 66% of the world's population is anticipated to be living in urban areas by 2050. Sub-Saharan Africa where Ghana is located, is the least urbanized but is the fastest growing area of the world (Ziraba et al., 2016). This population influx has increased pressures on cities around the globe as many city governments struggle to provide a safe and secure living environment for their residents (see figure 1a and b). Amongst its countless trials are solid waste management and urban flood risk management and the nexus of these two sectors is an issue receiving increasing responsiveness. However, most the studies that tried finding the nexus of waste and flooding fail to address the impacts of the two managerial short comings on rental values and such raises concern on policy anomaly on economic analysis.

(a) (b)

Figure 1 The state of Flooding and Waste disposal in Ghana.
Source: Picture taken from the Field, 2020

Conceptualizing Waste, Flooding and Rental Values

Waste controlling comprises three main steps according to Lamond et al., (2012); collection, transportation and disposal. Collection can be additionally alienated into primary, secondary and tertiary stage reflecting the scale of the operation and resulting in the incorporation of multiple waste streams into a body of waste materials that necessitate disposal. The order of reduce, reuse, recycle and recovery of energy from waste disposal can be applied before collection, at the point of collection and during disposal to decrease the amount of waste finally entrusted to landfill. Consequently, raising the awareness of residents regarding the benefits of waste reduction can be a first step in accountable waste management and flood risk lessening Sam, (2011).

The question is having the awareness creation been effective in emerging cities? And if so, has it yielded any positive result? The motive for the question is obvious as cases of urban flooding in developing cities, including Africa discussed in literature reveal upsetting effects where most flooding events are influenced by waste piled in water ways and gutters (World Bank, 2017; Amoako et al., 2014). The types of waste that are generated in cities of developing nations are not different from that of the advances nations (Links, 2006), though not same, (figure 2). However, In Africa and Ghana the types of waste that are critical to flooding are that of Agriculture, Municipal and Industrial waste.

Contextually, flood is a term used to describe an overflow of water over land and the process at which overflow is done is called flooding. Floods are said to be among the most devastating natural disasters in the world claiming more lives and causing more property damage than any other natural phenomenon (Anunobi, 2013). It is predictable that at least 20% of the population of the world are at the peril of one form of flooding or the other. Studies have shown that across the globe, floods have posed remarkable jeopardy to people's lives and properties accounting for one-third of all deaths, one-third of all injuries and one-third of all destruction from natural disasters (Etuonovbe, 2011).

According to Smith, (1996) as cited by Etuonovbe, (2011), floods claim 20,000 lives per year and badly affect around 75 million people globally. In the north of Africa, over 8,800 lives were lost between 1927 and 1995 in Algeria, Tunisia, Egypt and Morocco (Jha et al., 2011b) owing to urban flooding. Comparable events were also documented in the southern part of the continent amid 2000 and 2009. Substantial flood events ensuing from severe rains caused 1,148 lives, made 500,000 people vagrant and unemployed and wrecked 150,250 homes and several properties appraised at US$ 715 million in Mozambique, Zimbabwe, South Africa, Zambia and Namibia (Jha et al., 2011b). Moreover, in eastern Africa between 2002 and 2006, over 210 persons perished and thousands were rendered homeless (Amoako, 2012). Countries most pretentious were Rwanda, Kenya, Burundi, Tanzania and Uganda (Douglas et al., 2008) and Ethiopia (UN Habitat, 2007).

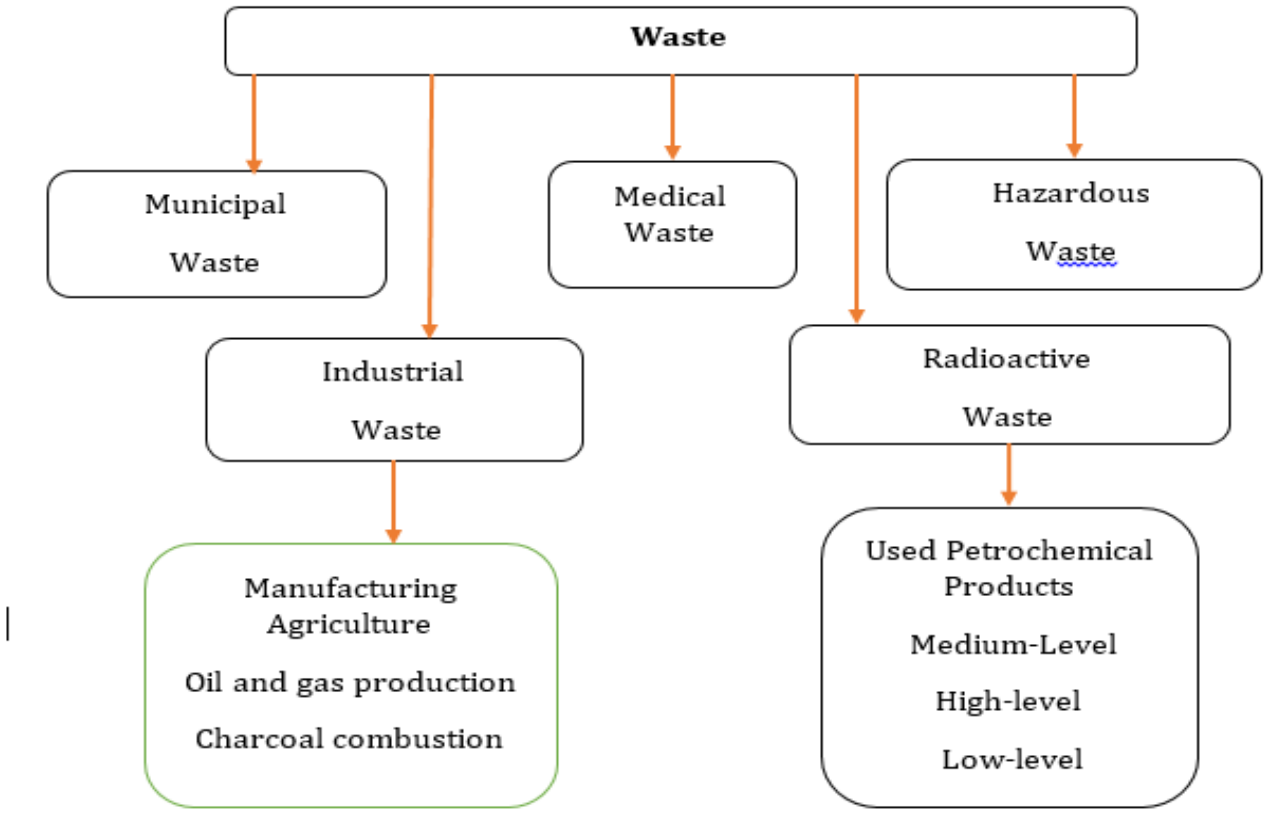

Figure 2 Types of Waste Produced in Ghanaian Cities
Source: Authors Construct Adopted from Wagner, 2020

Further disturbing floods in the sub-region occurred in Ethiopia (2005 & 2007), Kenya (2003, 2006 & 2008) and Uganda (2004 & 2007). Further to these, the West African sub-region had experienced the worst urban flood incidents on the continent. Flood incidents in 1982, 1991, 1995, 1998 and 1999 affected more than 500,000 people in each case (GFDRR, 2011b). In 2010 for instance, more than 1.7m people were affected by flooding coupled with 52,000 cholera cases documented in its rouse (GFDRR, 2011a). Countries mercilessly affected in terms of population include Togo (200,000), Benin (680,000), Nigeria (300,000), Burkina Faso (133,000) and Ghana (141,000). Recently in Ghana, out of flooding, 154 people died and hundreds suffered severe burns resulting in permanent physical disabilities. According to (Abhas et al., 2011; Hafiz, 2014), there are five major types of flooding that is experienced worldwide depending on the intensity of rainfall and the topographical characteristics of the flooding location. Among them are Pluvial or Overland Floods; these floods are caused by rainfall or snowmelt that is not absorbed into the land and flows over land before it reaches drainage systems or watercourses. This kind of flooding often occurs in urban areas where the land lacks permeability. Another is River or Fluvial Floods; which according to (Pittock and Xu, 2011) occurs when the surface water runoff exceeds the capacity of natural or artificial channels to accommodate the flow.

Moreover, Coastal Floods: Coastal Floods arise from incursion by the ocean or by sea water. They differ from cyclic high tides in that they result from an unexpected relative increase in sea level caused by storms or a tsunami (sometimes referred to as a tidal wave) caused by seismic activities. Again, there is Groundwater Floods which occurs when water levels under the ground rise during the winter or rainy season and fall again during the summer or dry season. Groundwater flooding occurs when the water table level of the underlying aquifer rises until it reaches the surface level. The last among them is Flash Floods; the US National Weather Service describes a flash flood as "A rapid and extreme flow of high water into a normally dry area". The severity of the flooding situation across the globe led to the recent development of an integrated Flood Risk Management handbook by the World Bank in 2015 and such indicates the necessity for mutual efforts by nations and the citizenry to have an all-inclusive approach for flood risk management (Ahadzie et al., 2016). Relative to the Ghana's worst flood disaster in June 2015 when 150 people lost their lives in the capital, Accra, it has been established that flooding is a long perpendicular hazard in Ghana and necessitates the development of an integrated flood risk management plan (Ahadzie et al., 2011).

Studies show that flooding has been known to be responsible for various problems. It does not only interrupt socio-economic activities, but often lead to loss of lives and destruction of properties. The situation has been so devastating to the extent that even the "Sahel sub-region" in central Africa, usually associated with desertification, has experienced flooding (Tschakert et al., 2010) with key flood events occurring in Mali (2002, 2003, 2007), Niger (2003, 2007, 2008), Chad (2001, 2007, 2008) and Sudan (2003, 2006, 2007). Property is a multi-dimensional artefact and the number and nature of factors that impact its value are likewise of diverse kinds (Paz, 2003; Megbolugbe, 1989). Property and land values tend to rise in areas with expanding transportation networks and increase less rapidly in areas without such developments. Swift and sustained rise in housing and land prices are projected in cities with transportation improvements and rapid economic and population progression (Ge et al., 2007).

Nkwunonwo, (2016) reported that between the period of 1985 and 2014, flooding in Nigeria has stuck more than 11 million lives with a total of 1100 deaths and property damage exceeding 17 billion US dollars. In 2012, the country experienced the worst flooding in more than 40 years as a result of heavy squalls that persisted for countless days. However, according to the Environment Agency, (2001) at least 10% of the population of England and Wales is directly at risk from flooding, with a larger proportion of the population being indirectly effected by flooding due to road closures, service disturbance and the loss of goods and produce. This also associates to 1.85 million residential properties in England being at risk of flooding, with an additional 185,000 commercial properties also being situated in flood susceptible areas. Relative to the upsurge in residential and commercial property statistics, there exist closely (5) million people in England and Wales who are directly at risk from a flood incident.

Waste Management Condition in Tamale and Kumasi

Ghana as a whole has over the last two decades faced with numerous waste management problems specifically solid waste: agricultural and industrial wastes. The problem gets augmented when people get more affluent. In accordance with (Lardinois & Klundert, 1995), the wealthier the citizens, the more waste is produced and in Accra for instance, high income groups produce 0.6kg/capita/day, middle income groups, 0.4 kg/capita/day and low-income groups 0.3 kg/capita/day. The situation in Tamale-Ghana is not different as the degree of solid waste generation and disposal has upsurge above the management capacity of the Metropolitan area and hence the waste generation has become a curse rather than blessing. Puopiel, (2010) reveals that, there is indiscriminate dumping of solid waste, uneven collection of waste produced and insufficient resources for the controlling of in Tamale.

He emphasized that the metropolis generates 810 tonnes of waste on daily basis with only 216 tonnes towed daily while an excess of 594 tonnes are left in open lots which end up choking gutters. The high level of the inability of the Metropolitan to collect the accumulated wastes is impeding the sustainable development of the city which is against the SDG 11. The inferior expanses in the city are the slightest possible to access benign disposal and collection of their domestic solid waste (Palczynski, 2002) and this according to (Oteng-Ababio, 2011) has indeed impacted by its treacherous social and health effect. The situation in Kumasi, the capital city of the Ashanti Region of Ghana is however, not exceptional. Studies conducted previously in Kumasi (Wahabu et al., 2014), reveals that, recovery of only plastics from the solid waste stream for reuse and recycling purposes is solely carried out by the informal sector without any support from the government despite having a huge potential to generate revenue and create employment Owusu-Sekyere et al., (2013).

In 2008, according to (Wahabu et al., 2014) in an effort to retrieve some of the funds injected into collection of solid waste and perhaps force residents to lessen the amount of waste disposed of, the Kumasi Metropolitan Assembly (KMA) introduced a unit pricing system, frequently practiced in Europe and America, where residents are charged a fee for waste collection based on the quantity of waste intended for disposal basically referred to as Polluter Pay Principle (PPP) (Hector, 2008). The trial therefore is to advance and endorse disposal systems that require a slightest level of mechanical apparatus Mensah et al., (2005). However, the method, in its preliminary execution stage, experienced disagreement from the public leading to indiscriminate disposal of waste at unauthorized places. It was as a result of this menace that the government of Ghana constructed the landfill in Kumasi in 2004 (Owusu-Sekyere, 2013), to accommodate the million tonnes of waste produced on daily bases. There is therefore a clear indication that wastes are poor collected and indiscriminately disposed off leading to chocking gutter and drains and this study wish to explore and ascertain whether or not this poor waste management in totality has influenced flooding and subsequently impacted of residential property values.

Theoretical Framework

In line with the current waste management situation in the study areas, the study is seen to be inconclusive without the waste management theory (WMT). However, issues of waste related flooding cannot be argued without discussing industrial ecology and

the reason been that ecological nature of industries affects the type, kind and nature of wastes produced and reused. Industrial Ecology (IE) in accordance with (Chertow, 2008) is the science that determine the phases of the production processes of goods and services from nature's perspective, trying to imitate a natural system by conserving and reusing resources. It is however, undoubted that waste related flooding incidents are influenced by the types of waste produced from the industry. Moreover, as far as rent is concerned, infrastructure becomes paramount and any event of flooding means depreciation in infrastructural value particular residential housing in our case.

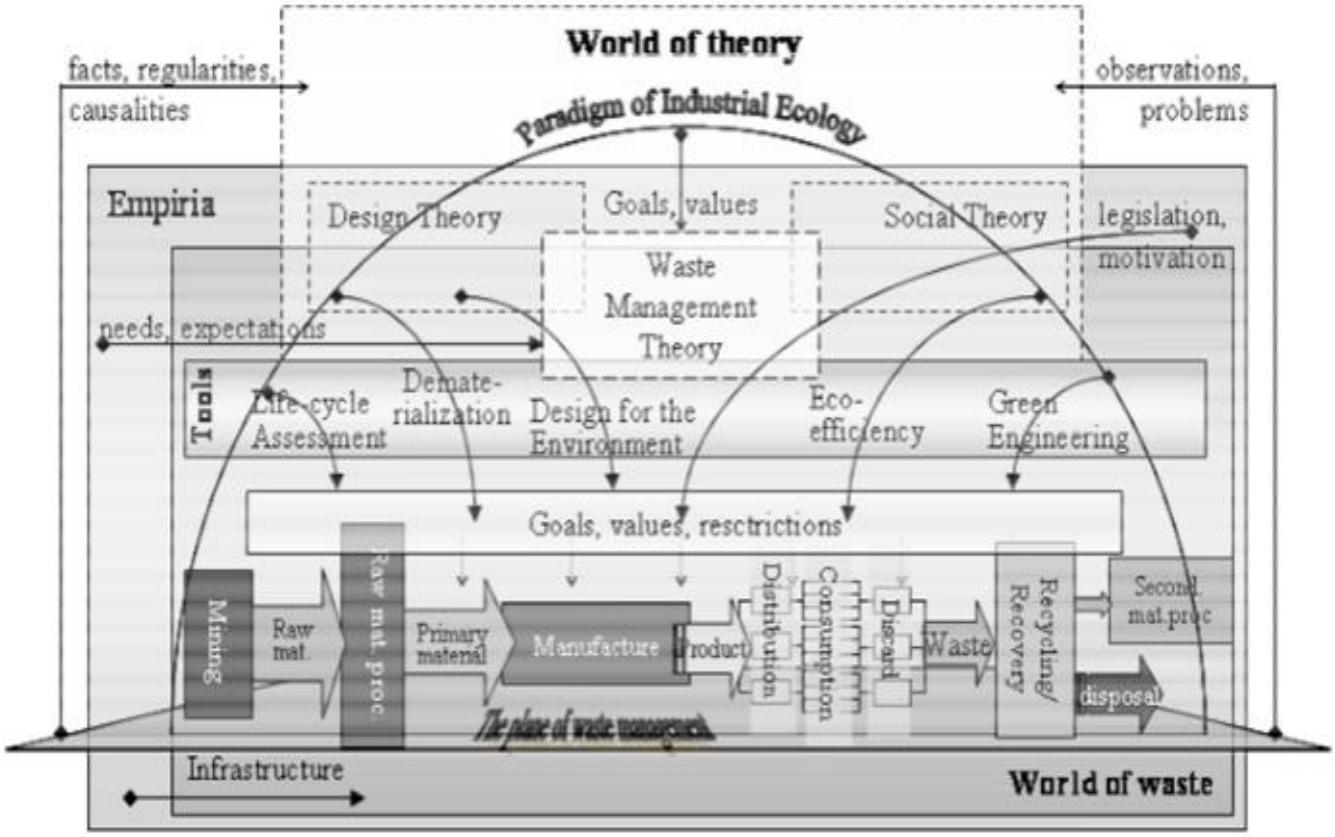

Figure 3 Waste Management Theory in the purview of Industrial Ecology.
Source adapted from Pongrácz et al., (2004).

Figure 3 exemplifies how WMT is placed amid supplementary linking theories and what tools need to be used to achieve the objectives of IE. The 'world of waste' is emphasised from "Empiria," to climax the prompting factors on manipulative waste management. It draws data from the prevailing waste management infrastructure and is limited by its legislative boundaries. On the event of waste management," WMT pursues to heighten resources use from untouched raw material, to shed. The goalmouths, values for resources enhancing initiate from the model of Industrial Ecology. It was contended that the goals in IE have to be adapted by WMT and to translate the goals of IE so that they are pertinent to an industrial component.

2. MATERIALS AND METHOD

The study was conducted in Kumasi and Tamale all in Ghana. The selection of the study areas was informed by the waste situations, the intense rate of flooding and the types of residential properties found in those areas. Using survey design, the study employed mixed method data gathering approach where information is sourced from both primary and secondary cradles. With this, primary data would be obtained adopting semi-structured questionnaires, face to face interviews buttressed by cartographical data to showcasing the realities and severities of the problem so identified as occurrences of flooding remain disastrous.

Moreover, literature on similar cases in journals as well as achieves from Metropolitan, Municipal and Districts Assemblies of such cases would be relied on as secondary data. The research therefore wishes to target residents (both tenants and landowners) of

the selected emerging cities, the Estate Surveying and Valuation firms operating within the immediate neighbourhoods and the officials from the National Disaster Management Organizations (NADMO) in the sampled cities. Taken cognisance with the two emerging cities targeted, the study sampled 616 respondents from Kumasi and 473 from Tamale using both stratified and systematic sampling techniques respectively. The sample size was obtained based on the number of houses and households at the flood and flood prone areas in the areas selected for the study.

Sampling Techniques and Criterion

Two main flood and flood prone area (Sepe Boukrom and Atonsu Ahensan) were selected in Kumasi, within these two communities were 1,847 houses, 789 in Sepe Buokrom and 1058 in Atonsu Ahinsan. Using a systematic sampling with an interval of every 3rd house, houses were selected from 263 Sepe Buokrom and 353 from Atonsu Ahensan using the same method. Moreover, in Tamale Township, there are about four (4) communities identified to be both flooded and flood prone areas: Gumani, Kalariga, Nyanshagu, Kulnyevila and Fou. However, the study selected Gumani, Kalariga and Kulnyevila owing to how severe these places have been prone to flooding and flooded persistently.

Three (3) communities were selected in Tamale because the settlement was scatted and the houses were not plenty as compared to that of Kumasi. Among these communities were 1,419 houses. 761 at Gumani, 412 at Kalariga and 246 in Kulnyevila. As a results, through stratification method and using a systematic sampling with an interval of every 3rd house, 254 houses were selected at Gumani, 137 houses were selected at Kalariga and 82 houses were selected at Kulnyevila community. With these total houses selected, households were the key respondents and the respondents were selected based on household sizes in each community.

3. RESULTS AND DISCUSSION

Response Rate and Questionnaire Distribution

Among the 263 houses in Sepe Buokrom, Kumasi, there were 961 households with an average household per house of 3.7 and within the 961 households were 4974 persons thus 5.1 average household size. Moreover, at Atonsu Ahensan, within the 353 houses were 1,209 households with 6,827 persons thus 5.6 average household size**.** Again, in Tamale at Gumani, of the 254 houses, there were 597 households with an average household per house of 2.4. Of the 597 households, there were 4,561 persons thus 7.6 average household size. Also, at Kalariga, of the 137 houses, there were 348 households thus 2.5 average household per house. Among the 348 households were 2744 persons implying that there is an average household size of 7.9. Also, at Kulnyevila community, the 82 houses had a total household of 215 with an average household per house of 2.6. Among the 215 households were 1672 persons thus 7.8 household size on the average. However, the respondents used in the study were selected from the total persons among the households in the selected areas.

As a result, there were a total of 11,801 household population within the two (2) selected communities in Kumasi and using the Taro Yamane sampling formula, $n=\frac{N}{1+N(\sigma)^2}$ with an alpha (error margin) of 3%, a total of 1,015 household respondents were selected. Moreover, in Tamale among the three communities, 584 household respondents were selected using the aforementioned sampling formula but with an alpha of 4%. However, the distribution of the respondents was done using proportional sampling and table 1 has the details.

Table 1 Selection and Distribution of Household Respondents

City/Community	Housing Units (HU)	Average (HU)	Household Population (HP)	Average (HP)	% Share (HP)	Absolute (HP)
TAMALE	-	-	-	-	-	-
Kulnyevila	82	5.8	1672	5.4	19	111
Kalariga	137	3.5	2744	3.3	31	181
Gumani	254	1.9	4,561	2.0	51	298
Total	473	11.2	8977	10.7	100	584
KUMASI	-	-	-	-	-	-
Atonsu Ahensan	353	1.7	6,827	1.7	58	589
Sepe Buokrom	263	2.3	4974	2.4	42	426
Total	616	4.0	11801	4.1	100	1015

Source: Field Survey, 2020

Table 1 indicates that 584 respondents were selected from the three (3) communities in Tamale and Gumani had the highest respondents selected. Moreover, 1015 respondents were selected from two (2) communities in Kumasi with the highest selected from Atonsu Ahensan. An average household size (population) of 10.7 in Tamale shows how congested people are in various houses in the Township. Though the average household size in Kumasi is 4.1 which is seen as small as compared to that of Tamale yet it does not meet the standard of 3 per household as stated by UN-Habitat.

Waste Management Condition in Kumasi and Tamale

Waste Collection and Disposal Condition at Sepe Buokrom and Atonsu Ahensan -Kumasi

The study wanted to know the state of waste collection and disposal in Kumasi relative to Atonsu Ahensan and Sepe Buokrom and respondents were asked to assess how waste is collected and disposed off in their community on a five points Likert's scale; Good, Very Good, Moderate, Poor and Very Poor and table 2 gives details to their responses.

Table 2 The State of Waste Collection and Disposal at Sepe Buokrom and Atonsu Ahensan

Scale	Frequency	Percent
Good	14	3.3
Very Good	19	4.5
Moderate	58	13.6
Poor	184	43.2
Very Poor	151	35.4
Total	426	100.0
Atonsu Ahensan		
Scale	Frequency	Percent
Good	37	6.3
Very Good	54	9.2
Moderate	83	14.1
Poor	254	43.1
Very Poor	161	27.3
Total	589	100.0

Source: Field Survey, 2020

Table 2 indicates 184 (43.2%) respondents grading the collection of waste collection and disposal Poor while 151 (35.4%) grading the situation as Very Poor. Though 58 (13.6%) graded the situation as Moderate with 19 (4.5%) grading it as Very Good yet the situation seems to be appalling as majority (78.6%) of the households are disappointed about how waste management is done in Sepe Buokrom relative to collection and disposal. Moreover, the situation at Atonsu Ahensan was not different as 254 (43.1%) graded the situation as Poor while 161 (27.8%) said the situation is Very Poor. The general implication is that waste collection and disposal in Kumasi as far as Sepe Buokrom and Atonsu Ahinsan are concerned is very poor and this confirms the study by Ketibuah et al., (2004) that opined that waste collection and disposal is generally a critical problem in Kumasi.

Waste Collection and Disposal Condition in Tamale

Tamale has over the recent years classified as a Millennium city in Ghana and the study wanted to know if the city is really doing well in the management of waste relative to collection and disposal. Table 3 shows the condition of waste collection and disposal in three (3) communities in Tamale that have over the last five years' experience flooding. The objective of the study hence called for an investigation into the flooding events and such necessitated for the probing of the households on how they evaluate the approach at which waste is collected and disposed off. From table 3, approximately (83.5%) of the household respondents said that the collection and disposal of waste in the Township are Poorly done thus 9.9% from Kulnyevila, 24.7% from Kalariga and 49.3% from Gumani correspondingly. Aside this, 64.0% of the households at Kulnyevila said the condition of waste management in their vicinity is Very Poor especially the way waste is disposed off. A tenant in one of the houses visited could not hide her frustration on how waste is indiscriminately disposed off around his house: *while some of us pay cash for the "Kaya Bola" to collect our waste every day, people just package their refuse in polythene bags and dump them in the bushes and gutter behind my house as you could see. Because of that all*

the gutters and bushes are littered and during rainy season we do not get nose to smell, as if we sell stinking fish here, she added. The lamentation of the tenant is a clear indication of waste collection and disposal situation in Tamale.

Table 3 The State of Waste Collection and Disposal Condition at Kulnyevila, Kalariga and Gumani

Scale	Frequency	Percent
Good	5	4.5
Very Good	4	3.6
Moderate	20	18.0
Poor	11	9.9
Very Poor	71	64.0
Total	111	100.0
Kalariga		
Scale	Frequency	Percent
Good	7	3.9
Very Good	14	7.7
Moderate	30	16.6
Poor	44	24.3
Very Poor	86	47.5
Total	181	100.0
Gumani		
Scale	Frequency	Percent
Good	20	6.7
Very Good	12	4.0
Moderate	41	13.8
Poor	147	49.3
Very Poor	78	26.2
Total	298	100.0

Sour: Field Survey, 2020

Kinds (Components) of waste commonly produced in Kumasi and Tamale

Kinds of waste commonly produced in Kumasi

Table 4 shows the components of waste frequently produced in Kumasi and Tamale. It indicates that the component of waste commonly produced in Kumasi is Plastic, thus 40.5% of the waste produced is made of plastics. Moreover, 35.5% of the waste produced in Kumasi is made of Organic majority of which are food and farm waste, used papers and textiles according to observation. Again, metal waste was contributing to the general waste components though in smaller quantities (8.4%). The situation in Tamale was not different, however, not similar quantities of waste components were found. Most of the waste components are made of Organic 36.0% of which food and farm waste was plenty. Most of the components are produced from basic household needs and such confirms the findings by Palm, (2011).

The implication is that a community where plastics and rubber constitute most of their waste is likely to experience flooding particularly when these wastes find their way into gutters and swampy areas. The findings confirm the study by (Vergara & Tchobanoglous, 2012; Bukari et al., 2017) that reveals that household solid waste are mostly made of pieces of paper, food, bottles, polythene bags sachets of used products and domestic animal droppings combined.

Table 4 Kind of Waste Commonly Produced in Kumasi

Kumasi		
Kinds of Waste	Frequency	Percent
Rubber	53	5.2
Plastic	411	40.5
Metal	85	8.4

Organic	360	35.5
Others	93	9.2
Glasses	13	1.3
Total	1015	100.0
Tamale		
Kinds of Waste	Frequency	Percent
Plastic	109	18.7
Rubber	133	22.8
Metal	66	11.3
Organic	210	36.0
Glasses	21	3.6
Others	45	7.7
Total	584	100.0

Source: Field Survey, 2020

Causes of Flooding in Kumasi and Tamale

Flooding as an environmental phenomenon is influenced by numerous factors at different durations and places. According to Addei, (2016), the major causes of flooding in the major cities of Ghana are poor architectural designs of buildings, poor waste disposal of waste, poor drainage systems, topography and poor siting of settlements and as a result, the study wanted to know which of them is most predominant in Kumasi and Tamale particularly at Atonsu Ahensan, Sepe Buokrom, Gumani, Kalariga and Kulnyevila. Table 5 shows the responses from the households when they were asked to choose from among the various causes of flooding in their community taken inferences from Addei, (2016).

Figure 4 illustrate that Indiscriminate disposal of waste contribute to approximately 33.0% of flooding events in Kumasi. Moreover, Lack of distillation of choked drains attributed to 22.1% of flooding events while Construction of structures in water ways also contribute to 22.0% of flooding events. In an interview at Sepe Buokrom, a 39-year-old mother of three could not hide her frustration: *I cannot imagine how somebody can just collect waste in his or her house and bypass sewage containers and dump them in gutters meanwhile there is nothing like communal labour to clear these gutters as you can see all are choked with garbage so when it rains just for 10 minutes then we have to leave our rooms and climb hills and trees why? She exclaimed.*

Figure 5 illustrates the causes of flooding in Tamale Township specifically Kulnyevila, Kalariga and Gumani. It indicates that flooding events in Tamale is mostly caused by Topography of Lands with 34.4% of the flooding events in the municipality are attributed to it. 21.4% of the flooding events were attributable to Poor Drainage system. Though Indiscriminate disposal of waste is a major cause flooding in Kumasi yet it less serious in the case of Tamale with 17.6% of Flooding events are attributable to it. Construction of structures in water ways was also one of the causes of flooding in tamale, though it was not extreme. In general, it is obvious to say that though households in both Kumasi and Tamale experience flooding, the cause of flooding in the two municipality is influenced by different factors. However, the Tamale municipality is situated on a low land that is surrounded by the Oti River and the White Volter River and there is no wonder majority of the household participants attributed the flooding events in their communities to the topography of their land. This result confirms the study by Braimah et al., (2014) that opined that most flooding events in the northern part of Ghana are caused by the nature of land and lack of drainage systems.

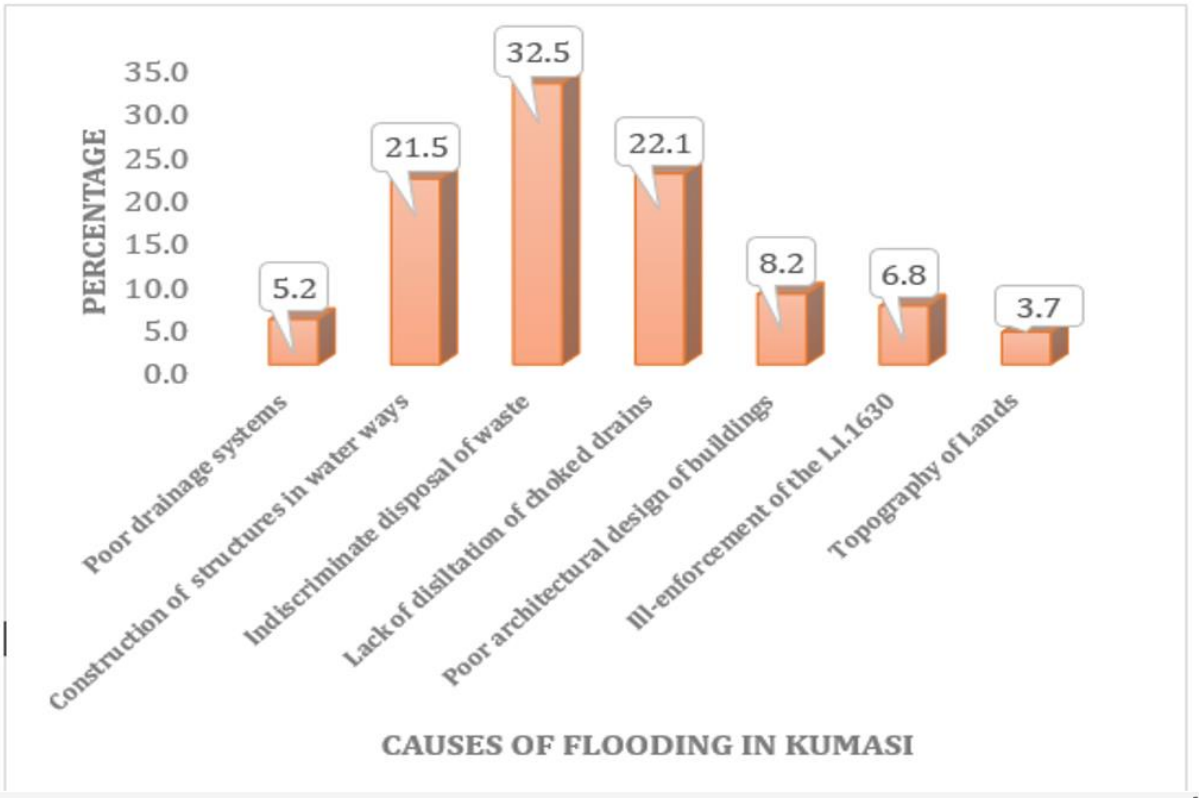

Figure 4 Causes of flooding in Sepe Buokrom and Atonsu Ahensan, Kumasi

Source: Field survey, 2020

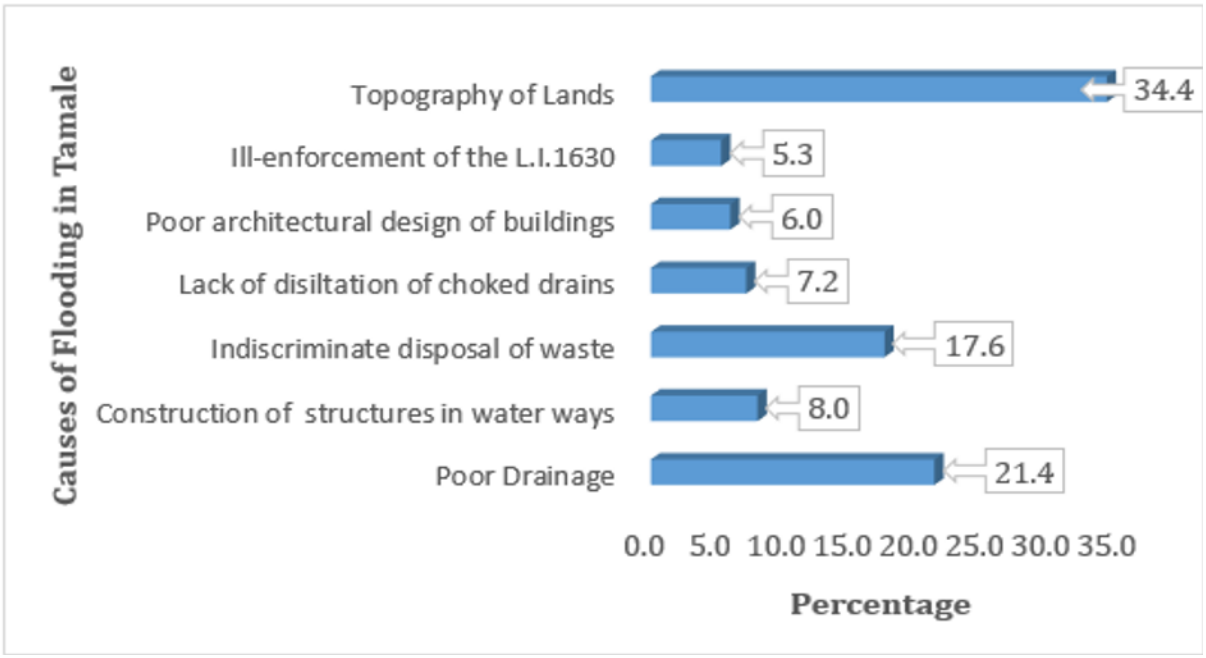

Figure 5 Causes of Flooding in Tamale

Sources: Field survey, 2020

Flood Occurrence in Ghana, Impact and Duration

The extensive flooding that has occurred throughout Ghana over the past fifty-two (52) years has increased the consciousness of the public in relation to the damage and tiresomeness that floodwater can cause to residential properties, rent and human lives. Table 5 indicates the occurrences of flooding events in Ghana since 1968 to date.

Table 5 Flooding occurrences in Ghana between 1968 and 2020.

Years of occurrence	City/Region
2017,2018,2019,2020	Tamale
2019,2020	Kumasi
2018	Northern (Buipe)
2004, 2018	Ashanti (Kumasi)
2002, 2010	Central (Kasoa, Swedru)
1968, 1997, 1986, 1995, 1999, 2001, 2002, 2003, 2004, 2005, 2007, 2008, 2009, 2010, 2011, 2013, 2014, 2015, 2016, 2017, 2018, 2019	Greater Accra (Accra)
2010	Volta (Keta)
2002, 2010	Central (Kasoa, Swedru)
2000	Central (Cape Coast)
2005	Central (Saltpond)
2007	Upper East (Bolgatanga)
1971, 2002	Western (Sekondi-Takoradi)

Source: Researcher's construct, 2020

Table 5 shows that though the capital city of Ghana (Accra) has been the harbour of flooding yet Kumasi and Tamale have also had some massive experiences of the unfortunate events. These two cities in question have recently experience severe flooding incidents where most buildings and farmlands were submerged and washed away by floodwaters. Thus, for the last three year (since 2017 to date) the two cities have had serious flooding occurrences which the most recent one happened on June, 2020 (field observation) where both cities had most of their principal suburbs and streets flooded with water exposing waste materials. Figure 6 (a and b) indicates the severity of waste related flooding in the study areas.

(a) (b)

Figure 6 a and b recent flooding events in Tamale and Kumasi

Source: Pictures taken from the field, 2020

Perceived Impact of Flooding on Residential Property Values (Rent)

Preceding studies in the U.S. (Guttery et al., 1997), Australia (Eves, 1999 and 2001; Fibbens, 1994) have emphasized that property values in flooding and flood prone area have complications of getting economic rent for their real assets. This difficulty includes but not limited to challenges of procuring insurance cover or mortgage finance for residential properties since financiers have the purview that residential properties located in flood or flood prone areas are feasibly not saleable in times of default or bankruptcy

on the side of the mortgagors. This study tried to assess the situation in Kumasi and Tamale to ascertain the extent of flooding impact on residential property values. Table 6 shows the types of residential properties usually commercialised in the study areas where flooding is rampant.

Table 6 Types of Residential Properties in Kumasi and Tamale

Kumasi		
Types of Residential Properties	Frequency	Percent
Chamber and Hall (CH)	449	44.2
Single bedroom apartment (SDA)	61	6.0
Two-bedroom apartment (DBA)	95	9.4
Four-bedroom apartment (FBA)	130	12.8
Three-bedroom apartment (TBA)	280	27.6
Total	1015	100.0
Tamale		
Chamber and Hall (CH)	383	65.6
Single bedroom apartment (SBA)	24	4.1
Two-bedroom apartment (DBA)	49	8.4
Four-bedroom apartment (FBA)	37	6.3
Three-bedroom apartment (TBA)	91	15.6
Total	584	100.0

Source: Field Survey

Table 6 shows that majority of the people in Kumasi and Tamale are resident in Chamber and Hall (CH) buildings. In Kumasi, of the 1015 respondents, 449 (44.2%) were housed in Chamber and Hall (CH) while 383 (65.6%) of the 584 respondents in Tamale were accommodated in Chamber and Hall (CH). Moreover, three-bedroom apartment was also common in both cities as 280 (27.6%) and 91 (15.6%) of the respondents were found in three-bedroom apartment in respectively in both Kumasi and Tamale. In the context of this study, however, it must be acknowledged that Chamber and Hall (CH) is a compound house with semi-detached walls where most tenants share facilities in common especially toilet and bath. The implication is that these houses are always congested due to high room occupancy ratios. The nature of residential apartments was in line with the economic status of the respondents and such could influence indiscriminate waste disposal that may in the long run chock gutters to bring urban flooding.

The extent of rent depreciation on residential properties at flooding and flood prone areas in Kumasi and Tamale

Kumasi

Table 7 shows the regression analysis of rent of residential properties and flooding relative to proximity from a residential property to a flooding or flood prone area in Kumasi (Sepe Boukrom and Atonsu Ahensan) respectively. The study focused on the R, R^2 and the P values in table 7. An R of 0.543 indicates that there is fairly positively strong association between proximity (Location) of a residential property to a flooding or flood prone area and rent of the residential property in question. The value implies that the further away a property gets from a flooding or flood prone area the higher its rent and the reverse is true. Though the association is not perfectly strong yet it shows a reduction in the dependant variable as the independent variable increases. This is confirmed by the R^2 value of 0.294 which implies that approximately 30% of the change in rent is as a result of the extent of liability an area is as far as flooding is concerned.

Moreover, a P value of 2.4E-182 (P=0.0000 < alpha 0.05) indicates the significance of the test statistics between the two variables under discussion. The implication of the values is that all properties that are located close to or within flooding or flood prone areas at Sepe Buokrom and Atonsu Ahensan, are having lower rents as compared to those that are far and this is very dangerous to the commercial real estate industry. The situation would be more critical in future as climatic condition keeps on changing in developing countries like Ghana and Kumasi where the destruction of ecology is high in the quest to improve the built environment.

Table 7 Regression Analysis

Summary Output								
Regression Statistics								
Multiple R	0.543							
R Square	0.294							
Adjust R^2	0.294							
Standard Error	1218.119							
Observ't	1015							
ANOVA								
	df	*SS*	*MS*	*F*	*Significance F*			
Regression	1	6.29E+08	6.29E+08	423.7128	6.26E-79			
Residual	1013	1.5E+09	1483814					
Total	1014	2.13E+09						
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	1926.309	53.74662	35.84055	2.4E-182	1820.841	2031.776	1820.841	2031.776
X Variable 1	701.8202	34.09495	20.58428	6.26E-79	634.9154	768.725	634.9154	768.725

Source: Field Survey

Tamale

An R of 0.449 in Table 8 indicates that there is weak positively association between proximity of a residential property to a flooding or flood prone area and rent. It shows that tenants do not fact the location of a residential apartment into their rent determination. This is confirmed by the R^2 value of 0.202 which implies that approximately 20% of the change in rent is as a result of the extent of liability an area is as far as flooding is concerned. A P value of 1.02E-86 (P=0.0000 < alpha 0.05) is evident with regards to the significance. The implication of the values is that at Kulnyevila, Kalariga and Gumani in Tamale the difference in rent between a residential apartment close to a flood or flood prone area and the one that is far is insignificant.

Table 8 Regression Analysis

Summary Output								
Regression Statistics								
Multiple R	0.449							
R Square	0.202							
Adjusted R Square	0.200875							
Standard Error	1025.949							
Observ't	584							
ANOVA								
	Df	*SS*	*MS*	*F*	*Significance F*			
Regression	1	1.55E+08	1.55E+08	147.5482	2.03E-30			
Residual	582	6.13E+08	1052572					
Total	583	7.68E+08						
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	1776.705	75.39686	23.56471	1.02E-86	1628.622	1924.788	1628.622	1924.788
X Variable 1	442.6683	36.44277	12.14694	2.03E-30	371.0929	514.2437	371.0929	514.2437

Source: Field Survey

Nature of Waste Disposal and flooding events in Kumasi and Tamale

The nature of waste disposal in the parlance of this study is about the methods by which wastes or trashes are been disposed and treated on site in both Kumasi and Tamale. Table 9 gives details of the various ways by which waste disposal is done relatively.

Table 9 Nature of Waste Disposal in Kumasi

Nature of Waste Disposal	Frequency	Percent
Incineration	37	3.6
Open Dumping	844	83.2
Open Burning	51	5.0
Recycling	46	4.5
Burying	28	2.8
Reuse	9	0.9
Total	1015	100.0
Tamale		
Incineration	32	5.5
Open Dumping	366	62.7
Open Burning	152	26.0
Recycling	12	2.1
Burying	18	3.1
Reuse	4	0.7
Total	584	100.0

Source: Field Survey

Table 9 indicates that in Kumasi the most common way to dispose and treat waste is Open Dumping with 844 (83.2%) of the households adopting it. Though the percentage for Open Burning as a method of waste disposal and treatment was insignificant relative to that of the Open Dumping, it is the second highest method adopted by the people of Kumasi. It was not encouraging to see that Recycling that is among one of the effective methods and approaches to waste treatment and disposal towards sustainability was practiced by only 46 (4.6%) households.

The situation was not different in Tamale as Open Dump method was dominant 366 (62.7%). However, Open Burning was practiced by many households 152 (26.0%) as compared to the situation in Kumasi. It was not surprising to have such number of people practicing Open Burning in Tamale due to the fact that the nature of residency relative to rural habitation is quite different from that of Kumasi. It could be acknowledged that in all the study areas, the practice of reuse was very insignificant. The results of this study are in contrast with that of Adu-Boahen et al., (2014) that revealed that the most common waste disposal method in Ghana particularly central region is burning. However, in respect of flooding events resulting from the nature of waste disposal practiced, some two key informants were interviewed in both Tamale and Kumasi.

In Tamale, a 49-year-old landlady in a community called Gumani when interviewed reiterated that; *when I built my house in 2002, I remember very well that though my building was on a low land but never experienced any flooding within the first seven (7) years. Until I started seeing heaps of waste most of which were plastics and rubbers within the gutters around this area coupled with overflow of public disposal bins in 2010/2011 then rain waters started draining into my house and now it is worse. Sometimes when it rains heavy, I have to leave my house and seek for refuge for fear of been drunk or taken away by flood waters at night. I think we must be careful about the way we generate waste at source towards integrated approach to disposing and treating them if not a time will come, we shall all relocate owing to flooding.*

In the same vien, a community leader at Sepe Boukrom when interacted had this to say: *As for this issue I do not even know what to say or do again my brother. You see, whoever blames the government on poor waste management especially on the aspect of collection and disposal must be wrong because look at our area there are a lot of public waste disposal containers or bins but it will surprise you that somebody can just carry the waste and upon reaching the bin, he or she throws the trash into the nearby gutters thinking that the waste collectors will gather them into the bin, can you imagine, he lamented. Now people have chosen to dispose their electronic wastes especially the Hatchback Television Sets under the bridges and big gutters so why wouldn't our rooms get flooding after little downpour?*

4. CONCLUSION, RECOMMENDATION AND POLICY IMPLICATION

Conclusion and Recommendation

The study assessed the rate of indiscriminate waste disposal in Kumasi and Tamale and their implication for flooding and real asset devaluation. It was able to find out causes of flooding in Kumasi and Tamale of which the most common was indiscriminate waste disposal especially in the Kumasi city. The study revealed that though indiscriminate waste disposal is a common practice in Tamale yet the series of flooding events occurrences is as a result of the poor topography of the land as most residency are located on a low or levelled lands. The regression analysis was able to show that there exists a fairly strong relationship between flooding and rent relative to how much tenants are willing to pay to occupy rooms in flooding and flood prone areas. It reveals that no tenant is ready to pay high for a room in a flooding or flood prone area irrespective of the architectural designs owing to how destructive it is to have your residency flooded.

The study found that the causes of flooding events in Kumasi and Tamale are anthropogenic in nature as the high level of poor waste disposal is more attitudinal than inability of government to supply facilities. Majority of the people practicing open dumping is an indication of poor sanitation in future as the cities get urbanized and such calls for proper implementation and enforcement of sanitation laws to avoid waste related disasters resulting from flooding. The study can therefore conclude with statistical evidence that most flooding events in Ghana are caused by chocked drains resulting from poor disposal of wastes right from the source of generation. An integrated approach to waste management is recommended as Reuse and Recycles practices had insignificant value in terms of percentage in relation to the number of households that practice those methods of waste disposal.

Policy Implication

An emerging city like Ghana having majority of her citizenry in premier towns practicing open dumping is very dangerous as far as the SDG11, SDG13 and SDG 3 are concerned. The preponderance of flooding occurrences in Tamale and Kumasi implies that Ghana is sitting on time bombs as far as disaster is concerned and such raises serious anxiety on disaster management. The high level of tenants' resistance to pay higher rents for residential properties located close or near to flooding and flood prone areas sends a strong signal to real estate owners relative to high default risk in mortgage payments. The SDG11 is much emphasis on sustainable cities to include housing and the rate of indiscriminate disposal in Ghanaian cities is much worrying when it comes to achieving such goal on the global perspective. People building in water ways coupled with poor drainage systems is a threat against national security and decent housing. Failure of the government to regulate the sanitation ministry will mean that the secondary mortgage market dwindling since indiscriminate waste has direct effect on the value of real assets. Such could be detrimental to revenue generation as incomes from commercial real estate market reduces.

Informed consent

Not applicable.

Ethical approval

Not applicable.

Conflicts of interests

The authors declare that there are no conflicts of interests.

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Data and materials availability

All data associated with this study are present in the paper.

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