



## **Review on Connecting the Complex Dots of Environmental Problems in Greater Accra Metropolitan Area (GAMA) of Ghana**

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### **Authors' contributions**

*This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.*

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### **ABSTRACT**

For years, Accra has been facing huge environmental challenges. Efficient policy frameworks coupled with prudent urban management are deemed as reasonable balance to environmental benefits. Research reveals urban areas in Ghana are confronted with the rapid loss of natural resources as urbanization increases. This synthesis report examines the ramifications of major issues faced by the Greater Accra region based on existing literature by (i) highlighting contemporary environmental problems in Accra (ii) probing into human-induced and natural factors that alterate environmental harmony in the study area (iii) discussing measures on safeguarding the environment through a sustainable approach in Accra, and (iv) presenting policy implications of environmental problems in Accra. Findings indicated urbanization, poverty and inappropriate urban planning systems influence environmental degradation in the study domain. Anthropogenic activities such as pollution and natural hazards like: flooding, drought and windstorms events have altered the physical properties of Accra. This paper reveals the assumption and execution of values to safeguard environmental resources in the Greater Accra Metropolitan Area.

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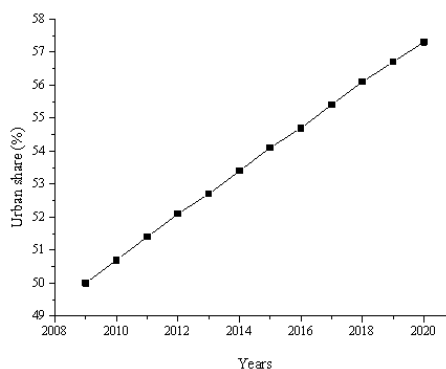
**Keywords:** Environmental problems; poverty; population; urbanization; urban planning.

## 1. INTRODUCTION

In recent years, the occurrence of environmental hazards experienced across the globe have amplified. The devastating impacts associated with these hazards are mostly felt by developing economies due to poor adaptive capacities [1,2,3]. Implications that originate from these stressors include land, air and water pollution; poor waste management, and degradation of forest areas that hamper the sustainability of environmental resources such as flood plains, natural reserves and public parks [2-4]. The 21<sup>st</sup> century has witnessed a rapid increase in urban population virtually in all countries [5,6]. Many developing countries are characterized by low per-capita income, and an increasingly urban population [7]. This situation has worsened environmental conditions due to pressure on its usage. Studies by [3] concluded that environmental issues associated with climate change and increased urbanization, are likely to contribute to prolonged dryness and heatwaves, frequent formation of rainstorms, temperature rise, and flooding events. Moreover, environmental problems subject cities' infrastructure to several risks [8]. High demand for public open spaces, greater risk of natural resource depletion, destruction of buffer zones for water resources, and increasing need for emergency management, coupled with relief services are just few examples [9,10]. Flood events have caused severe losses to most developed and least developed economies in recent years [11]. A flood analysis by Sarr et al [12] cited in [13], shows an increase in the frequency and magnitude of flood events in West Africa. Prior to the 1990s, the rate of occurrence was less than two each year. This number has

increased from two to an average of eight per year since the 2000s. For instance, the major flood event experienced in 2016 caused undesirable effects to several livelihoods in Accra. Human negligence and occupation of waterways were noted to be the main causes of flood events in Accra [14]. Studies by [3] and [15] noted that variables that culminates into Accra's dilemma spans from an aggregate of local, regional, and worldwide factors that results in uncertainties and endangers people among other ecological processes. To minimize the dangers and consequences of environmental threats to facilitate the safety and well-being of residents in Accra, many institutions within the region must be prepared to address environmental issues [3].

Presently, the question of how institutions in GAMA deal with threats posed by environmental problems amid rapid urbanization and climate change, among other factors remains unanswered [3]. It is projected that the demand for new buildings, water supply, sanitation, electricity, telecommunications and transportation services among other infrastructure is set to increase as urban population escalates [16]. Importantly, what should institutions do to regulate or minimize high susceptibility rates?. Over the years, problems emanating from human-environmental interactions have been enormous, and Accra is not an exception [3] [17,18]. Using GAMA as a case study, this synthesis report sought to connect the complex dots of environmental problems in its domain. It further attempted to find answers to critical questions about what urban developers and management should do to move operate in a sustainable manner.



**Fig. 1. Urban population as a share of total population. (World Bank, 2020: Population growth and projections)**

The distribution (Fig. 1) shows the degree of urbanization in Ghana from 2009 to 2020. Here, urbanization represents the share of urban population against the total population of a country. In 2020, the urban population for Ghana was 57.3%. Over the past 50 years, Ghana's urban population has increased considerably from 29.02% to 57.3%. In 1985, it increased at an annual rate of 2.13%, followed by a decline (1.13%) in 2020 [19].

## 2. DATA COLLECTION AND METHODS

Existing literature on environmental problems in Africa, specifically Greater Accra region of Ghana were reviewed to identify underlying theories, strengths and opportunities, coupled with frameworks or tools to establish a logical conclusion. The study adopted a consistent approach, previously employed by Cohen [20] to conduct comprehensive analysis with accessible literary data, obtained and analyzed through local and cross-national timelines. Books, peer-reviewed papers and studies related to urban environmental problems were constructively evaluated based on the study objectives. Content analysis was employed after detailed desk review to identify trends and create applicable literature evidence to enhance the understanding of environmental problems in urban centres, coupled with the most appropriate technological practices to regulate them.

Data for this research were obtained from policy documents, existing literature and reports of international and national organizations. Various concepts associated with environmental problems were used in carrying out the web search in major electronic databases [15,17,21-23].

Policy documents, international and state reports on the dynamics of environmental problems in African cities, specifically the case of Ghana, along with efforts toward the preservation of environmental resources. Documents and reports used in this study included WHO documents on environmental health in relation to information or data on air pollution and the formation of diseases. UNDESA/PD [24] in their report entitled: "Analysis on prospects of urbanization", coupled with a 2015 report summary from the UN Statistical Division [25] on slum development and urban population; World Bank's [26] report on rising through cities in

Ghana focusing on urbanization and its environmental implications; WHO and UNICEF's [9] report on sanitation and quality of drinking water, as well as the Ghana Statistical Service (2012-2014) reports [27] on urban population dynamics in Ghana.

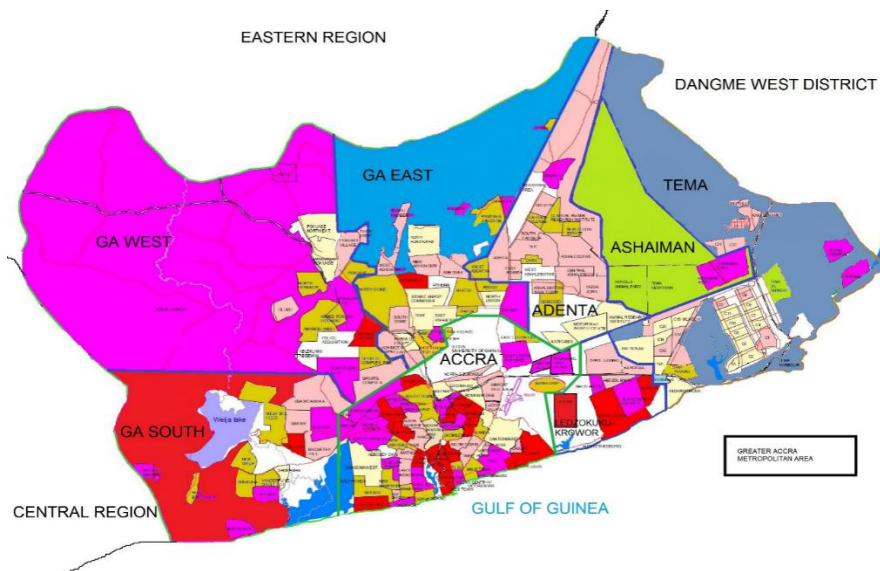
### 2.1 Study Area

Accra serves as the administrative capital of the Greater Accra region of Ghana. The GAMA consists of the Accra Metropolis, Tema Metropolis, and six other municipalities for development planning in Ghana namely: Ga South, Ga East, Ga West, Adenta, Ashaiman and LedzokukuKrowor as shown in Fig. 2. The region hosts the country's only international airport, and houses one of the two seaports in the country. A notable feature of the metropolis is that majority of its population are migrants seeking for better living conditions. This coupled with rapid urbanization, has caused GAMA to be afflicted by several socio-economic and environmental problems. Ghana's 2010 housing and population census puts 50.9% of the population in urban areas. The Greater Accra region is the most urbanized region with 90.5%. Accra and Tema are regarded as the most populous areas.

However, effective management of urbanization rates can alleviate poverty, and facilitate sustainable development. Peri-urban centres and efficient policy-frameworks can encourage investment, promote innovation and increase productivity. However, under-managed urbanization will intensify current issues, thereby making cities more vulnerable to environmental problems.

GAMA rapid population growth has led to urban sprawl and uncontrolled physical expansion from the municipal boundary of Accra. Overcrowding has been particularly severe in the unserved and unplanned slum areas within the metropolis.

Accra, has a population of about four million. In each rainy season (April to October), the area experiences flooding events that lead to the destruction of several properties worth millions, loss of lives among others which slow-down economic activities. Urban Ghana faces a host of significant environmental concerns, including air and water contamination, erosion, bad sanitation and floods [17] [28-31].



**Fig. 2. Greater Accra Metropolitan Area (GAMA) of Ghana. (Accra Metropolitan Assembly 2015)**

The people's inability to afford accommodation within the metropolis, have resulted in the development of slums in flood-prone areas. Again, profit-oriented oil or petrochemical industries have continuously set up stations or outlets on waterpaths, further impeding flow of natural paths. Hence, have resulted in several unintended consequences [32].

However, attempts to resolve these issues have been jeopardized by institutional lapses, misunderstandings, and practicable or innovative solutions. Urban studies are often critical to monitoring environmental changes [3,14,33, 30].

To grasp the full extent of environmental problems, it will be essential to assess the factors that subject cities to severe environmental degradation. This is aimed at gaining a comprehensive knowledge about the diverse elements and interdependency of factors that generate an uncertain future. It will then be possible to address conservative measures in terms of sustainable urban development in Ghana. It is necessary for understanding how cities cope with the threats associated with environmental stressors and disturbances. The current situation in Accra provides a vital opening to redirect development strategies in a manner that will not simply enhance the socio-economic well-being of urbanites in Ghana, but also improve the quality of the urban environment where they inhabit.

### **3. CONTEMPORARY ENVIRONMENTAL PROBLEMS IN ACCRA**

#### **3.1 Indiscriminate Solid Waste Disposal and Poor Drainage Systems**

In developing countries, many rivers in urban areas are more like open sewers. Indiscriminate solid waste disposal and bad drainage systems are the major environmental problems affecting Ghana's urban centres. In most parts of the cities, there are often large accumulations of uncollected garbage. Accra generates nearly 900,000 metric tons of solid waste annually, approximately 67% out of this total constitute organic matter [34]. The city estimates that 88% of waste generated is collected by the waste collection units. However, waste collection services are only provided in a limited area; only 40% of households in the city have waste collection bins [34]. The rate of waste generation in Ghana stands at 0.47 kg/person/day, translating into an estimate of 12,710 tons of waste per day averagely [35-36].

Solid waste collection in Accra is predominantly privatized. The metropolitan assembly currently has contracts with ten (10) waste collection firms that are responsible for waste generated at the residential, commercial, and industrial levels. There is evidence of indiscriminate disposal of waste in most parts of Accra when waste collection services are unavailable. Abandoned stone quarry sites, gouged natural depressions in the earth, and man-made holes are examples of

informal trash disposal sites. Some open dump sites have open burning, especially during the dry season [37].

The majority of these wastes are either thrown into open dumps, marshes, landfills, and uncontrolled dumps or are incinerated in open air in certain scenarios (see Table 2). Consequent to the bad conditions of public depots, numerous types of solid trash may be discovered on open streets and around private dwellings. In some cases, front spaces of residential dwellings are used as depots for the various forms of solid waste.

The phenomenon has a number of causes. One is poverty which induces people not to pay for municipal garbage collection services. This compels them to resort to indiscriminate disposal of garbage in open gutters and vacant plots [38].

The principal sources of solid waste constitute residential, commercial, industrial, and agriculture or agro waste. The comprehensive example of the sources and the types of solid waste reported in the study area according to UNESCAP (2012) report entails:

Moreover, inadequacy of existing garbage collection systems (coverage) and delays in the collection of garbage, especially in densely populated areas are among other notable factors that compounds the problem. Thirdly, handicap imposition on garbage collection through the absence of motorable streets in most residential areas is among the key factors. Limited road networks in most of the densely populated urban areas does not allow access to the municipal garbage collection vehicles. In such areas, the length of walk to the nearest garbage bins, especially women with young children to cater for, deters them from such exercise [37-38].

**Table 1. Estimated waste generated of Accra (2000-2030)**

Years	Population	Waste generation (Tons/Day)	Waste collection (Tons/Day)	Residual (Tons/Day)
2000	1,658,939	2,127	1,702	425
2005	1,960,797	3,369	2,695	674
2010	2,317,583	2,654	2,123	531
2020	3,237,730	3,390	2,712	678
2030	4,523,203	4,419	3,535	884

Source: Oteng-Ababio, 2014.

**Table 2. Solid waste generation and management in Ghana by GAMA**

Municipal Solid waste	Quantity (t)	Percent (%)
Total	501,903	100
Collected	298,178	59.4
Burned by household	13,402	2.7
Public dump(container)	156,481	31.2
Public dump (open space)	23,647	4.7
Dumped indiscriminately	5,408	1.1
Buried by household	1,412	0.3
Other	3,375	0.7

Source: GSS, 2014a: population and housing census district analytical reports

**Table 3. Types and sources of solid waste in GAMA**

Types of Solid Waste	Sources
Agriculture/Agro waste	Vegetable residues, baggage, rice and wheat, straw and husk, sisal groundnut, nut, shell, pesticides etc.
Industrial waste	Construction debris, steel slag, bauxite red mud, packaging, food waste.
Residential waste	Paper, glass, polythane bags, plastics, electric cables, metals, textile
Commercial waste	Cardboard, plastics, wood, broken glass, metals, limestone, hazardous waste

Source: UNESCAP, 2012

Most parts of the city have no integrated drainage networks. The existing system consists mainly of open earth or concrete trenches, and few drainage boxes along the main roads [39]. These trenches are generally too narrow, and shallow to accommodate the water efficiently during heavy rains. Consequently, many streets become flooded and unmotorable. Again, increase in population density influences discharge of sewage that could pose serious health risk when not treated. The study area has several open gutters filled with solid waste, mainly plastic bottles and tins, which are ideally not meant for such purposes.

#### **4. FACTORS INFLUENCING ENVIRONMENTAL PROBLEMS IN ACCRA**

##### **4.1 Urbanization**

Accra is rapidly undergoing structural changes driven by economic growth. For instance, the area's population increased by about 240% between 1950 and 1960 [31]. Population growth and distribution is a key driver for development. Conversely, it is also a key driving force for environmental degradation when it exceeds the threshold limits of support systems. The environmental effects of an increase in human population are mostly triggered by the use of natural resources and the processing of waste, as well as environmental pressures, such as biodiversity, air and water pollution, along with increasing demand for resources. The strain on cities contributes to air, water and noise pollution, coupled with reductions in housing and green vegetation.

Lack of opportunities for gainful employment in most villages, along with ecological stress has resulted in the migration of poor families to urban areas. This has resulted in the development of slums. This, however, indicates slums have negative effects on natural ecosystems. Approximately 60% of all urban inhabitants in sub-Saharan Africa live in slums. Also, their degree of deprivation is known to be relatively high. Given recent urbanization patterns on the continent, a significant part of predicted urban population increase is expected to be consumed by the slums [40] (Fig. 1). Notable areas with slums are Ashaiman, Jamestown, Fandama, Agbogbloshie, Nima among others. This has caused major gaps between demand and supply of infrastructural services such as energy, housing, water supply, sewerage and recreational amenities. Results in the growing

trend in the deterioration of air and water quality generation, the proliferation of slums and undesirable land-use changes, together contribute to urban poverty [41].

An increase in this irregularity within a reasonably limited period implies a rising proportion of unemployed, homeless and low income social stratification or class in the population. This mounts pressure on urban planners and managers [26]. Research indicates that Ghanaian cities are doubling in both population along with increasing slums and squatters [17, 42-43].

##### **4.2 Poverty**

Poverty is said to be one of the key predisposing factors in pollution problems. The round relation between poverty and the environment is a highly complex marvel. Discourse on sustainable urban planning in Ghana and Africa in general is centered on extreme urban poverty [44,17]. Poverty rates have amplified across Ghana and many regions of Africa [21]. The World Bank [26] estimates that over the past two decades, overall poverty and urban poverty in Ghana have dropped below 25% and 11% respectively. Contrarily, coastal and forest zones in Accra, Kumasi and Sekondi-Takoradi over the past ten years have since poverty rates amplifying. The poverty-environmental damage nexus in Accra must be seen in the context of population growth dynamics and statistical studies. These urban areas are struggling to create employment opportunities for their rapidly growing urban migrant populations [26].

The rapid rise in human population is in tandem with abject poverty. The growing levels of the situation prevalent in Ghana are related to the increasing patterns of restricted access to land in the city due to land tenure systems, disputes and so on [26]. Various reports imply there is a cause for concern about environmental challenges in Accra. The analysis above suggests that underlying cause of these environmental challenges are mainly anthropocentric, with less biophysical factors. Subsequent sections examine human actions and natural events which threaten environmental resources, and their impacts on environmental health in Accra.

##### **4.3 Inappropriate Urban planning System**

The ultimate goal of urban planning is to prepare for the future, or, more ambitiously, to build a

better and more sustainable future. Over the last century, rapid urban population increase has occurred on less than 3% of the global terrestrial floor, but the resultant effects have been enormous. 75% of greenhouse gas emissions can be traced to towns, and the ecological footprint of cities is tens to hundreds of times higher than the total urban area inhabited [45]. Tremendous weight has been given to the importance of echoing urban planning as a means of addressing the global environmental challenges given rise to cities, and transforming urban areas into sustainable communities [46]. Urban planning has been the most dramatic of institutional phenomenon that has marked all phases of Ghana's urban development.

Post-independence era in Ghana's history marked the need to strategically plan urban areas as a mark that gives positive tendency to shape urban development trajectories of Ghana. There is some ambivalence as to its significance to the planning and management of urban Ghana [14]. According to World Bank's [26] report, the existing urban environmental problems in Ghana have been undermined by inappropriate sanitation practices, inadequate infrastructure, slum development and unregulated urban growth as a consequence of poor economic and urban planning results since independence. Not

unexpectedly, major urban areas in Ghana (e.g., Accra and Kumasi) have frequently had to undergo major decongestion and eviction exercises as radical urban planning measures to correct the failures of urban planning and recover or protect environmental resources. As many cities are displaced and their living conditions get deteriorated, more people are compelled to resettle in slum communities, natural reserves, open spaces that threaten urban environmental integrity [26]. At the same time, a sharply rising urban population occupation in poor locations particularly slums, floodplains, waterways and natural reserves has contributed to frequent but avoidable flood events, pollution and poor sanitation practices in urban Ghana [41]. These developments put an acute strain on urban environmental resources across Ghana.

There are limited efforts to reform urban planning systems in Accra. The performance of the government of Ghana in implementing the reforms necessary to turn the fortunes of Accra into becoming the most beautiful and cleanest city in Africa remains critical and requires strategic planning. The following sections address human activities and natural disasters that endanger urban ecosystem infrastructure and their implications on urban Ghana's environmental health.

**Table 4. Total population and percentage urbanized (1970-2020)**

Year	Total Population (in millions)	Percentage Urbanized (%)	Urban Population (in millions)
1970	8,735,495	28.5	2,489,533
1975	9,985,946	29.4	2,954,226
1980	11,056,116	30.4	3,366,222
1985	12,783,613	32.7	4,183,103
1990	14,773,277	36.1	5,330,699
1995	17,014,057	39.5	6,727,643
2000	19,278,856	43.2	8,319,630
2005	21,814,642	46.7	10,191,110
2010	24,779,619	50.2	12,430,997
2015	27,849,205	53.6	14,918,455
2020	31,072,940	56.7	17,625,567

Source: Adapted from GSS, 2020

**Table 5. The proportion of slums dwellers in urban Ghana (1990-2018)**

Year	Proportion of urban living in slums
1990	65.50
1995	58.80
2000	52.10
2005	45.40
2010	40.10
2014	37.90
2018	30.40

Source: The World Bank, world development indicator (2020)

## 5. HUMAN AND NATURALLY INDUCED IMPACTS ON ENVIRONMENTAL HEALTH IN ACCRA

Research by Cobbinah and Aboagye [47] indicates that one out of every two households resorts to public dumping sites (commonly referred to as “borla”) to dispose their waste, while less than afifth of households have them collected by waste vans [48]. However, they further revealed 84.7% of residents had their solid waste collected by either trucks (61.3%) or tricycles/ push carts (23.4%), whilst 95.1% engaged in such exercise at least once a week. Their findings revealed the expenditure on household solid waste management could go up to GHC150 for 97.5% of households in Accra and Tema.

Also, urban cities and pervasive poverty have a major depriving impact on air, sea and land supplies because of these environmental problems [21]. The poor urban planning systems in Accra has intensified the level of air and water pollution in Accra. Many residents and families discarded their liquids and solid waste in gutters, running water and open land. Additionally, the 10% annual increase in vehicle ownership of which most of them are old, unmaintained and sub-standard vehicles because of limited investment funds in environmentally approved devices. All these devices in Accra emit pollutants, generating negative environmental

consequences on air quality, ground and surface water through runoff from transport pollutants.

Degradation of land resources, mainly conversion of natural areas and improper disposal of solid waste, are of major concern in Accra. Rapid urban development in Ghana forced many people to live illegally, resulting in the degradation and decrease, in fragile and sensitive areas, including swamps, ponds, steep hillsides and other areas which are usually protected as natural areas [14]. The challenge of insufficient waste disposal in urban Ghana is compounding the dilemma of natural area depletion (Fig. 3).

The World Bank [26] suggests that in Accra, air pollution is almost twice the African regional average. It is estimated to be higher than that of China, considering the comparatively small engine rates.

Air pollution exposes the city to severe health hazards. Pollution remains the fundamental environmental concern in Accra, threatening the health of the citizenry.

Overall, data on air pollution in Accra are not easily accessible, though it has to be recognized that Accra is in a better position compared to other African cities, due to the existence of long tradition of measurements and analysis of air pollution data [49].



Fig. 3. Indiscriminate dumping in Accra. (Africa Environment Information Network, 2016)



**Table 6. Overall annual mean for PM<sub>2.5</sub> in four Accra**

Year	Annual means for PM <sub>2.5</sub> (µg/m <sup>3</sup> )
2015	78.17
2016	97.39
2017	93.30
2018	79.87

Source: Appoh, 2018

**Table 7. PM<sub>10</sub> measurements in Accra 2012-2015**

Monitoring station	2012		2013		2014		2015	
	No. (%) of samples collected	Annual mean PM10 concentration (µg/m <sup>3</sup> )	No. (%) of samples collected	Annual mean PM10 concentration (µg/m <sup>3</sup> )	No. (%) of samples collected	Annual mean PM10 concentration (µg/m <sup>3</sup> )	No. (%) of samples collected	Annual mean PM10 concentration (µg/m <sup>3</sup> )
First Light	54/61 (88.5%)	174	53/60 (88%)	177	NA	NA	10/60 (16%)	180.6
Shangri La	57/61 (93.4%)	151	56/60 (93.3%)	168	50/61 (82%)	170	51/60 (85%)	153
Achimota	29/61 (47.5%)	107	44/60 (73.3%)	145	49/61 (80%)	165	52/60 (86%)	143
La Palm	55/61 (90.1%)	150	53/60 (88.3%)	203	53/61 (86.9%)	191	14/60 (23%)	322
Mallam Market	NA	NA	55/60 (91.7%)	198	45/61 (73.8%)	189	50/60 (83%)	148
Graphic	56/61 (91.8%)	178	52/60 (86.7%)	204	37/91 (60.7%)	187	48/60 (80%)	164
Weija Junction	NA	NA	51/61 (85%)	259	34/61 (55.7%)	251	53/60 (88%)	257
Kasoa	NA	NA	43/60 (71.7%)	168	49/61 (80%)	175	43/60 (71%)	170
Tantra Hill	NA	NA	NA	NA	NA	NA	10/60 (16%)	206
Amasaman	NA	NA	NA	NA	NA	NA	10/60 (16%)	281
Dansoman	NA	NA	NA	NA	21/61 (44%)	67	9/60 (28%)	114
North Industrial Area	NA	NA	NA	NA	27/61 (44%)	135	17/61 (28%)	85
South Industrial Area	NA	NA	NA	NA	22/61 (36%)	79	26/60 (43%)	89
Odorkor	NA	NA	NA	NA	29/60 (48%)	108	12/60 (20%)	162

Source: Appoh, 2018

Air pollution is connected with a wide variety of contaminants. Particulate matter (PM) is hazardous. As of September 2018, air pollution was responsible for over 28,000 fatalities in Ghana [50]. According to the WHO, the annual mean level of PM<sub>2.5</sub> in Ghana in 2016 was 31.1g/m<sup>3</sup>, considerably exceeding the recommended yearly threshold for human health of 10g/m<sup>3</sup> [50]. This demonstrates the deterioration of Ghana's air quality and its consequences for human health.

The widespread use of fuelwood as an energy resource exposes the public to pollution-related health threats. Dust, smoke, particulate matter, and some plastic deposits in urban areas are found in outdoor air, especially industrial sites and along major routes because of machinery and vehicle emissions fumes. This heightens the risk of acute respiratory infections, hypertension, heart attacks and strokes [21].

The two most important natural events in Accra are probably floods and warming temperatures [28, 31, 10, 51]. In Accra where there is widespread unauthorized physical development in protected areas, floodplains and waterways, floods pose real danger to lives and properties (Fig. 4).

Flood in Accra has been a perennial issue which many governments have tried to solve but to no avail. Parts of Accra still get flooded after few hours of heavy downpour. Properties and lives are lost due to recurrent floods in the region. There are certain areas with GAMA where you can escape the worrisome issue of flooding in Accra. However, these are some flood prone areas in Accra.

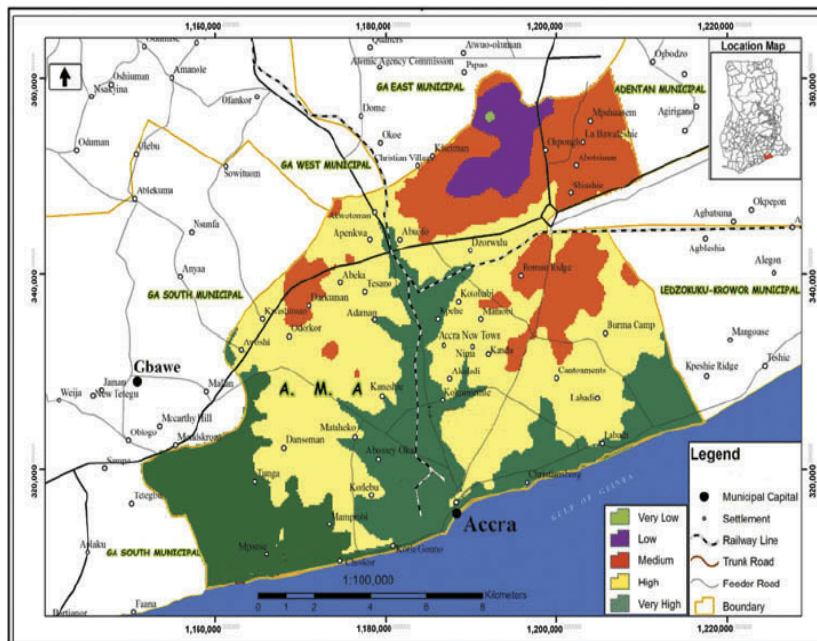
It is worth mentioning that floods occurring in Accra emanate from poor planning and non-adherences to planning requirements [51]. On June 3 2015, floods claimed approximately 150 lives and destroyed properties worth millions of dollars. [14] reported that the event was primarily man-made due poor urban planning, coupled with architects and urban developers not adhering to planning standards and appropriate protocols. Thus, ensuring institutions and individuals does not erect unauthorized and haphazard buildings, among other physical structures (in waterways, nature reserves, and floodplains) in unauthorized locations. The June 2020 floods were associated with devastating effects [52-54]. According to Mensah and Ahadzie [55] in a study entitled: "The causes,

consequences, and coping methods of floods in Ghana", the leading cause of urban floods was poor urban designs as a result of rapid urbanization. Accra's increasing development has necessitated the demand for land. According to Mensah and Ahadzie's research [55], people with low income who are unable to purchase homes in flood-free regions choose to locate in flood-prone areas, which are less expensive. [49] has compiled a report on the number of unlawful constructions established on waterways in GAMA as presented in Table 7.

Notwithstanding, several studies [56-57] have reported that flash floods in well-planned cities across the world have often been described as a natural phenomenon associated with climate change. Fig.5 shows flood incidents in Accra largely result from poor urban planning and management, and non-adherence to planning requirements by developers as argued by [14, 51]. In this condition, it is not surprising that the recent floods in the region was followed by knee-jerk decisions by city authorities to demolish structures and remove land use systems, perceived to be located on waterways [14]. Today, every downpour results in some form of flooding no matter how mild or limited it may be.

Flooding is a serious environmental issue affecting Accra, and with rising sea levels, it may become recurrent going forward. Floods in Accra currently are usually of short duration, caused by heavy or continuous/prolonged light rains that generally occur in June and July. Major flood events or disasters were recorded in 1955, 1960, 1963, 1986, 1991, 1995, 1999, 2001, 2002, and 2010 [58, 59, 60]. Many drivers have been attributed to this event. The issues of flooding in Accra has been linked to an overflow of odaw river out of its natural valley and catchment [60-61]. Besides, massive and uncontrolled growth in population distribution in Accra, along with poor drainage systems [59-61], and prevention of natural infiltration by impervious surface [31, 61] are other notable factors reported in some studies. The general slope of the city is gentle (below 11%), with water table varying between 4.80 and 70m below the surface [62].

The impact of flooding on household livelihoods and key stakeholders has been a major cause for concern. Previous studies in Accra estimated that properties, damaged as a result of July 3, 1995, and June 13, 1997 floods were worth thousands to millions of dollars [63-64].



**Fig. 4. Map of flood prone areas in Accra**

Source: Centre for Remote Sensing and GIS (CERSGIS), University of Ghana, Accra, July–August 2013

**Table 8. Illegal structures on waterways**

Towns	Number of illegal structures on water way
Ada East	390
Ada West	85
Ningo Prampram	205
Kpone Katamanso	55
Shai Osudoku	25
LADMA	25
Adenta Municipal Assembly	455
La – Nkwantanang	45
Ablekuma South Sub-Metro Assembly	750
Ga Central Municipal Assembly	1110
Ledzokuku – Krowor Municipal Assembly	5325

Source: UNCT GHANA, 2015



**Fig. 5. Flooding in the city of Accra (Ghana)**

**Table 9. Magnitude of daily precipitation and flood events**

Date	Precipitation a day before floods (mm)	Precipitation flood day (mm)	Monthly Total (mm)	% precipitation on flood day
June 27, 1960	0	98	371	26
September 29, 1963	0	97	190	51
July 4, 1968	5	33	372	9
June 22, 1973	0.3	175	411	43
July 14, 1991	2	157	263	60
July 3, 1995	0	244	274	89
June 13, 1997	38	114	353	32
June 27, 2001	27	81	247	33
June 9, 2002	0	123	421	29
March 26, 2007	0	59	63	95
May 18, 2008	0	151	395	38
October 25, 2011	58	98	184	53
June 3, 2015				

Source: Ghana Meteorological Agency (GMet) precipitation data, Accra

**Table 10. Death toll of flood in the last decade in Accra**

Year	Death
2010	10
2011	15
2015	152
2016	10
2018	6

Source: Okyere et al. 2013; Amoako and Boamah 2014; Asumadu-Sakodie et al. 2015a, b; Tabiri 2015)

**5.1 Negative Environmental Consequences of Pollutants on Ground and Surface Water**

There are several manmade pollutants that contaminate water sources. They often originate from industrial premises, towns, agricultural installations, manure storage and landfills. Most of these are diffused from the source, such as leaching of nitrates and pesticides into surface and ground water during rainfall, soil infiltration, and surface run off from agricultural lands. Such sources cause considerable variations in the contaminant load of water over a given period [65].

Many pollutants which are released into water bodies are toxic organic compounds which are non-biodegradable. Biomagnification accumulates over a given period in the ecosystems which affect food web, which may cause cancer (carcinogenic) and other respiratory diseases in humans. Moreover, others are converted into carcinogens when they react with chlorine used to disinfect water, thereby altering fish stock and other aquatic organisms; some are nuisances, giving water and fish offensive taste or odor. Acidification of

inland waters by acidifying compounds of sulfur and nitrogen affects quality of water. This may pollute ground or surface water, thereby making them unhealthy.

**6. DEVELOPING A SUSTAINABLE APPROACH TO ENVIRONMENTAL MANAGEMENT IN ACCRA**

Environment, as we perceive it, is our invention. Problems associated with water pollution, sewage disposal, air pollution and so on are perceived as critical since they can be directly seen, traced or observed [66]. According to the World Bank [67], planned administration and institutional structure are fundamental to effective waste management. Ineffective management decrease the performance of environmental management [68]. Poor awareness regarding environmental issues among politicians, citizens, and bureaucracy is compounded by the low levels of literacy and poor sensitization among the general public.

Most of Accra's environmental problems such as urban slums, flooding and water pollution are linked to poverty and underdevelopment. Under such conditions, politicians, bureaucrats, and the

population have to be educated on the consequences of such actions. Alternative ways of satisfying basic needs ought to be considered, and applied by instituting appropriate programs.

In most Ghanaian cities, especially in Accra, the population density is relatively high, spilling beyond the administrative control into adjoining districts [69, 3, 17]. However, some protected areas and flood plains within the city which are less suitable for human habitation are clearly 'over settled' and densely populated across the major cities in Ghana [28, 42,70]. Considering the drainage systems in Accra, this is less desirable in most of the cities. Here, existing systems consist mainly of open earth or concrete trenches, along with few drainage boxes along the stretch of main roads. These trenches are generally narrow and shallow to drain the water efficiently during heavy rains. Eventually, many streets become flooded (Fig. 4), creating the need for public sensitization, aimed to shape people's behaviours or lifestyle.

### **6.1 Amelioration of Public Policy Measures**

The environmental problems in Accra are more complex than the undemanding impression connecting environmental degradation to urban growth. Studies on urbanization and environmental problems in Accra indicate multiplicity and interdependency of factors that predispose Accra to severe environmental challenges, including high rate of urbanization, improper urban planning systems, and poverty [17, 14, 39, 44]. The above-mentioned factors are focused on the complex relationships of both anthropogenic (pollution, poverty, urban growth) and natural (floods, drought and wind) factors, which gives room for urban environmental problems in Accra. Given this complexity, no simple solutions are available. Regardless of the concepts or policies adopted, to succeed, they must stimulate and enhance the city's interest in safeguarding the environment in a sustainable manner by involving them directly in the process; reduce the incidence of poverty to minimise the pressure on environmental resources, and demonstrate to urbanites how city survival can go hand-in-hand with the maintenance of urban environmental quality.

A significant proportion of the urban environmental problems in Accra, especially those of poor housing quality, congestion and bad streets layout seems remediable only by

compulsion through relocation of people. Since remedies of this sort are not necessarily feasible economically, socially and politically, it seems reasonable to consider some public policy guidelines which can contribute to the amelioration of some of the physical problems. The suggestions are based on the concept of the "boot –strap strategy" which aims to conserve and upgrade existing properties but without displacing the occupants. It opines that everything is improvable and worth pursuing. Regulatory procedures should also aim to remove those distortions in the urban administrative process that tend to inhibit and restrict the full participation of urbanites. Interestingly, demolition and decongestion exercises without forewarning the involvement of the urbanites, and spatial inequity in terms of socio-economic activities might favour the rich and formal sector workers at the expense of the poor and the informal sector workers. As in some cases, such areas are redesigned and allocated to the highest bidder despite being planned. Such distortions, of course, are partly responsible for the degradation of environmental resources in many urban areas in Ghana (occupation in nature reserves and floodplains). The government should also assist the people to improve the physical environment of such residential areas. Much could also be done by enhancing social infrastructure linked to improvement in road networks, footpaths and the extension of drainage systems of such poor sections in the cities.

### **6.2 Social Planning as a Strategy**

The strategy for improving poor environmental conditions in Accra is placing people at the fulcrum or centre (socio-economic interventions) instead of property-owning initiatives. A large proportion of environmental problem in this city is related to poverty, ignorance and the attitudes of the people towards urban life. To raise the level of urban incomes, there is a need to improve the economic base of the cities thereby providing adequate jobs for the people. Under such policies, potential employers should be provided with lands, properly equipped buildings, along with appropriate services to attract them to locate their industrial enterprises in some selected areas within the city.

Furthermore, since a large proportion of urban dwellers migrate from rural areas, strategies for improving the economic base of the city should not neglect the rural areas. The productive

system of the rural areas should be improved by introducing modernized systems of agricultural production such as mechanization and the use of fertilizers. This however, does not connote more people should remain in rural areas. On the contrary, it means rapid movement from villages to urban areas. This suggests in addition to investments in agricultural infrastructure, the most productive investment in the rural area would be in education to prepare potential migrants for a better life.

Simply setting land aside for environmental sustainability or creating public open spaces and green areas, however, does not mean being able to manage them effectively. Most city authorities in Ghana lack logistics and financial muscles to adequately administer environmental resources, talk of investing in new ones. This situation is particularly common in the cities of Accra and Kumasi [46, 30]. Innovative strategies, such as the involvement of private groups, community based organisations and non-governmental organisations may provide another viable option for conserving urban environmental resources. Such organisations are considered to be better placed in terms of raising funds to (i) support conservation activities by reviving existing ones (ii) creating or managing new ones to incorporate urbanites in environmental management decisions (iii) managing conflicts in the use of natural resources [21].

## 7. CONCLUSIONS

In this study, we examined contemporary issues faced by the Greater Accra Metropolis. These issues have stemmed socio-economic growth and development in the area. Challenges echoed in the present study are anthropocentric in nature, with several implications on ecosystem functions and endpoints. Findings revealed rapid economic growth (i.e., urbanization), poverty and inappropriate urban planning systems influenced environmental degradation in the study area. More so, pollution and natural hazards including flooding, droughts and windstorms have altered the physical properties of Accra. These factors have been accompanied by several undesirable implications which has impacted public health among other ecosystem processes.

The composition of these phenomena in Accra requires a holistic approach which entails total commitment, proactiveness, and stringent approach to regulate these. Further assessment and re-visitation of housing unit schemes,

population growth and distribution dynamics, poor drainage systems, indiscriminate waste disposal practices and management systems, as well as lifestyles/attitudes in ensuring harmony and unity with nature. Relevant stakeholders need to take up responsibility through co-management, innovative techniques and investments across various institutions to strengthen political or institutional frameworks that would monitor and enforce rules and regulations. Again, limited weight has been given to the ineffectiveness of urban planning and environmental laws in Ghana towards promoting equity and equality across relevant sectors to facilitate poverty alleviation and environmental sustainability.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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