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Urban Resilience in Africa: A Study of Land-Use Stresses on the Urban Environment in the Greater Accra Metropolitan Area, Ghana

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Abstract

The Greater Accra Metropolitan Area of Ghana is experiencing rapid urbanisation at the expense of the environment, with substantial pollution compromising the area's resilience. This article examines the spatial dynamics of pollution from land use in the area and its health-related impacts. Drawing on a desk review of the literature and a transdisciplinary empirical approach, this study employed participatory mapping and qualitative methods of analysis to examine the extent to which the Greater Accra Metropolitan Area is building resilience in the face of increasing environmental pollution induced by land use. The researchers found spatial variations in the phenomenon, i.e. community-specific land-use pollution and general land-use pollution. Community-specific land-use pollution comes from dust and fumes, quarries and sand weaning, historical preservations, and transport corridors. General land-use pollution found across the study area related to dusty areas, noise from markets and churches, contamination of water bodies, solid and liquid waste, as well as excessive spillage of lubricants and carbon monoxide from car engines – all of which poses a threat to human health. Although both local and successive national governments have initiated different actions and platforms to mitigate pollution from land use and its health impacts, Ghana must work harder to build a framework of more sustainable and robust urban resilience.

Keywords: Land use; Pollution; SDGs; Transdisciplinary research; Urban resilience

1.0 Introduction

Ghana's Greater Accra Metropolitan Area (GAMA) has witnessed significant socioeconomic development and improvements in living standards, but at the cost of severe modifications of the natural environment and escalating land transformation. This has resulted in major challenges

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related to land use, such as flooding, environmental degradation and resource depletion, severe waste management crises, urban heat island effect, and ballooning health challenges (Wemegah et al., 2020; Kanhai et al., 2021; Puplampu & Boafo, 2021).

Furthermore, the unprecedented rate of expansion of GAMA has impacted natural green space availability and ecosystem services delivery, with some studies highlighting poor planning and land tenure challenges as key constraints to green space maintenance (Owusu, 2018). Some estimates indicate that green spaces have alarmingly declined from 41% to 15% in 27 years (Puplampu & Boafo, 2021). Given the vigorous climate change debates; evaluating green space availability, accessibility and management in GAMA, as well as eliciting further interventions for strengthening GAMA's resilience is an absolute imperative (Owusu, 2018). However, understanding the dynamics of land-use activities and associated pollution is equally critical to tackling societal challenges in the areas of health, food security, climate change, and biodiversity loss.

This report derives from a scoping study conducted in GAMA, seeking to examine the spatial dynamics of pollution related to land use and its health-related impacts in the area. The report deepens understanding of the trajectory of patterns of land use, its related environmental pollution and how it relates to specific SDGs. It also identifies the reasons for as well as the manifestations of risk and vulnerability in disproportionately polluted urban communities and examines the existing institutional framework and innovative approaches to addressing the effects of poor urban environmental quality. GAMA is selected because it epitomises the confluence of diverse environmental and socioeconomic forces that explain the state of environmental change in Ghana and many other developing countries.

2.0 Literature Review

The unprecedented scope, intensity and impact of global land use have directly transformed more than 75% of the earth's ecosystem, resulting in huge biodiversity loss worldwide as greenhouse gas emissions from land use remain a major trigger of global climate change (Ellis, 2021). Furthermore, an estimated 25% of global greenhouse gas emissions have been blamed on existing negative land-use practices, with more than 1.3 billion people condemned to degraded agricultural land and climate stress that excludes them from harnessing the benefits of socioeconomic development (OECD, 2020; UNCCD, 2017). Winkler et al. (2021) estimate that in just six decades about a third (32%) of the global land area has been affected by land-use change, with geographical divergence between the Global North (which is affected more by afforestation and cropland abandonment) and the Global South, which is affected by deforestation and agricultural expansion. The compound effect of a soaring global population and shifts in patterns of consumption towards more carbon-rich foods are anticipated to exacerbate the strain on global land-use systems (OECD, 2020).

The traditional economic models adopted by many sub-Saharan African (SSA) countries for the supply of goods and services have simultaneously increased socioeconomic opportunities and degraded the environment (Imasiku et al., 2020). For instance, the combined effects of increasing population and land-use activities endanger the terrestrial ecosystem's capacity to deliver quality water for human consumption and maintenance of healthy practices. Malherbe et al. (2018) also observed that poor wastewater management by informal urban development shares the blame for nitrogen pollution of groundwater. Consequently, better adaptation strategies and responsible management of natural capital and land degradation, particularly in developing countries, will remain imperative to ameliorate diverse threats to human security (UNCCD, 2017). In 2015, more than 3.96 billion people lived in cities (ICLEI, 2016) – a figure projected to increase to about 66% of the global population by 2025 (Hernantes et al., 2019). While urbanisation confers several socioeconomic endowments, it also triggers unparalleled changes in land use and land cover because of the spatial expansion of construction lands (UNISDR, 2013; Li & Cao, 2019).

Several studies show that urbanised areas have extraordinarily large ecological footprints (ICLEI, 2019; Ortega-Montoya & Johari, 2020) and often exert an indirect multifaceted influence on their natural surroundings. Their 'dissipative structures' also imply the consumption of vast amounts of energy and material resources, leading to significant waste generation (Khan & Uddin, 2015). This has often subjected urban areas to increased vulnerability to a wider range of stressors including rising land-surface temperatures and heat waves, flooding, severe droughts, earthquakes, extreme climatic events, sea-level rise and social upheavals (Hernantes et al., 2019). According to a recent IPCC synthesis, these stresses will intensify and have an extremely significant impact on cities (IPCC, 2014). The sheer scale of concentration of people and wealth in urban centres may be intensifying disaster risks, thus substantially influencing local communities. It is a grave concern that not only are megacities located in areas prone to major environmental stressors, but smaller cities are also ill-prepared to manage disasters because of infrastructural challenges and weak institutions (UNISDR, 2013).

As one of the fastest urbanising regions, Sub-Saharan Africa (SSA) and its cities are largely ill-equipped to deal with hyper-urban growth, particularly due to its spontaneity. This is because its large and mostly poor urban residents generally live in informal settlements that are highly vulnerable to natural and human-made stressors. Given the wide-ranging accumulation of urban risks, developing the capacity of cities for reducing risk and planning resilience in many SSA cities has become even more urgent (Spaliviero et al., 2020).

To reduce these risks and enhance safety and well-being, there will be a need for cities to be more resilient and better prepared to deal with these stresses in a holistic manner (Collier et al., 2013; Hernantes et al., 2019). Three global frameworks, i.e. the Sendai Framework for Disaster Reduction, the Sustainable Development Goals (SDGs) and the Paris Agreement, all acknowledged the urgent need for resilience building at all levels (ICLEI, 2016). This will equip governments and all other stakeholders with the requisite mandate to act swiftly and boldly to create more resilient cities. Although building resilience in rapidly urbanising environments plagued by chronic violence, disaster and extreme poverty remains challenging, it is vital for attaining the SDGs (Patel & Nosal, 2016). According to Hernantes et al. (2019: 96), city resilience may be defined as the capacity to resist, absorb, adapt to, and recover from shocks and stresses, to keep critical services functioning, to monitor and learn from ongoing processes through the city and cross-regional collaboration, and to increase adaptive abilities and strengthen preparedness by anticipating and appropriately responding to future challenges.

The broad and complex nature of resilience means that cities can exhibit a wide range of resilience gradients, thus defying a one-size-fits-all approach to resilience building (Meerow et al., 2016; Hernantes et al., 2019). Understanding this resilient scale and the position of a city is an initial prerequisite for initiating action towards resilience building. Ghanaian cities may require an internal understanding of land-use stresses and levels of vulnerability in their quest to build resilience and achieve the SDGs.

3.0 Method

3.1 Study Area

Figure 1 provides an overview of the study area, i.e. GAMA, with Ghana inset. GAMA is an economic region consisting of 25 of the 29 Metropolitan, Municipal and District Assemblies (MMDAs) in the Greater Accra Region of Ghana (GAR), created in the 1990s because of their close geographical and functional links (Grant & Yankson, 2003). These MMDAs operate independently of one another and are led by Chief Executive Officers. GAMA has a population of approximately 5 million people (Clark et al., 2021).

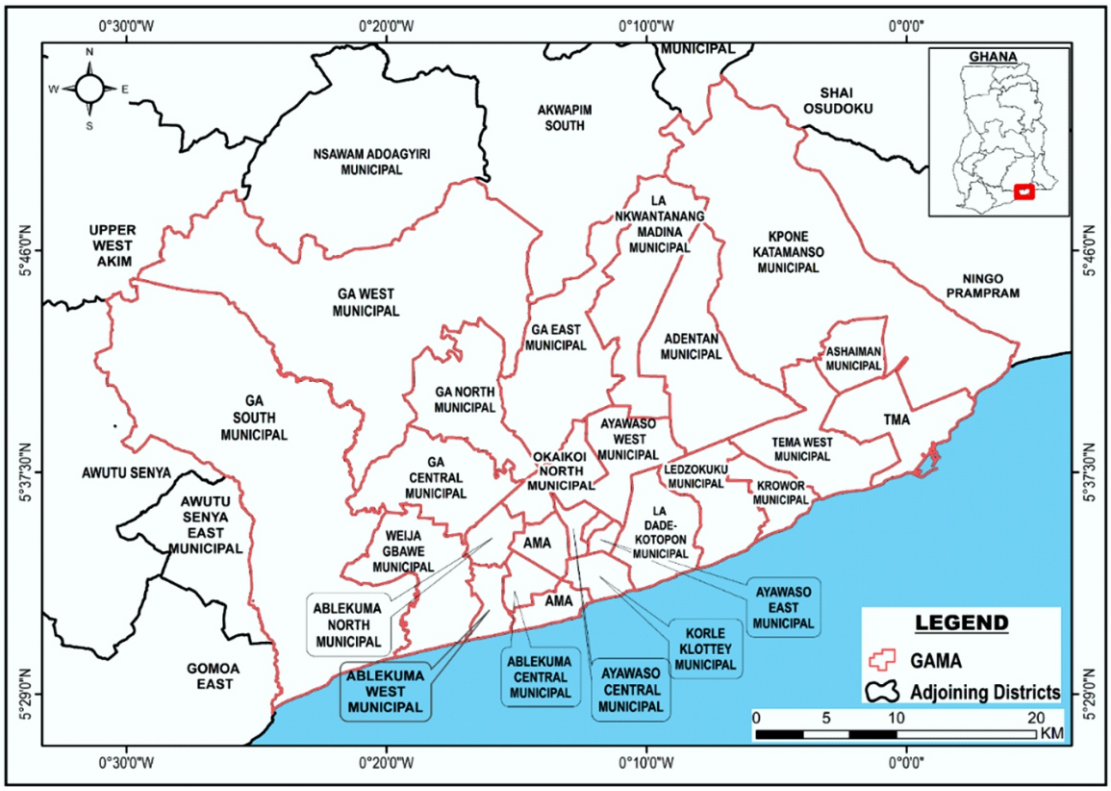

Figure 1: Map of the study area

Source: Authors' Construct (2023)

3.2 Study Approach and Data Collection

The study adopted a transdisciplinary approach, thus allowing for the integration of knowledge from across academic and non-academic spheres (Bergmann et al., 2012). Participants in the non-academic spheres included practitioners with local knowledge of pollution related to land use and its impact, including land-use types, the associated pollution, communities (location), institutional frameworks and innovations that have been either proposed or are being implemented. Both primary and secondary data were used. The secondary data were published and unpublished works, including statistics, inter-ministerial and agency reports, and other literature. The primary data were mainly the identified land-use pattern, pollution types, their location and impacts, as well as the existing institutional frameworks and innovations that were documented during a one-day stakeholders' workshop involving 25 participants. The participants consisted of six (6) experts selected from six (6) different fields of specialisation and 19 government employees and local community members with varying backgrounds residing in the area and working for different institutions and organisations.

Table 1: Summary of composition of workshop participants

Participant ID	Organisation of work	Area of specialisation	Sex	Age
1	University of Ghana	GIS and Spatial Planning	M	50+
2	University of Ghana	Urban and Development Planning	M	Upper 40s
3	University of Ghana	Gender and Development	F	50+
4	University of Ghana	Medical Geography	M	50+
5	National Development Planning Commission	Policy Expert	F	30+
6	University of Ghana	Development Planning	F	Upper 40s
7	University of Ghana	Project and Applied Management Specialist	M	50+
8	Zoomlion Ghana Limited	Waste Management Specialist	M	50+
9	National Development Planning Commission	Project Management and Policy Expert	M	Mid 40s
10	Ablekuma West Municipal Assembly	Development Planning	F	30+
11	Friends of the Earth (NGO)	Environmental Specialist	M	Upper 40s
12	Ga Traditional Council	Traditional Leader/ Herbalist	M	60+
13	Adentan Municipal Area	Community Task Force and Advocacy	M	Mid 40s
14	Social Welfare Market Women Association	Trading	F	Upper 40s
15	Accra Metropolitan Assembly	Planning	F	Mid 40s
16	Accra Metropolitan Assembly	Spatial Planning	M	Mid 40s
17	Accra Metropolitan Assembly	Environmental Management	M	30+
18	Environment Protection Agency	Environmental Protection Analyst	M	Mid 40s
19	University of Ghana	Geography/ Private Business Practice	F	30+
20	Land Use and Spatial Planning Authority	Spatial Planning	M	30+
21	National Service Scheme/University of Ghana	Geography	F	20+
22	National Service Scheme/University of Ghana	Geography	F	20+
23	University of Ghana	Organisational Leadership and Governance	F	Upper 40s
24	Ghana Real Estate Developers Association	Administration	M	Mid 40s
25	University of Ghana	Urban Geography	M	50+

Transdisciplinary Research Workflow

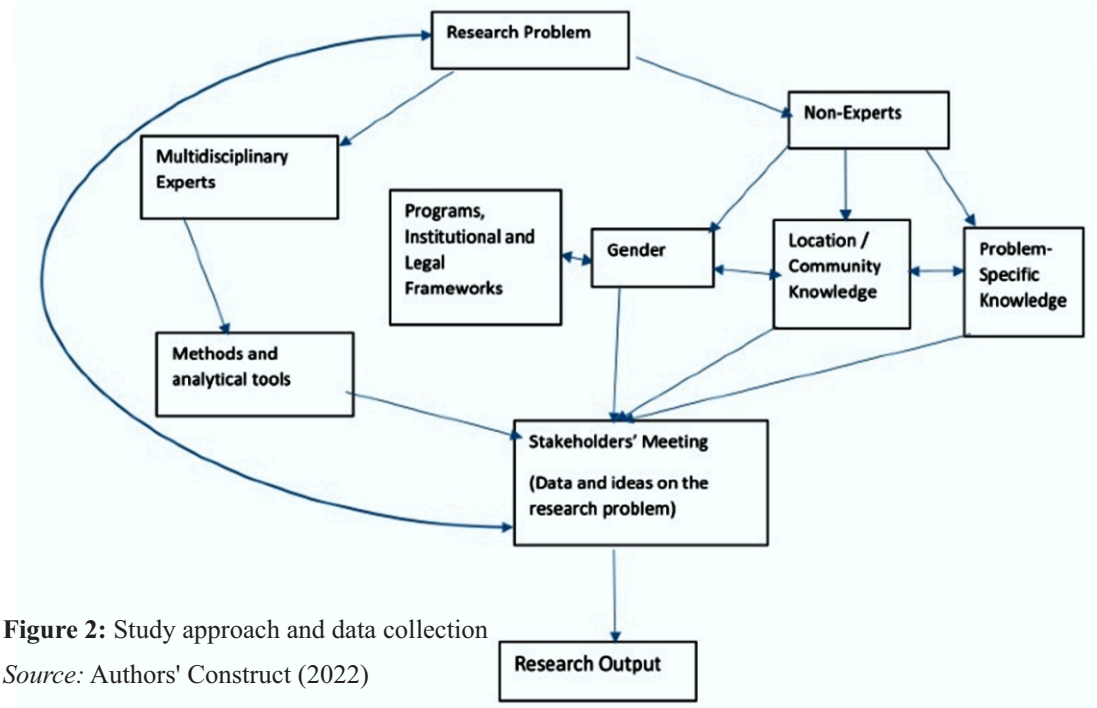

Figure 2: Study approach and data collection

Source: Authors' Construct (2022)

The participants were grouped into three (3) in a working session to address three thematic areas of the study. The thematic areas are:

Group 1: Determining the trajectory of environmental pollution related to land use in Accra, the types and location.

Group 2: Identifying and discussing communities that are more vulnerable to issues related to poor environments including health, food insecurity, safety and security, water shortage and natural disasters.

Group 3: Discussion of the existing institutional framework and innovative ways for addressing the effects of land use on urban environmental quality (Environmental Pollution).

Each group spent two hours discussing and documenting the results and data emerging from their discussions. Another hour was devoted to a plenary presentation of each group's discussion results. Each group's presentation was followed by a question-and-answer session. Another thirty minutes was devoted to synthesising the outcomes, which were documented in a scoping study report. Data on communities and types of land use related to pollution were mapped using Geographic Information Systems (GIS). Moreover, data on pollution types and state and their related impact were analysed qualitatively and presented as observations and opinions of nonexpert focus group discussion results. Similarly, existing institutional frameworks and innovations that are already being implemented and those in the proposal stage were all discussed and documented. This provided insights into the various resilience strategies being employed in GAMA and Ghana in general.

3.3 Results and Discussions

The scoping study from which this report emanated generated results on communities that are more vulnerable to environmental issues and implications deriving from negative land-use

practices including health, food insecurity, safety and security, water shortage and natural disasters. It also discussed the existing institutional framework and innovative ways for addressing the effects of land use on urban environmental quality (Environmental Pollution) in GAMA. Now we present the results and discuss types of pollution related to land use and their location differences, implications of pollution related to land use in GAMA, efforts in addressing the effects of such pollution as well as their implications and impact on efforts at achieving the relevant SDG goals.

3.3.1 Types of Pollution Related to Land Use and their Location Differences

In ranked order, land-use activities identified and discussed at the workshop are residential, industrial, mixed-use, commercial (markets), transportation, water bodies and wetlands, historical preservations, sanitary areas, and green areas/parks. The discussion revealed that the forms of pollutants produced by land-use activities are similar in certain cases, while others are unique to specific locations or communities.

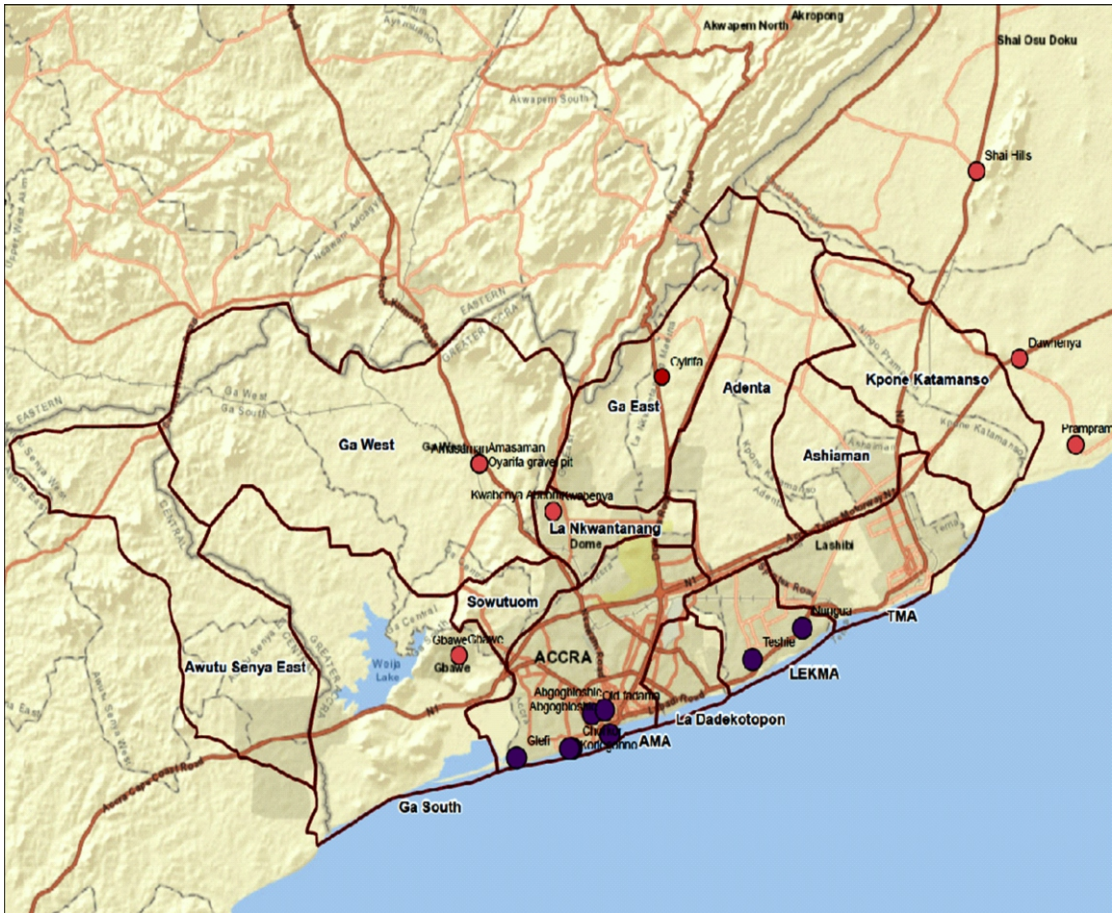

Figure 3: Major types of pollution related to land use in GAMA

Source: Authors' Construct (2022)

Stakeholders at the workshop, especially those from the various MMDAs, held the view that the entire GAMA is polluted, although there are spatial variations in the types of pollution. Communities such as Gbewa, Amasaman, Abgogbloshie, Kwabenya, and Oyirifa were identified to experience more air pollution (dust and fumes). Noise pollution is common in all communities with markets and bus terminals. Water pollution is associated with the Ga Mashie area (James

Town, Chorkor, and Korle Gonno), Old Fadama, Glefi, Agblobloshie, Teshie and Nungua, while land pollution/degradation is common in Kwabenya Abuom, Gbawe, Amasaman, Oyarifa Gravel Pit, Prampram, Dawhenya, Shai Hills, etc., where quarrying and sand weaning activities are performed. The quarry and sand weaning produce stones and sand respectively for the building construction industry.

Table 2: Major pollution types related to land use in GAMA

Community	Pollution Type	Ranking
Gbawe	Dust and Fumes	Ver Poor
Amasaman	Dust and Fumes	Moderate
Abgogbloshie	Dust and Fumes	Very Poor
Kwabenya	Dust and Fumes	Low
Oyirifa	Dust and Fumes	Low
James town	Water pollution	Very Poor
Chorkor	Water pollution	Very poor
Korle Gonno	Water pollution	Very poor
Old Fadama	Water pollution	Very poor
Korle Gonno	Fumes and Flies	Very Poor
Glefe	Water pollution	Poor
Abgogbloshie	Water pollution	Very Poor
Teshie	Water pollution	Low
Nungua	Water pollution	Poor
Kwabenya Abuom	Quarry and Sand weaning	Moderate
Gbawe	Quarry and Sand weaning	Poor
Amasaman	Quarry and Sand weaning	Very Poor
Oyarifa gravel pit	Quarry and Sand weaning	Very poor
Prampram	Quarry and Sand weaning	Poor
Dawhenya	Quarry and Sand weaning	Moderate
Shai Hills	Quarry and Sand weaning	Poor
Tema	Industrial Pollution	Poor
North Industrial Area	Industrial Pollution	Moderate
Old Fadama	E-Waste	Very Poor
Ashiaman	E-Waste	Very Poor

Source: Authors (2022)

Residential pollution was a common type of land-use pollution affecting the entire study area. It manifested as solid waste; liquid waste mostly polluting water bodies due to poor sewage and drainage systems in many homes (both planned and unplanned communities) and the city; noise pollution emanating from various social events including parties and religious ceremonies/prayer events; air pollution typically associated with the burning of waste as well as biomass for cooking in many households; forest/vegetation loss/wetland loss housing construction; flooding (a common phenomenon in the city that is attributed to people building houses on waterways and other unapproved spaces); and the building of houses on designated parks and open spaces.

Industrial areas typified by different manufacturing and processing companies were noted for causing air, water and noise pollution. Some industrial establishments, according to a

participant, use old machines that are not environmentally friendly, while others simply ignore environment-related best practices. Machine emissions often contaminate the air, while noise pollution is caused by machine noise as various other forms of industrial waste pollute water bodies. Many mixed land-use areas in GAMA – comprising residential, commercial, institutional, recreational and industrial complexes – were identified to suffer from this type of pollution. They also contribute to the generation of solid waste, liquid waste and noise as well as air pollution, as previously discussed. The Tema-Ashiaman enclave, the Kwame Nkrumah Circle and the Kaneshie Industrial Area, as well as Accra Central, are just a few of the notoriously polluted communities.

Solid waste/land pollution, air pollution, liquid waste, noise pollution, inadequate safety and security (due to the nature of construction) and erosion were identified in commercial centres. Although commercial centres include stores, malls, banks and hotels, this study focused on open-air markets inside metro area communities. In Ghana, these marketplaces have a reputation for producing large quantities of solid waste, accounting for a considerable component of the urban waste stream (Asomani-Boateng, 2016). According to one participant, "the sheer overcrowding in our marketplaces contributes significantly to waste generation and other forms of pollutants."

The waste generated is poorly managed, resulting in overflows in open containers and waste pouring into street drains and roads facing the market (Asomani-Boateng 2016). The level of air pollution in and around commercial centres varies. Some are caused by various modes of motorised transportation, while others are caused by the smell of decomposing food, waste burning, and cooking. As for cooking, the source of pollution is the smoke emanating from the biomass used for cooking. Moreover, sewage sludge and wastewater from the washing of goods, vehicles and food items are examples of liquid waste identified in commercial centres. As for noise pollution, this was associated mostly with aircraft, road transport and heavy sound from music and loud speech (religious preachers, advertising vans and peddlers of various goods). This partly confirms Clark et al.'s (2021) finding that human speech and musical sound are often at higher decibels in residential areas, particularly in the high-density areas of Accra.

The study found that GAMA's increasing urban expansion means that most residents must commute long distances to work and other destinations – a situation that leads to rising levels of air pollution. This is coupled with the high incidence of emissions from old and ill-maintained vehicles. GAMA, like many other Ghanaian cities, is experiencing a rapidly expanding car-wash industry, driven by massive automobile imports into the country. Car-wash stations have been cited for using excessive amounts of water and leaking filth, heavy metals, disinfectants and toxic chemicals into the environment, especially into water bodies (Monney et al., 2020). Automobile repairers and service providers were also identified for improper disposal of wastes including oils, which ultimately affect the soil, vegetation and aquatic life.

Similarly, the study found that in GAMA water bodies, e.g., rivers, serve as sources of potable water, yet many of them encounter challenges of pollution due to agricultural, industrial and domestic activities. This phenomenon confirms a recent news item in which a traditional leader bemoaned the extent of pollution of water bodies in GAR through anthropogenic activities (GNA, 2021). The Odaw River in Accra, according to participants, is extremely polluted with human excreta as well as solid and industrial wastes, rendering it dead. Furthermore, wetlands in GAMA, which are naturally supposed to contribute to improving urban environmental quality, are also not spared in the barrage of pollution induced by land use. Two Ramsar sites, i.e. the Densu Delta wetland and the Sakumono lagoon, are both situated in very densely populated areas of GAMA and are endangered by pollution and housing encroachment resulting in wetland draining, deforestation, ecosystem degradation and biodiversity loss (Kondra, 2016).

Shrines, palaces, castles, statues, royal graves and other sites of historical preservation are

distinct and specific community-based land uses that generate pollution. In this study, however, the scope of historical preservation was limited to cemeteries, which were identified as an anthropogenic source of pollution and contamination of groundwater – for obvious reasons.

Participants, including former and current MMDA officials in GAMA, argued that, despite multiple efforts to efficiently manage waste in the city, local authorities remain overwhelmed by the city's rapid rate of expansion. Besides, it is difficult to find suitable land for managing waste since existing landfill sites are poorly engineered.

According to Hunter et al. (2017, Appendix 2, p.37), "urban green spaces, such as parks, playgrounds, riversides, green trails or urban gardening, can be applied as a spatial determinant to improve the quality of urban settings delivering diverse environmental, social and health benefits to the local community." Similarly, participants suggested that green spaces can improve urban air quality, beautify the environment and prevent erosion. However, others think there is a limited chance to achieve this in GAMA. As argued by one participant: "This will not work effectively since GAMA is fast becoming a concrete jungle filled with the construction of buildings."

The absurdity of this phenomenon is evidenced by the replacement of several zoned green spaces and parks with buildings (Owusu, 2018), resulting in myriad environmental challenges in the city. Even agricultural lands have not been spared, suggesting a failure in land-use plan enforcement and a veritable threat to urban food security. The emphasis on horizontal – rather than vertical – expansion in the face of growing urbanisation also has dire consequences on the city's green and open spaces, thereby threatening sustainable urban development.

3.3.2 Implications of Land-Use Pollution in GAMA

Thus far, pollution induced by land use has been identified to have implications for the urban climate, human health, food security and water availability. While the high concentration of vehicles and the vast asphalted road networks in Accra are expected to ease mobility, they were found to contribute to the formation of urban heat islands in GAMA. Given the fact that agriculture in Ghana is largely rainfed, high temperatures coupled with inadequate rainfall can also affect urban agriculture and worsen food insecurity (Dubbeling et al., 2019).

According to EPA (2018), as GAMA's population and housing density continue to grow on its limited land space, air pollution issues related to car emissions and cooking stoves are expected to increase. Some participants also expressed concern about Accra's ambient air pollution burden, which is projected to cause around 1,700 deaths per year (Mudu, 2021). Although the implications of water pollution are known to be multifaceted, this study emphasised accessibility. As indicated by a participant: "Pollution of water sources in Accra and Ghana in general may lead to water shortages soon. This can worsen the socioeconomic woes of the poor and everyone." Polluting waterbodies with solid waste and building on waterways and wetlands were also revealed to be key contributors to perennial flooding in the city. A notable flooding event happened on 3rd June 2015 and claimed numerous lives while destroying properties and livelihoods (World Bank, 2017).

On noise pollution, participants indicated that continuous noise exposure can lead to health challenges. This is consistent with Clark et al.'s (2021) finding that noise pollution can have a variety of negative effects on human health, including hearing loss, cardiometabolic disorders, sleep disturbance, reduced cognitive function, and causing stress/annoyance. The study also noted that day and night-time sound levels in most parts of the GAMA exceeded national and international health-based guidelines.

The overcrowded nature of open markets and stalls construction styles pose health, safety and

security risks (Adjokatse et al., 2022). This explains why very few goods are salvaged in the event of a market fire – a phenomenon that is rising in most urban areas of Ghana (Oteng-Ababio & Sarpong, 2015). Apart from economic losses, these market fires pollute the air and endanger human health.

3.3.3 Accra's Efforts in Building Resilience

Building urban resilience is a public good that requires government initiative and commitment to reduce risks and disasters. Ghana's National Environmental Policy underscores the State's willingness to build resilience via concerted conscious efforts at managing the environment using an integrated and holistic management system (Ministry of Environment Science and Technology, 2014). The policy encourages Ghanaians and institutions to work together to manage the environment in achieving sustainable development. This clarion appeal for a unified strategy for environmental management appears to have been heeded to some extent in GAMA. Multiple actors comprising state institutions (Greater Accra Regional Coordinating Council [GARCC] and MMDAs), civil-society organisations, the private sector and ordinary citizens play various roles in addressing environmental issues, including pollution, in GAMA. A notable activity in this regard is the introduction of a sanitation programme called "Operation Clean Your Frontage", which mandates all individuals and businesses to be accountable for cleaning and greening their immediate environs. The programme is complemented by clean-up exercises organised in communities and institutions by civil-society organisations and groups.

The MMDAs also hold monthly clean-up campaigns where citizens clean their neighbourhoods. However, this exercise has slowed down in recent times because of a lack of enforcement by the MMDAs. In general, all these clean-up campaigns have contributed to improving sanitation and reducing the risk of floods and disasters in vulnerable communities. In recent times, the MMDAs provided free waste bins to households as part of their efforts to manage sanitation in the city. Moreover, the MMDAs have demolished several structures built on waterways and unapproved locations, in addition to prosecuting individuals and organisations at the sanitation courts for various environmental offences.

There is also the Green Ghana programme and a tree planting programme aimed at addressing Ghana's reforestation needs to save its depleting forest reserves as well as ensure climate change adaptation. Consequently, various MMDAs in GAMA have planted different tree species. Undoubtedly, this exercise has many gains for the city's environment including the potential to contribute to reducing the formation of urban heat islands. The latter provides a framework for addressing many types of environmental concerns, including pollution. Private companies also collaborate with MMDAs in managing waste of various types. There are also sanitation policies and bye-laws of individual MMDAs, alongside environmental laws by the Environmental Protection Agency.

The Land Use and Spatial Planning Authority has the mandate and prosecutorial powers to ensure proper spatial planning, prorogation of new land-use plans and building codes and enforcing existing ordinances and regulations. Participants believed that this would soon sanitise land use and enforcement of regulations. Similarly, the recent land records digitalisation programme has been hailed as a concrete effort by the government to sanitise the land market and enforce land ownership and tenure systems. This will facilitate land use by speedily resolving land disputes and squatter development issues in Ghanaian cities. Despite the efforts being made by government, city authorities and organisations to manage pollution in Ghanaian cities, the issue of pollution remains a key challenge. As indicated by a participant, "the issue of pollution continues to exist in GAMA because of the lack of resources and enforcement of the existing laws, regulations, and policies." Undoubtedly, this threatens the state's endeavour to build resilience.

3.3.4 Implications of Pollution-Mitigating Efforts for Achieving the Sustainable Development Goals

Reflecting on the mitigation measures discussed earlier, it is evident that Ghana is making gains in achieving some of the SDGs. For example, the multi-actor approach to managing environmental issues has implications for achieving SGD 11, which aims at making cities inclusive, safe, resilient and sustainable. This approach demonstrates the state's support for inclusivity in environmental management, which has implications for building resilience and decreasing mortality while also assisting in reducing economic losses associated with pollution-related disasters.

SDG 6 focuses on ensuring the availability and sustainable management of water and sanitation for all persons. This resonates with Ghana's policies and regulations on protecting water bodies, as well as with the sanitation campaigns that are being undertaken in GAMA. Finally, SGD 13 encourages nations to take conscious and urgent action to combat climate change and its impact. The national tree-planting exercise and the enthusiastic participation of MMDAs in GAMA represent a clear attempt to fight climate change and its impact. This study considers the tree-planting exercise as timely, given the significant loss of vegetation to concrete buildings in GAMA.

4.0 Conclusion

The unprecedented urbanisation witnessed in GAMA is characterised by lateral expansion, making the city-region parasitic. Its accompanying land uses for residential, industrial, commercial and other anthropogenic-driven activities are causing pollution with major consequences for human well-being and survival. Efforts at addressing these challenges have culminated in national and local programmes aiming at building resilience. Major challenges are observed in poor law enforcement and lack of resource challenges, which undermine GAMA's resilience. However, institutional reforms and a participatory approach to implementing policies and programmes hold a good promise for GAMA in its drive to achieve the SDGs.

Following this study on the extent of pollution related to land use, as well as its environmental and health implications for GAMA and its residents, it is noted that the study's transdisciplinary approach helped the researchers to offer empirical, verifiable conclusions. The approach also created a shared learning mechanism for expert and nonexpert participants who were frontline workers of the resilience drive. This shared learning experience will drive efforts towards resilient community building in GAMA.

Similarly, the identified and mapped land-use pollution gives a tool for surveillance and the possibility of generating local solutions. Moreover, pollution ranking and the associated environmental and health implications serve as the first step for action. To a large extent, participants agreed that the MMDAs within the metropolitan area, as well as the regional administration and successive national governments, have initiated different actions and platforms for collectively addressing issues of land use as well as pollution and its impact, although more needs to be done. The fact that actions have been taken by successive administrations is an admission that a serious problem exists and that current solution models are not effective enough. Consequently, this study argues that, apart from ensuring that laws are adequately enforced and the necessary resources are made available by authorities to mitigate pollution, it is imperative to develop new approaches to building urban resilience.

We propose that instead of relying mostly on government initiatives, a bottom-up approach, e.g., a sustainable-communities initiative where local communities themselves initiate action and collectively create the environment they want, is imperative. Adequate collaboration and efficient coordination are needed among government agencies/departments, local communities and civil-society organisations to mitigate pollution related to urban land use. Moreover, more

financial investments are needed to promote environmental management and broaden the scope of educating people of all ages and social statuses on environmentally friendly practices for building resilience in GAMA. Indeed, there is no gainsaying the fact that GAMA needs to start building resilience and at the same time being sustainable in the drive to meet the SDG goals.

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