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**BUILDING FLOOD RESILIENT AND SUSTAINABLE CITIES USING SMART TECHNOLOGIES IN GHANA**

**Introduction**

Rapid urbanization is transforming the world and the way we live and interact in our cities. It is estimated that by 2050 about 70% of the world would be living in cities. This urbanization is both an emblem of our economic and social progress and a challenging strain on the existing urban infrastructure that is struggling to cope with an ever increasing population.

Coupled with the problems of rapid urbanization, Ghanaian cities since the dawn of independence have been struggling with floods and its related problems (Graphic Online, [2015](https://www.graphic.com.gh/news/general-news/flood-disaster-profile-of-ghana.html)). The problem only seems to be increasing as populations in our cities sour high, coupled with the increasing severity of weather related-related events linked to climate change (e.g. changing rainfall patterns and rising sea levels), the problem is becoming harder to deal with every year. City dwellers face the risks of perennial flash floods in the rainy seasons and are hungry for some kind of solution to this problem. Any kind of solution will calls for innovative and disruptive ideas and strategies in the planning and management of our cities.

**Problem Statement**

Floods is Ghana’s most costliest and most deadliest disasters, displacing thousands of families and destroying millions of dollars in properties every year—even claiming lives of victims in extreme events ([Joy New Online, 2020](https://www.myjoyonline.com/june-3-at-5-the-ghastly-ulcer-ghana-has-failed-to-treat/)). The people who bear the brunt of this problem are the urban poor and those who are ill equipped to cope with the negative effects of this on their lives.

With flood events and risks expected to increase due to increased congestion in urban areas, haphazard development and the increasing severity of weather elements due to climate change, various studies have been conducted over the years to understand floods and the risks they pose on cities and city life in Ghana. Despite efforts from the Government and private bodies to deal with the flood problem in the country—these include the National Water Policy which seeks to mitigate floods by providing early warning systems and enforcing buffer laws (Government of Ghana, [2007](https://www.gwcl.com.gh/national_water_policy.pdf)) and the Blue Agenda which addresses floods by focusing on public education and enforcement of building regulations, just to mention few—the problems still persist and call for more innovation and research to develop solutions that not only help cope but adapt our cities to flood and build resilience right into the urban fabric of the country.

According to the VNR report on the implementation of the 2030 agenda for sustainable development (Government of Ghana, [2019](https://sustainabledevelopment.un.org/content/documents/23420Ghanas_VNR_report_Final.pdf)), the problems agencies face most in the management of disasters include: limited early warning systems, poor coordination among institutions and weak post disaster recovery and rehabilitation mechanisms. Scientific research and advancement in technology has led planners, policy makers, engineers and all stakeholders involved in planning and building settlements understand disasters better and has provided us the tools with which to manage efficiently the risks that come with disasters—and all involved in the planning process must make use of them. The emergence and development of artificial intelligence, internet of things (IOT), GIS, robotics, automation, big data, cloud and other ICTs have placed the whole human race at a better position of understanding, adapting and making more informed and data backed decisions in emergency situations. These systems do not only equip us with the tools with which to adapt but have made it possible to share data, information and solutions between different bodies involved in finding solutions to the flood problem, making inter-disciplinary and multi-agency decision making possible and easier than ever.

The purpose of this research is to explore various ways cities in Ghana can begin to take advantage of these smart technologies to integrate flood resilience into city infrastructure, how to develop and integrate monitoring, observation, analysis, modeling, testing and forecasting of floods into city infrastructure and how to effectively share data and solutions between different agencies.

**Research Questions**

* What kind of smart sensor technologies will be most effective for the implementation of a flood monitoring system considering their design and requirements for installation and maintenance work.
* How to efficiently implement real-time data transmission, filtering and analysis from remote flood monitoring devices to a central station.
* What computational methods and simulation components to use for analysis of real-time data collected by flood monitoring system.
* How to efficiently develop a detailed analytics system that will assist authorities and citizens in choosing right flood protection tactics and in managing the risks of floods.
* What possible ways can data collected from the flood monitoring system be made public to aid research and development of more innovative solutions.

**Research Objectives**

* Identification of fast and efficient smart sensor technologies that are easily deployable, resource efficient and environmentally friendly.
* Flexible and modular system within the flood monitoring system to provide easy testing of different computation models to assess which is best for each site.
* Development of open decision support system to aid authorities, citizens and stakeholders have easy and open access to data and analytics platform to make informed decisions before and after flood events, and also promote research and development.

**Methodology**

Arriving at a solution to the flood risk management problem is based on different steps and at the middle of all this lies data driven smart systems connecting critical infrastructure and stakeholders to make better decisions on how to manage risks. Although the final solution will have to be customized to work efficiently in the city it is deployed in, the following steps will be followed to develop a generic solution;

1. Gather historic data and studies on floods in Ghanaian cities to understand such events have affected Ghanaian cities and what has and can be done about it.
2. Conceptualize a model based on what has been learned from the historic data and basing the model’s design on technologies that can be effectively implemented in a lower-middle income country like Ghana.
3. Simulation testing models to uncover any undefined behavior and identifying stress points to help make models more resilient against floods.
4. Exploring the different ways to implement the models in flood prone areas with the aim of improving the resilience of the city and the quality of life of city dwellers.

**Conclusion**

Floods hinder social and economic progress of humanity, if they are not managed using the best tools that human progress presents us, can lead to the complete destruction of settlements if they are neglected. Employing smart technologies with their data accumulation and analysis capabilities equips planners and stakeholders involved in the planning and building of cities to create systems that help plan/prepare, adapt, absorb, respond and recover from floods better.