UNIVERSITY OF GHANA
REGIONAL INSTITUTE FOR POPULATION STUDIES
Postal Address/Addresse Postale: P. O. Box LG 96, Legon, Ghana

IDRC CITIES & CLIMATE CHANGE PROJECT

Integrated Climate Smart Flood Management for Accra – Ghana

FINAL TECHNICAL REPORT
JANUARY 2020

UNIVERSITY OF GHANA, LEGON
ACCRA, GHANA

IDRC | CRDI
International Development Research Centre
Centre de recherches pour le développement international

Project Title: Integrated Climate Smart Flood Management for Accra – Ghana

IDRC Project Number-Component Number: 108262-001

Research Organisation involved in the Study: Regional Institute for Population Studies (RIPS), University of Ghana, Legon.

Location of Study: Country/Region: Ghana/Africa

Author Full Name: Dr. Delali Benjamin Dovie (Project PI)

Full Name of Organization: Regional Institute for Population Studies (RIPS), University of Ghana, Legon.

Report Type: Final Technical Report

Date Submitted: January 16, 2020

Name(s) of Researchers/Members of Research Team:

Dr Faustina Frempong-Ainguah	Regional Institute for Population Studies (RIPS)
Dr Mumuni Abu	Regional Institute for Population Studies (RIPS)
Dr Philip Antwi-Agyei	Kwame Nkrumah University of Science and Technology (KNUST)
Dr Opoku Pabi	Institute for Environment and Sanitation Studies (IESS)
Dr Linda Akua Darkwa	Legon Centre for International Affairs and Diplomacy (LECIAD)
Dr Cynthia Addoquaye Tagoe	Institute for Economic, Social and Statistical Research (ISSER)
Dr Benjamin Delali Dovie	Regional Institute for Population Studies (RIPS)
Prof. Samuel Codjoe	Regional Institute for Population Studies (RIPS)
Prof Daniel Twerefou	Economics Department, University of Ghana

Contact Information of Researcher/ Research Team Members: Dr. Benjamin Delali Dovie
E-mail: dbdovie@rips-ug.edu.gh; Telephone: +233 242 576 987

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List of Acronyms

AdMA	: Adentan Municipal Assembly
AMA	: Accra Metropolitan Assembly
AR5	: Fifth assessment report
DRR	: Disaster Risk Reduction
EPA	: Environmental Protection Agency
FGDs	: Focus Group Discussions
GAMA	: Greater Accra Metropolitan Area
GAMADA	: Ga Mashie Development Agency
Gh-NDCs	: Ghana's Nationally Determined Contributions (Paris Climate Agreement)
HPLF	: High Level Political Forum
IPCC	: Intergovernmental Panel on Climate Change
LUSPA	: Land Use and Spatial Planning Authority
MCEs	: Metropolitan Chief Executives
MLGRD	: Ministry of Local Government and Rural Development
MMDAs	: Ministries, Departments and Agencies
MoF	: Ministry of Finance
MTDP	: Medium Term Development Plan
NADMO	: National Disaster Management Organisation
NDPC	: National Development Planning Commission
OHLGS	: Office of the Head of Local Government Service
PAA	: Population Association of America meeting
SDGs	: Sustainable Development Goals
SDRRF	: Sendai Disaster Risk Reduction Framework
VNR	: Voluntary National Reviews

1. EXECUTIVE SUMMARY

1.1 Vulnerability, Impacts and Adaptation

The study suggests that any intervention that seeks after an integrated flood risk management should address the challenges of physical infrastructure within the Greater Accra Metropolitan Area (GAMA) in Ghana. Yet there are disagreements amongst the policy community that managing infrastructure such as the existing drains to adapt to the increasing surface runoff of rainwater was a challenge in reducing flood risks rather than poor spatial planning and law enforcement. Household surveys show major causes of flooding in the Greater Accra Metropolitan Area (GAMA) as follows (i) building along water ways (42% of respondents); (ii) poor construction of drains (20.2%) and (iii) choked gutters (15.6%). On the factors not identified as major causes of flooding were the effects of heavy storms, represented by the responses of 3.4% of households. Gender representations were key to opinions from communities as findings from the focus group discussions (FGDs) revealed that whereas both female adults and youth groups ranked flooding as the major environmental problem in their communities, male adults ranked poor sanitation as the major environmental problem and followed by flooding. Flood risks were also associated with other environmental problems identified as inadequate toilet facilities and gutters, lack of refuse dumps, choked gutters, untarred roads causing dust and lack of storm drains or improperly built drainages. On the impacts of flooding and associated coping strategies, all three FGD groups above identified the destruction and loss of properties as the main impact followed by morbidity and displacement. The impact of institutions and flood management variables on the probability of flooding were mixed. We found that an inclusion of a waste disposal fee makes the impact of rainfall variation on the probability of flooding insignificant. Subsequently, psychological and socio-economic factors influence households' flood protective response in the Greater Accra Metropolitan Area of Ghana (GAMA) and that public information on flooding does not appear to influence private protective responses. The probability of residents relocating as a result of floods decreases with increased public adaptive measures suggesting that public adaptive measure has the propensity to reduce vulnerability to floods in GAMA. Flood hazard is exacerbated by poor waste management, lack of / poor flood management infrastructure and spatial planning. The levels of exposure to floods does not similarly match the level of vulnerability. There is no clearly defined governance structure for flood response due to poor policy coherence and lack of capacity.

Though the Focus Groups were aware of adaptation solutions, response measures taken by individuals and households such as the washing or drying of wet belongings to enable reuse was not sustainable. Likewise, are the relief items and handouts given to flood victims by the National Disaster Management Organisation (NADMO). Communities therefore suggested more sustainable adaptation options such as the expansion of drains; concealment of existing drains as well as the formulation of land use and land regulations management and enforcement of by-laws related to solid waste disposal. A contingent valuation technique was used to analyze the overall household economic value of adaptation to flood risk. The analysis was based on the households' response to a scenario for their Willingness to Pay (WTP) for a flood adaptation strategy project. The willingness of citizens and residents to contribute resources towards the provision of a public good is premised on the assumption that they (the contributors) trust that recipients will be able to use the resources for the intended purpose that maximizes their welfare. Survey respondents have about 39.7% confidence in the Government of Ghana to effectively implement adaptation intervention to respond to flood, if given the resources. Certain proportion of the respondents - 38.9%, 43.5% and 56.8% trusted respectively, the (i) Private Sector Profit Making organizations, (ii) Private Sector Non-Profit Making organizations and (iii) International Development Agencies, to complement efforts by public institutions. Thus, given the resources, respondents will see to the effective implementation of flood adaptation strategies in their communities, suggesting that state or the government could not be relied on to directly implement or engage in flood response measures. Significant policy options across different sectors of the economy exist to enable District Assemblies to properly integrate waste management and flood reduction strategies towards minimizing trade-offs and waste of state resources. Solid waste has been found to be a major cause of flooding hence this is human-made and can be resolved through intense citizen engagement and public awareness. Citizen engagement would forewarn and help the population to prepare for eminent floods beyond some of the strategies being used by the population. Managing solid waste and the related issues of sanitation and floods should come with clearly identified hotspots such as proximity to water bodies and drains using spatial technology of Remote Sensing (RS) and Geographical Information Systems (GIS) origins.

1.2 Transformative Action

Transforming governance and institutions to mainstream adaptation solutions into planning requires the three communities of change which are (i) science, (ii) policy and (iii) practice acting concurrently under a common framework. Yet, such transformations must be guided by relevant mix of methods of understanding problems on the ground, responding to recent calls to make methods for data collection and analysis on cities exciting to managers. Thus, the methodological nexus in this project motivated transdisciplinary and multi-stakeholder approaches to co-develop metrics that enabled the Work Packages of the research team to match the research outcomes of different disciplinary perspectives, the conceptual origins and demand of stakeholders. The co-incorporation of human and biophysical dimensions of assessing flood risks in aspects of exposure within the Districts was a major step for stakeholders' roles to thrive in preventing flood risks and providing adaptation solutions by availing platforms for simple solutions to adapt to complex challenges. For example, the flood inundation maps developed from the spatial analysis and combined with survey outputs can be shared with residents in flood prone environments. These maps are useful for depicting the probable impact of an approaching flood which have relevance for public awareness and emergency preparedness. The synergistic effects of the methods to support resilience building lock into developing multi-sector plans to manage flood risks and flooding regimes, including designing appropriate legislation, governance reforms and re-zoning of low-lying areas. The combined methods further elicit information on climate change as an external perturbation, in ensuring that climate elements are very well integrated into flood management and national level development planning towards a Climate Smart Integrated Flood Management (CSIFM). The CSIFM therefore provides pathways for formulating research and policy questions that are demand-driven by cities which are institutionally trapped in responding to the challenges and the opportunities that flood risk might present to managers and the citizenry. The CSIFM could be described as not terminal in character but provides opportunities for monitoring flood management plans and interventions and getting to review and appraise the options for response measures. Importantly, the CSIFM framework provides pathways for empowerment to pursue actions on adaptation, whilst enhancing further research, policy and adaptation solutions that bring about resilience building to flood risks through the bridging of the gaps between science and policy, and theory and practice, and key to the Sustainable Development Goal (SDG) 11. Thus, "*Make cities and human settlements inclusive, safe, resilient and sustainable*".

1.3 Policy Influence and Vertical Integration

i. Membership of decision making bodies such as the Accra Metropolitan Authority (AMA) Climate Action Planning Steering Committee
ii. Supporting the National Disaster Management Organisation (NADMO), the Ministry of Environment, Science, Technology and Innovation (MESTI), and the Ministry of Local Government and Rural Development (MLGRD) through the National Development Planning Commission (NDPC) on operationalizing the Sendai Framework for Disaster Risk Reduction Framework.
iii. Building capacity of local government agencies on assessment of flood risks and development of action plans
iv. Working with private sector players such as the Ghana Private Enterprise Federation to mobilize its membership made up several private sector associations, cooperatives, etc.
v. Capacitating the cities and climate change District Assembly fellows to use findings of the research in their Medium Term Development Planning Framework
vi. Development of Policy Briefs and Project Handbook / Manual

1.4 Research and Development Impact

The surveys on the economic issues especially using the Willingness to Pay (WTP) was an eye opener to households on how their voluntary contributions could be accounted for and monetized towards better appreciating participating in communal level actions on flood adaptation interventions. The collaboration with state-level organizations such as the National Development Planning Commission (NDPC) and National Disaster Management Organisation (NADMO) provided policy dialogue platforms for the project to contribute to ongoing national level discourse on disaster risk management, to be incorporated into the Voluntary National Review (VNR) of the Sustainable Development Goals (SDGs). The Policy Dialogue was based on the Sendai Disaster Risk Reduction Framework (SDRRF), which from the perspective of this project has become a major cornerstone of disseminating project findings because of its adoption by Ghana as the main instrument for disaster risk reduction. The outcome synthesis report of the Policy Dialogue thus highlights progress on the Sendai Framework for Disaster Risk Reduction, facilitated through the Cities and Climate Change Project.

Dissemination meetings with district assemblies have not only enhanced relationship between academia, research and policy and governance but also helped to establish the reality of the importance of research for development planning. The outcome of this relationship translated finally into the co-hosting of the project's final dissemination conference (CCPOP-Ghana2019) with the Accra Metropolitan Assembly, bringing together all project districts. The preliminary joint work plan of the project with partners constituted a form of capacity building to enable them to fit their own programming into flood risk management issues whilst empowering them to expand their scope of work and partnership across scale, policy and agency. Strategic institutional partnership with institutions such as the Land Use and Spatial Planning Authority (LUSPA), responsible for national urban and spatial planning have provided lead to nurturing the project's relationship with similar activities in the spatial planning space. The Conference of Parties (COP) of the Framework Convention on Climate Change (UNFCCC) activities was important platform for the project nationally and internationally in partnership with the Ministry of Environment, Science, Technology and Innovation (MESTI) through Ghana's Focal Point to the UNFCCC. Pre-CoP events provided the platform for not only technical and policy stakeholders to share knowledge about climate adaptation linkages with agriculture, flood risks and the SDGs but also young people in Senior High Schools were given the opportunity to learn and interact with experts on the issues discussed. Considering the success rate of the climate festival, plans were put in place to collaborate with the Environmental Protection Agency (EPA) to host a stocktaking colloquium (Post - CoP) after the negotiations in Bonn in 2017. It was to help strategize towards engaging policy makers on critical areas for redress in Ghana, regarding climate change. The Post-COP event provided the platform for not only technical and policy stakeholders to share knowledge about their lessons from the COP 23 including climate financing, investments and coordination of climate action, corporate emission cuts and government ratifications; but also an avenue for the African Group of Negotiators (AGN) to collate views from citizens to be included in further discussions within international climate change negotiations.

Through interests expressed by some development partners such as the World Bank and the United Nations Development Program (UNDP) in the project, the project's data was key to the World Bank's City Strength Diagnostics and UNDP's Advocacy and Capacity Building for Disaster Risk Reduction and Preparedness programs. Both boundary partners provided critical opportunities for institutional collaboration and policy enhancement towards interventions where the project team received

invitations to participate in a number of related fora. Other impacts of the project include synergies with projects such as the Making All Voices (MAVC) project. Establishing and working with such identifiable synergies was crucial as the Cities and Climate Change project provided the framework intervention for MAVC. Additionally, the 100 Resilient Cities (100 RCs) project hosted by the Accra Metropolitan Assembly (AMA) with support from the Rockefeller foundation, was provided with relevant information on the Cities project with the aim of helping cities around the world become more resilient to the physical, social, and economic challenges that are a growing part of the 21st century. Also through our partnership with the National Disaster Management Organisation (NADMO), data on contingency plan on droughts and floods in Ghana was contributed from our field work to support NADMO's contributions to the African Risk Capacity (ARC) program. The cumulative effects of the project's research output were the joint training of 26 out of 29 District Assemblies in GAMA to develop their own Climate Actions Plans in a joint collaboration with C40 Cities Climate Leadership Program, representing significant upscale of the project from the initial 7 Districts.

2. THE RESEARCH PROBLEM

2.1 Knowledge Gaps

Globally, The challenges of population growth are compromising spatial planning in urban and peri-urban communities and cities across the world. Haphazard development of human settlement such as building on waterways and green spaces as well as increased demand for housing and industries has exposed several residential sites especially that of people living in low-lying areas to increased flood risks. In coastal environments such as the Greater Accra Metropolitan Area (GAMA) in Ghana, accelerated sea level rise has compounded flood risks leading to inundation of settlements and erosion of the shoreline. Recent floods in GAMA coupled with fatal deaths and injuries; damage to property, infrastructure and/or the environment; and the disruption of life and the functioning of the community also presents institutions and society with new challenges of adaptation solutions. However, not much leadership has been demonstrated in integrating climate resilience into city planning and flood management. Thus, this three-year research project on Managing socio-demographic change and climate induced flood risks in the Greater Accra Metropolitan Area (GAMA) is built on the fifth assessment report (AR5) of the IPCC which affirms an increased frequency of floods in coastal cities and the apparent disruptions of infrastructure that may occur.

Such global assessments have been shown and confirmed locally through various projects funded by IDRC, USAID, UNITAR and CDKN at the Regional Institute for Population Studies (RIPS), University of Ghana upon which the Cities and Resilience project has been formulated. Recent floods in GAMA and associated death, injury or disease; damage to property, infrastructure or the environment; and / or disruption of life and the functioning of the community presents institutions and society with new challenges of adaptation solutions. However, not much leadership has been demonstrated in integrating climate resilience into city planning and flood management. Therefore several barriers exist in delivering on adaptation solutions to flood risks in GAMA in developing indicators that are climate sensitive with the goal of instituting climate smart integrated flood management framework that drives city planning including policies and interventions to reduce annual losses attributed to floods. In an attempt to fill the knowledge and intervention gaps, this project is intended to engage the policy community, civil society and private sector actors on integrating determinants and drivers of social-demographic change into climate resilient flood management.

Additionally, in Ghana's ambitious Intended Nationally Determined Contributions (INDCs) to the UNFCCC, developing and managing climate resilient infrastructure was one of the major focal areas for adaptation and thus underscoring the relevance of this project. Efforts of policy, practice and civil society to address issues arising from climate change are challenged by lack of intersectoral collaboration, technocratic approaches, weakly integrated understandings of population dynamics, insufficient use of evidence in decision making, and imbalances in community, civil and private sector input to decision-making. The lack of gender sensitive indicators, poor land use planning and enforcement of laws, limited collaboration amongst stakeholders and general lack of awareness of planned adaptation still hang over attaining a resilient city goal in GAMA. Additionally, policy, planning, practice, and private interests in cities often reflect traditional development approaches (e.g. regional urban planning) that compounds flood risks because the unit of management is often zonal or regional beyond the reach of local dynamics. The project has five technical objectives that are expected to deliver on social, economic, awareness enhancement, gender dynamics and policy frameworks and outcomes towards providing adaptation solutions to floods in the GAMA. The project will provide the requisite platform to integrate the population – flood risk nexus into (i) national governance, (ii) awareness and education, (iii) flood risk reduction and early warning and (iv) mitigation and preparedness measures of government, to constitute "Climate Smart Integrated Flood Management (CSIFM)" framework for Ghana. Thus the aim of the project is to frame innovative adaptation solutions and means of implementation that seek to remove barriers to the adoption of research-into-use in flood prone areas through multi-criteria decision-making.

2.2 Overall Objective

The overall research objective is to engage policy, civil society and private sector actors on integrating determinants and drivers of social-demographic change into climate resilient flood management, whilst supporting Ghana's iNDCs to the UNFCCC on resilient infrastructure (Dovie 2015, Dovie et al. 2015).

2.3 Specific Objectives

(i) Strengthen framework for aligning and analyzing population-related social, economic and environmental determinants of flood risks and provision of adaptation solutions.

(ii) Appraise capacity of managers to use technologies such as Geographical Information Systems (GIS) and Satellite Imagery alongside digitized maps and economic tools (e.g. cost-benefit analysis) to manage human dimensions of climate change and flood risks.

(iii) Design gender-sensitive multi-criteria decision framework for resource and knowledge mobilization on surveillance systems for effective flood risk reduction.

(iv) Evaluate Research-into-Use (RIU) practice, barriers and opportunities of adaptation solutions at the nexus of population growth, hydro-climatic risks and city planning.

(v) Analyze climate smart indicators to recommend technical feasibility, economic efficiency, social acceptability and environmental viability of adaptation solutions for consideration for Medium Term Development Planning

(vi) Training of PhDs, MAs and Non-degree Short Courses

2.4 Expanded Research Objectives

Objectives/Work Package (WP)	Description	Results / Interventions
Objective 1 (WP1) - Strengthen framework for aligning and analyzing population-related social, economic and environmental determinants of flood risks and provision of adaptation solutions.	This objective seeks to use information from within the study areas to target development policy frameworks such as Ghana's Medium Term Development Plan and the Climate Change Policy on how the goals of such frameworks meet the needs of the population in terms of socioeconomic development (e.g. poverty alleviation, livelihoods) in concert with how the population is able to adapt to flooding. Thus, there is the need for us to understand the barriers and opportunities of these framework towards recommending relevant policy interventions	• Decision support / Policy framework / guide for mainstreaming development planning, climate change adaptation and flood risk management
Objective 2 (WP2) - Appraise capacity of managers to use technologies such as Geographical Information Systems (GIS) and Satellite Imagery alongside digitized maps and economic tools (e.g. cost-benefit analysis) to manage human	The objective will help us to unearth what resources and tools are available to managers within the local government, civil society and the private sectors and whether or not they meet the requirements of helping management to respond to floods and in the process we will go through some of the tools and analyses with them and testing them towards their acquaintance and sustainability	• Demarcation of flood prone areas in GAMA • Development and dissemination of flood maps • Toolkits for capacity building of technocrats for awareness creation

dimensions of climate change and flood risks.		
Objective 3 (WP3) - Design gender-sensitive multi-criteria decision framework for resource and knowledge mobilization on surveillance systems for effective flood risk reduction.	Referring to development policy frameworks as mentioned for objective 1 to understand how they meet gender requirements towards assisting the major stakeholders to introduce indicators that conscious targets vulnerable groups especially women in using climate information and being able to respond to floods through early warning and forecasting.	• Recommended designs for flood management e.g. market stalls and drains (structural) and poster / education materials (non-structural) • Early warning systems and contingency plan for GAMA
Objective 4 (WP4) - Evaluate Research-into-Use (RIU) practice, barriers and opportunities of adaptation solutions at the nexus of population growth, hydroclimatic risks and city planning.	Objective 4 is intended to analyze the adoption of existing and on-going research nationally to understand adaptation solutions that have been applied in the area of flooding and associated dynamics including success stories based on which a harmonizing framework will be proposed for implanting specific adaptation solutions that will be recommended.	• Investment options for upscale and out-scale by industry and the private sector • Recommended tangible options for adaptation solutions for budget mainstreaming and funding by public and private sectors
Objective 5 (WP5) - Analyse climate smart indicators to recommend technical feasibility, economic efficiency, social acceptability and environmental viability of adaptation solutions for consideration for Medium Term Development Planning.	The objective 5 will help us to understand costs and benefits associated with on-going adaptation to floods and proposal of adaptation solutions to emerge from this project. This implies that we will monetize such costs and benefits to inform decision making on options that the population choose when responding to the impacts of flooding.	• Budgets associated with recommended investment and adaptation solutions to respond to flood • Comprehensive impact assessment report on identified adaptation solutions • Flood response / adaptation strategy document (viz: Climate Smart Integrated Flood Management, CSIFM)
WP6 – Training of PhDs, MAs and Non-degree Short Courses	The WP6 is intended to draw on the five objectives in building and sustaining capacity in our formal and informal training to bring with its mentorship whilst ensuring that their project topics are acceptable without any administrative barriers.	• Increased leadership • Maintenance of institutional memory • Sustainability of project goals

3. PROGRESS TOWARDS MILESTONES

3.1 Months 01 – 06 Milestones

Milestone	Outputs / Events / Markers
Project agreements finalized	a. Project proposal revised from the original based on comments from the Program Specialist b. Terms negotiated and contract signed
Project coordinator recruited	a. To work closely with the PI, deputy PI, Researchers, Consultants, Administrative staff, Projects' accountant, etc. b. To organize planned and unplanned Management meetings, Team meetings, Stakeholder meetings, workshops, seminars, conferences, etc. c. To organize planned and unplanned travels for projects team d. To coordinate planned and unplanned consortium and work package level meetings as may be defined by the PI e. To ensure timely delivery of outputs such as reports, minutes, etc. f. To communicate with the consortium coordinator (where applicable) weekly g. To ensure the circulation of relevant project information to Projects Teams and other levels (e.g. consortium level) where applicable h. To review finances and keep track of budgets i. To assist with Project Monitoring and Evaluating j. To gather and provide material for management of the Projects websites and social media k. To be the first point of call for queries regarding the Projects l. To provide support to Work Package leads through timely communication with the Project partners m. To be an excellent ambassador for the Projects, promoting activities and innovations in the interest of the Projects and implement other tasks as may be assigned by the PI.
Partner institutions informed and terms appraised and agreed	a. Meeting was held with all the frontline partners to appraise them of the project objectives and their roles. b. The meeting aimed at drawing synergies from other organizations who are working on projects related to creating resilient cities in Ghana. c. The meeting ultimately provides a platform where the identified partners could have a discussion on what they intend to do on the project.
Informed participating districts and specific project communities / sites	a. District Assemblies and representatives of the various communities were informed in writing and invited to the project launch and inception. b. In all, 7 District Assemblies were chosen and two communities each selected to bring the total communities to 14, as opposed to the initial 6 Districts and 12 communities. The additional District was demand-driven by other Districts to have the additional one due to confounding interrelatedness of issues to the selected ones.
Steering Committee meeting	a. A nine- member Steering committee was identified to represent the public sector, private sector/industry, Academia, civil society, media, National development agency and two ex-officio members. b. The Steering Committee was responsible for the provisioning of support, guidance and oversight of project progress.
Scientific committee meetings	a. Joint scientific meetings were organized to synthesize the roles of the Work packages and realign activities to the project objectives. b. In addition to this there have been adhoc specialized meetings by the respective Work Packages to reappraise their methodologies and data collection approaches based on baseline reviews gathered
Boundary partners / other collaborators identified	Relevant organizations other than partners decided (e.g. NADMO, Ministry of Water Resources and Sanitation)
Official project launch	

Milestone	Outputs / Events / Markers
Project inception workshop	The project launch and inception workshop provided the platform to create national and international awareness about the project. It was well attended by a total of fifty-five (55) participants representing the project partners, Development planning and Town and Country Planning Officials from the seven (7) research districts, district assembly representatives, sponsors, Faculty members, PhD students and the media. Out of this number twenty-eight (28) were men and the remaining twenty-seven (27) were women.
Procurement finalization of logistics and equipment	a. Twelve (12) computers have been purchased for use by each work package, PhD students and the Coordinator's use. b. Additionally, one (1) Canon Advance Image runner and cartridges have been purchased for the project's management office.
Overall update on progress	Progress markers / indicators identified and agreed
Baseline report / output on the state of flood risks and adaptation in GAMA	a. The framework for collecting field data was developed with a target sample from two (2) communities each within the seven research districts. b. Research instruments drafted for surveys and focus group discussions components established for adult male and female populations separately
Policy interventions and adaptation solutions synergy established	Protocols for understanding total economic impact of policies and adaptation interventions established
GIS and Remote Sensing analysis of flood hazards Flood risk assessment fieldwork	a. The IPCC concept of flood hazard, with the components of risk which are exposure, hazard and vulnerability have been adopted to manage the human dimensions of climate change and flood risks. Digitized maps of the study districts and communities have been developed using Global Positioning Systems (GPS). Appropriate digital instruments have been identified to be purchased for the project. b. Reconnaissance visits have also been made to these communities to confirm and validate their selection c. A geo-spatial approach is adopted for the flood risk assessment using, largely, ArcGIS. Other suitable software would be deployed, where necessary. A map of selected districts and communities for the project implementation has been composed
District information / data management	Awareness of data needs and sources discussed with relevant focal points
Research into Use [RIU] Practice	Determinants of the barriers to / and opportunities of adaptation solutions identified
Selection of policy fellows	a. Focus disciplinary areas identified and linked to selected relevant departments of the District Assemblies b. Concept of the fellowship also underwent a revision
Master's degree scholarships / admissions	First Master's student to pursue studies in Environmental Science recruited
Three junior scientists / researchers recruited	Three (3) PhD Students pursuing studies in Population Studies, and Development Economics.
First policy dialogue / roundtable	Framework for public-private-partnership for flood management established with the Private Enterprise Foundation
Household interviews communities	Instrument for establishing baseline data on household level adaptation solutions going through ethical considerations and approvals
Finalization of baseline indicators for monitoring and evaluation	a. A participatory impact monitoring tool has been developed to monitor progress made within the project in alignment with the objectives. b. The baseline indicators will be finalized for the entire project by the next reporting period to further inform the monitoring process.
Finalization of framework for project information and results dissemination	Change / transformation agents identified and included in the designing of a communication strategy for the outcome and finding mechanisms of converting scientific knowledge into practical usable materials for the communities.

3.2 Months 07 – 12 Milestones

Milestone	Outputs / Events / Markers
Steering Committee meetings	Steering Committee meetings held, discussed the progress of the project and opportunity to address emerging boundary issues.
Scientists / combined work package meetings	Scientists and Work Package members met to discuss progress of the project in general and specifically plan towards a write shop retreat scheduled for May. Scientists shared updates on the activities planned and undertaken during the period under review. Each WP shared their plans for publication(s), indicating the proposed topic, data to be considered as well as other team members whose support will be needed for the development of the paper and the intended contribution of the paper. The highlights of the discussions included: a. the scheduled cross-sectional paper on the methods/frameworks used by the different WPs (Integrated framework) to focus on synthesizing methodologies adopted by all the WPs in their work implementation. b. The confirmation from the lead WP for the surveys, that analysis on flood risks and flood management could be done either using the perspectives of individuals, households, communities and/or the district provided focus for scientists in determining their publication focus. c. Additionally, the preliminary findings from the institutional analysis was being developed into a paper d. The development of a gender sensitive decision support framework for flood risks (to individuals) and levels of sensitivities e. Scientists shall utilize the write shop retreat to conduct peer reviews of papers developed to enable effective revisions from authors during the write shop
Draft impact analysis report	Indicators established for consensus with scientists towards data collection
GIS and Remote Sensing analysis of flood hazards continues	Flood prone / hazards maps generated as inputs into physical vulnerability mapping
Flood risk assessment fieldwork continues	
Flood response (e.g. solid waste & drainage network management)	a. Desk analysis completed b. Drainage master plan for GAMA reviewed and comments submitted to government
Investments framework for waste, recycle and drain infrastructure management	Concept drafted and using the AMA as the case-specific study because of all the seven districts, only the AMA had initiated a Resilience Action Plan
Established capacities and barriers to policies and measures related to Ghana's iNDC	Indicators for policy framework to mainstream climate resilient infrastructure established and follow-up discussions with NADMO and the NDPC carried out
Policy brief on the project science	Content drafted and passed on the project objectives and expected results of the project science
District information / data management	District Assembly level consultations through Townhall meetings and desk analysis carried out
Project representation at conferences	Participation in the Resilient Cities Forum in Bonn, Germany in organizing a Reality Check Workshop with contributions from: a. Regional Institute for Population Studies, University of Ghana, Legon, Ghana b. National Disaster Management Organisation, Accra, Ghana c. Cities Alliance, Future Cities Africa Project, Ghana d. Department of Climate Change & Food Security, University for Development Studies, Tamale, Ghana
Principal investigator international meeting	a. Presented on the topic "Impacts of climate change on the determinants of population health and implications for health resilience building" as platform to speak about project

Milestone	Outputs / Events / Markers
	b. This was followed by a Project Poster on the basic indicators / determinants
Policy fellows continue	Intervention proposal by fellows invited for analysis and selection
MA/MSc candidates finalize study	a. Two Master's degree candidates added and bring the number to 3. b. First recruit presented a draft thesis report
Three junior scientists / researchers continued (PhDs)	Coursework completed by two and the third also finalized fieldwork protocol / instruments
Short course module finalized	a. A two-day's Scientific writing short course was organized for active researchers and those under training working for universities and research institutions in Ghana with goals to publish in international and high Impact Factor Journals. b. The short course was organized on the back of the Regional Institute for Population Studies' flagship conference on Climate Change and Population (CCPOP). Applications were received from a total of sixty (60) applicants from public and private Universities with Post-Graduate and/or Doctoral qualifications. c. Twenty-five (25) applicants were selected to participate in the training which was conducted by Faculty members from the Institute as well as some external resource persons.
Policy dialogue / roundtable	Government and private sector engagement: State of integrated risk management, loss and damage functions in Ghana a. Risk management involves the private and public sectors. The need to encourage and support the private sector in enhancing its awareness and understanding of risks posed by natural hazards, especially floods, storms and agricultural drought attributed to global environmental change, global warming and climate change, in Ghana was long overdue. b. The private sector and subsequently industry should also consider adopting appropriate structural and non-structural risk management tools through forging partnerships domestically and internationally to support Ghana's commitment to climate change adaptation.
Focus groups	Focus Group Instruments completed and waiting on Initial results of the household interviews / surveys to be analyzed and key community level issues incorporated
Household interviews	Instruments completed (enumerators identified and trained, household listing completed, pre-testing / pilot analyzed and actual fieldwork started)
Monitoring and evaluation	Progress markers and indicators measured and continued
Project information and results documentation continues	Recognized and indicators incorporated to draft communication strategy
Virtual knowledge platform	Online information sharing database / clearing house established as part of the RIPS official website

3.3 Months 13 – 18 Milestones

Milestone	Outputs / Events / Markers
Steering Committee meeting	a. Steering Committee meetings held to discuss the progress of the project over the reporting period. b. Two new members representing the Land Use and Spatial Planning Authority (LUSPA) under MESTI and Private Sector Enterprise joined the committee.
Scientific committee meetings	Scientists met on the updates of WP activities and to collectively review the first batch of applications submitted by prospective fellows from the district assemblies. Prior to the first round of assessment by scientists, a total of eight (8) applications were received mainly from the Planning and NADMO officials from the project district assembly offices. Applicants were assessed based on the following criteria: a. Proposal focused on actions to be undertaken that will reduce susceptibility to floods by not using physical structures b. Ability to demonstrate achievable goals using little or no financial resources likely to be borne by project or applicant c. Fellowship activity potentially implemented jointly by applicant and other officials in the district.
Monitoring and evaluation continue	Progress markers and indicators assessed
Reports finalized on physical / spatial problem analysis	A total 1,290 households, drawn from 30 households in each of the 43 EAs across the seven (7) study districts were interviewed.
Research into Use [RIU] Practice	Barriers to / and opportunities of adaptation solutions identified
Investments framework for waste, recycle and drain infrastructure management (climate finance model)	Framework established for trapping of solid wastes, collection, cleaning, bagging and transfers a. Several types of stakeholders are usually involved in solid waste management. These include policy-makers at the regional and local levels who set and enforce standards; waste management agencies who participate in monitoring and complying with standards; individual community members who manage waste on a day-to-day basis; other downstream groups affected by the waste (e.g. businesses) and environmental interests. b. This activity will involve fixing nets at different points across the Odaw and Onyeasi streams using line nets that cut across the canal width and anchored to the base of the drains to the height exceeding the depth of the canals e.g. 5m in height at Odawna to ensure that insignificant waste can escape. The waste that gets trapped will solely depend on the flow of water and collected at different times of the day based on the quantum collected. This is to ensure that waste does not accumulate to become impediment to flow. Rafters will be provided to enable swimmers who will be part of the enterprise to perform the collection along the net and using sweeping devices to move sunken wastes. c. Once the wastes are offshore, separation will be done based on the types of waste (e.g. plastics, glasses, metal scrap, papers, wood debris), cleaning where necessary will be carried before bagging which will including weighing is carried out in readiness for transfer to the buying centers. Leftovers will be disposed will now be disposed of in the most appropriate manner
Finalized models on climate change scenarios with and without adaptation solutions	a. Both public and private precautionary measures undertaken in the past complement rather than impede private protective responses while public information on flooding does not appear to influence private protective response. b. We recommend policy choices to focus on the provision of the needed community level flood protection infrastructure since it stimulates private flood precautionary measures while paying less.
Evaluation of updated results against Ghana's iNDC on climate resilient infrastructure	Flood action plans and policy mainstreaming indicators established

Milestone	Outputs / Events / Markers
Focus groups in all districts	Baseline data on community level adaptation solutions on-going
District information management on validation and policy mainstreaming	Started with building capacity of fellows to facilitate the engagement process on validating the survey data and the focus group outputs
Flood maps ready for awareness creation	Framework for flood risk management concluded
Flood early warning decision making system	Climate smart integrated flood management defined and shared with the district assemblies
Virtual knowledge platform continues	Active online information sharing continued
Three junior scientists / researchers continue (PhDs)	a. One MPhil student has graduated b. Data entry, validation and exploration in progress for PhDs
Policy fellows continue	Capacity building continued

3.4 Months 19 – 24 Milestones

Milestone	Outputs / Events / Markers
Scientific committee meetings	Scientists met to discuss progress of the project in general and specifically plan towards a write shop retreat scheduled for May. Scientists shared updates on the activities planned and undertaken during the period under review. Each WP shared their plans for publication(s), indicating the proposed topic, data to be considered as well as other team members whose support will be needed for the development of the paper and the intended contribution of the paper. The highlights of the discussions included: a. the scheduled cross-sectional paper on the methods/frameworks used by the different WPs (Integrated framework) to focus on synthesizing methodologies adopted by all the WPs in their work implementation. b. The confirmation from the lead WP for the surveys, that analysis on flood risks and flood management could be done either using the perspectives of individuals, households, communities and/or the district provided focus for scientists in determining their publication focus. c. Additionally, the preliminary findings from the institutional analysis was being developed into a paper d. The development of a gender sensitive decision support framework for flood risks (to individuals) and levels of sensitivities e. Scientists shall utilize the write shop retreat to conduct peer reviews of papers developed to enable effective revisions from authors during the write shop
Steering Committee meetings	Meetings / communications continued in different forms including a field trip. a. Steering Committee members visited Ogbojo, a community in the Adentan Municipal Assembly to experience first-hand incidence of flood risks exposure experienced by the community. b. It was observed that poorly constructed drains and unlawful construction of residential structures are contributing factors to the flood situation in the district. c. Members agreed to take up some of the issues and petition the Department of Urban and Feeder Roads of the Ministry of Roads and Highways to address some of these structural issues with road contractors and property owners.
Monitoring and evaluation continue	Progress markers and indicators assessed
Finalized models of adaptation solutions	a. Strategic investment framework on-going b. Gender mainstreaming determinants analyzed
District Strategic Environmental Assessment (SEA) of floods	Climate viability, sustainability and compatibility of interventions assessed using the Choice experiment
District Social Impact Assessment (SIA)	Social acceptance and barriers to adoption identified
District information management on validation and policy mainstreaming	Government and stakeholders engaged on validating data for policy implications
GIS-based flood awareness creation	On-going
Policy brief on adaptation solutions	4-pager A4 sized document produced
Project representation at conferences	a. During the 6th CCPOP, project scientists convened a panel to share research experiences and preliminary findings from the project with participants at the conference. b. Also, in attendance were the district assembly policy fellows.
Principal investigator international meeting	There was no participation due to unavailability of opportunities
Virtual knowledge platform continues	Active online information sharing continued

Junior scientists / researchers continue (PhDs)	One PhD candidate has submitted his thesis for examination
Visiting policy fellows continue	Enhanced policy influence with mentoring continued

3.5 Months 25 – 30 Milestones

Milestone	Outputs / Events / Markers
Scientific committee meetings	Scientists met to take stock of project scientists' work to assume responsibilities of action plans in previous meeting: a. Finalization of draft scientific manuscripts and submission to international journals b. Participation in international conferences. Specifically, the gender work package to be nominated to possibly participate in the Women Deliver conference in Vancouver, Canada if selected and the scientific team to be represented at the Resilient Cities conferences in Bonn, Germany if proposed panel is approved.
Steering Committee meeting	Steering Committee meeting of the project was hosted by its Chairman, also the Vice Chancellor of the Regional Maritime University (RMU), Ghana a. Present was the IDRC Programme Specialist, Ms Edith Adera. b. Major discussions during the meeting included the adoption of a proactive communication strategy to respond to climate change impacts and utilize this in communicating the project findings in effective ways. c. Key among the list of implementation strategies was the convening of a pilot Photo Exhibition within the project communities, highlighting stories of flooding and effects of human actions and inactions on flooding in Ghana. This would be done in collaboration with the project's partners of which the Ga Mashie Development Authority (GAMADA) will lead. d. An intention of a no-cost extension of the project was expressed. This was against the backdrop that the project could not be completed within the agreed time frame because of delays in the release of the project funds for the 4th period activities.
Monitoring and evaluation continue	Progress markers and indicators assessed
District information management on action plans, project impacts, and dissemination	Implementation, climate finance and communication frameworks introduced to Policy Fellows of the various District Assemblies
National level interventions matrix (hard and soft), e.g. policy change, infrastructure design, investments	a. Climate smart integrated flood management framework established as the baseline b. Intervention matrix developed for solid waste management to respond to flooding
Institutional / national readiness for interventions	Institutional mainstreaming of adaptation solutions analyzed
Finalization of preparations for 1no. non-technical one-time policy / intervention dissemination meeting / event	Preparations progressed well in collaboration with the RIPS Climate Change Resource Centre – Ghana and the City of Accra (AMA)
Junior scientists / researchers continue (PhDs)	Confirmed results studies and initial field report from two PhDs received

3.6 Months 31 – 36 Milestones

Milestone	Outputs / Events / Markers
Scientific committee meetings to evaluate work packages	Work Package reports appraised
Steering Committee meeting	Meeting held and sustainability of project outcomes discussed
Monitoring and evaluation continue	Progress markers and indicators assessed
District information management on action plans, project impacts, and dissemination	Two district level dissemination meetings were held with the Adentan Municipal Assembly (AdMA) and Accra Metropolitan Assembly (AMA) to share preliminary findings from the household survey and focus group discussions (FGDs) conducted. a. District specific data was shared with key officials from the districts representing departments or units for development planning, statistics, health, waste management, works and housing, National Disaster Management Organisation (NADMO), as well as Coordinating Directors and Municipal/Metropolitan Chief Executives (MCEs). Also, in attendance in AMA were district Human Resource officers and Resilience and Sustainability Officers. b. Representatives from the communities where the research was conducted were also present.
Scientific publications	• Papers at various stages of publishing discussed
Project representation at conferences	This was done. Internationally, part of the findings of the project was shared at the 2019 Population Association of America meeting (PAA) in Austin, Texas, USA. The paper led by the WP 1 team and titled "Drivers of Social Vulnerability to Flooding in an Urban Context: A Case Study of the Greater Accra Metropolitan Area" was presented in the session on Empirical Assessments of Linked Human-Ecological Adaptive Responses to Climate Change. Full abstract at http://paa2019.populationassociation.org/uploads/193944
Principal investigator international meeting	Participated in PAA 2019 in Austin, Texas, USA as Co-author of the Project Paper "Drivers of Social Vulnerability to Flooding in an Urban Context: A Case Study of the Greater Accra Metropolitan Area"
Policy brief on project's policy influence / reflection published	4-pager A4 sized document drafted
Non-technical one time policy / intervention dissemination meeting / event	a. CCPOP-Ghana 2019 dedicated to the Cities and Climate Change Project confirmed for 12-14 November 2019 b. Joint hosting with the Accra Metropolitan Assembly confirmed c. Post conference side event with C40 Cities' Climate Leadership also confirmed to include scaling out the project findings and use as capacity building for 29 District Assemblies in GAMA from 10-11 December
Project outcomes handbook	• CSIFM concept and contingency planning toolkit in progress
Junior scientists / researchers continue	• Scheduled to complete July 2020 • Two Masters (overflow from support for the originally two already graduated)

3.7 Months 37 – 42 Milestones

Milestone	Outputs / Events / Markers
Scientific committee meetings to evaluate work packages	a. Scientists met to finalize their first set of draft scientific results subject to peer to peer review b. Scientists also seized the opportunity to mentor graduate students yet to submit their dissertations and theses by reviewing and commenting on their write-pups
Steering Committee meeting	There was no steering committee meeting during the period due to the unavailability of the Co-Chairs
Monitoring and evaluation continue	Progress markers and indicators assessed
District information management on action plans, project impacts, and dissemination	Five districts levels dissemination meetings were held in the form of Townhall meetings to discuss the findings of the surveys and focus groups as part of feedback process to the Assemblies involved and building consensuses around providing adaptation solutions. These were LadMA, AshMA, TMA, KKMA, and LEKMA
Scientific publications	a. Eight papers in the draft stage and heading for finalization and submission to Journals b. At least three of the said papers have been finalized and submitted to various Journals
Project representation at conferences	a. The project team organized a Pre-Formed Panel at the 16th International Conference on Urban Health People Oriented Urbanization: Transforming Cities for Health and Well-Being: 4 - 8 November 2019 | Xiamen, China (http://www.isuhconference.org/) b. The Panel entitled "Interoperability of human well-being, climate change, and flood risk towards Accra's resilience in Ghana" under the theme numbered 2 of the conference "Climate Change and Healthy Cities" http://www.isuhconference.org/conference-topics.asp
Principal investigator international meeting	Participated in Resilient Cities Forum 2019 in Bonn Germany on an IDRC Global Sessions and spoke on the topic "Managing Flood Risks, Scale and Policy Incoherence in Accra, Ghana" and also on a CDKN Panel on the topic "Climatic hazards and livelihood assets by trade within the coastal urban landscape of Greater Accra Metropolitan Area, GHANA"
Roadmap for implementing the project's communication strategy	a. Capacities of district assembly fellows and journalists earmarked for the long-term management of the communication strategy b. Key indicators / determinants and guidelines identified as entry points for the implementation and monitoring through institutional mainstreaming of key partners
1no. non-technical one-time policy / intervention dissemination meeting / event	a. CCPOP-Ghana 2019 dedicated to the Cities and Climate Change Project was organized from 12-14 November 2019 and co-hosted with the Accra Metropolitan Assembly with over 200 Participants on the Opening Day half of which stayed for the Scientific Sections and Days 2 and 3. Amongst the dignitaries on the opening day were: b. Post conference side event with C40 Cities' Climate Leadership was also organized for District Assemblies in GAMA from 10-11 December 2019
Junior scientists / researchers continue	a. Scheduled to complete July 2020 b. Two Masters (overflow from support for the originally two already graduated)
Capacity building of District Assembly Departments on Project upscale	Capacity built for District Assembly Fellows of the 7 project districts on doing Climate Action Plan using data / information from the cities and climate change project. In all 26 of the 29 District Assemblies in GAMA were represented and up to 55 participants from departments of physical and development planning.

4. SYNTHESIS OF RESEARCH RESULTS AND DEVELOPMENT OUTCOMES

4.1 Value of Adaptation within GAMA

On the willingness of respondents to contribute either labor, cash or both to implement the flood adaptation project 89.1% did, with over 80% of them certain that they will make the contributions. Of these, 70.4% were willing to contribute at least 8 hours of work per month to implement projects, whilst 68.7% of respondents were over 80% certain that they will contribute at least 8 hours per month. Monetizing this was estimated at Gh₵38.0 per capita per day, which is in excess of the daily minimum wage of Gh₵9.7 per capita per day as at 2018. About 8.2% of the respondents indicated their willingness to contribute between 8 labor hours once per week and once per year inclusive towards implementing a project. This amounts to cash equivalent of between Gh₵38.01 and Gh₵1,976.52 per household per year. Respondents of up to 14.5% of indicated their Willingness to Pay (WTP) cash of more than GH₵100 per year to implement an intervention project, with 7.0% of the households showing WTP GH₵40 or more but less than GH₵100 per year compared to 10.4% which indicated a WTP less than GH₵40 per year towards a project. Overall, about 10.9% of the respondent households indicated they were not willing to contribute either cash or labor for the implementation of the project, because not all households experienced flooding, managing floods is the responsibility of the government through developing the communities, prevalent poverty and lack of physique to provide labor. Generally, households in GAMA would accept both the structured and non-structured flood adaptation options. The household survey showed that a major cause of flooding in the Greater Accra Metropolitan Area (GAMA) is building in / along water ways (42% of respondents); poor construction of drains (20.2%) and choked gutters (15.6%). Effects of heavy storms was not identified as a major cause of flooding (3.4% of respondents).

4.2 Strategic Interventions of Flood Risk Reduction in GAMA

Prior to the above research findings, institutional assessments were conducted on some key institutions responsible for flood risk management in Ghana namely: Land use and Spatial Planning Authority (LUSPA), Ministry of Local Government & Rural Development, Ministry of Environment, Science, Technology and Innovation (MESTI), Environmental Protection Agency (EPA), Ministry of Works and Housing, National Disaster Management Organization (NADMO), Ministry of Lands and Forestry, National Development Planning Commission (NDPC). The assessment gathered data and

information through in-depth interviews and discussion with relevant institutions and agencies to identify specific flood management-related roles/responsibilities, management structures and processes that exist in these institutions. The following findings were made from these assessments:

a. General deficits in knowledge, skills and logistics for flood risk management exist
b. Low institutional appreciation of integrated flood risk management where all elements are fully considered in flood management.
c. Non-existence of operational integrated planning at MMDAs
d. No standard procedure for integrated flood risk assessment exists.
e. Actual risk maps based on hazard and vulnerabilities are not available; where maps exist, they are hazards of flood inundations at scales and resolutions not suitable for operational decisions for low lying and subtle variability in elevation of landscape of GAMA.
f. Low publicity of policies that relate to flood risks

Overall, emerging flood adaptation solutions can be grouped into four major strategic areas as below with diverse options which will have differing details for each community and District.

Strategy	*Options*
Reducing Flooding	Dams and reservoirs Dikes, levees, and flood embankments High flow diversions Catchment management Channel improvements
Reducing Susceptibility to Damage	Flood plain regulation Development and redevelopment policies Design and location of facilities Housing and building codes Flood-proofing
Mitigating the Impacts of Flooding	Flood forecasting and warning Information and education Disaster preparedness Post flood recovery Flood insurance
Preserving the Natural Resources of Flood Plains	Flood plain zoning and regulation

4.3 Spatio-Temporal Assessment of Flood Exposure Pathways

There is increased exposure of people and critical livelihood assets to flooding globally, and this is projected to rise in the coming decades. Studies on exposure to flooding have however focused on quantifying the proportion of people and livelihood assets, differential exposure across regions, and socio-economic disparities in the exposed population. This leaves knowledge gaps in the exposure pathways of flooding. This study assesses the degree of anthropogenic influence on the natural socio-

ecological landscape and discusses the implications on exposure of urban population to flooding in two districts-AMA and AdMA in Accra for the defined periods 1970 and 2017. The novelty of this study is the use transdisciplinary techniques across the social and biophysical sciences that encompassed participatory learning approaches and Remote Sensing/GIS. Biophysical observations were discussed with segments of the populations disaggregated by age and sex. The results indicate rapid conversion of natural landscape such as forests, wetlands and water bodies into settlements and other concretized surfaces. Expressly, more than a quarter of vegetation cover and about a tenth of water bodies in AdMA were converted to settlements and open spaces between 1991 and 2017. Up to about 56.5% and 78.9% respective proportions of natural land cover in AMA and AdMA is projected to be lost by 2060 with increased flood hazard given the current land use practices. Evidence from the participatory methods indicates that flood hazard is exacerbated by poor waste management, lack of/ poor flood management infrastructure, and poor spatial planning.

4.4 The Choice of Adaptation Strategies to Flood Risk Management

This section investigates the psychological and socio-economic factors as well as the constraints that inhibit private precautionary flood-risk mitigation measures among urban households in Greater Accra Metropolitan Area of Ghana using the Protection Motivation Theory and data from the Integrated Climate-smart Flood Risk Management Survey undertaken by the Regional Institute of Population Studies of the University of Ghana. We find that both psychological and socio-economic factors influence households flood protective response in the Greater Accra Metropolitan Area of Ghana and that the Protection Motivation Theory is relevant in explaining private protective and non-protective responses to floods in flood-prone areas in the Greater Accra Metropolitan Area of Ghana. Also, both public and private precautionary measures undertaken in the past complement rather than impede private protective responses while public information on flooding does not appear to influence private protective response. We recommend policy choices to focus on the provision of the needed community level flood protection infrastructure since it stimulates private flood precautionary measures while paying less.

4.5 Determinants of Relocation Against Flood Risk in Urban Households

In this study, we investigate the factors influencing households' willingness to relocate from flood-prone areas in the Greater Accra Metropolitan Area using the probit model and data from a household survey. The results indicate that households are less likely to relocate as they grow, but the likelihood increases at later ages possibly as a result of increased vulnerability to flooding risk as one grows while households that receive flood information are more likely to relocate compared to those who do not. The probability of relocating decreases with increased public adaptive measures suggesting that public adaptive measure has the propensity to reduce relocation in the metropolis. We observe that households that perceive the level of flood risk to have increased in the past five years are more likely to relocate compared to those who perceive it to have remained the same. The extent of losses in previous floods matters as households that lost income and assets from previous flood are more likely to relocate compared to those that did not lose income and assets.

Further, households that have stayed in their communities for less than five years or between five and ten years, are more likely to relocate compared to those that have stayed there for more than ten years while those that have secondary/technical education have a higher probability of relocating compared to those without formal education. Expectedly, tenants have a higher probability of relocating compared to homeowners. We recommend the implementation of smart engineering solution such as building tanks, drainage channels and the protection and recovering of swamps and wetlands that serve as natural tanks while designing relocation programmes to focus on large households, non-indigenes, tenants, households' headed by female as well as those that have suffered losses in income and assets.

4.6 State of Waste Management, Sanitation And Flooding

The increasing trend in urbanization of Ghana's population alongside the pace of development has led to increased strain on limited social, commercial and physical infrastructure resulting in congestion, overcrowding, urban sprawl and the growth of slums. At a projected average urban growth rate of about 3% between 2000 and 2030, Ghana's urban population is expected to increase by 25% from about 52% of the total population in 2010 to around 65% by 2030. Cities will become the major destination with Accra already showing signs of its inability to cope with the pressure as total economic cost of resource degradation and poor environmental management including poor sanitation has been estimated at, at least 10% of GDP. Water, sanitation and waste management are being heavily impacted and expected to be worsened by climate change. This is because climate

change has increased frequency and intensity of rainfall meaning that there will be more water on the ground and drains in shorter time periods than before. Poor disposal of solid waste will further drive the severity of the floods from choked drainage networks in the city yet there are both formal and informal sector players with jurisdiction to keep the city and drains clean and void of foreign materials. About 20 – 30% of domestic, commercial and industry solid waste generated by the citizens daily is not collected and finds its way into open spaces and drains. Funds from central government is scanty and yet there are equally important sectors such as waste management hence not all issue of water, sanitation and waste management service delivery can be resolved. It would require some conscious and timely interventions to sustainably manage waste in Accra. The analysis suggests that there is need for deeper partnership between the private sector, AMA and the citizenry calling for co-evolution of new forms of managing waste to ensure that appropriate technologies on managing sanitation and waste are introduced. Accra's location between the ocean and the catchments of the Akwapim mountain ranges means that new forms of sanitation and waste management can no longer be avoided due to the dual influences of ocean and storm waters which often bring with it huge amounts of debris into some water channels and communities to cause flooding. The analysis suggests that there is a general lack of institutional capacity to manage solid waste and floods and that most of the challenges were severe. The need to now view waste management as a cross-sector activity was long overdue and there is the need to plan across sectors. Also, based on the household survey, community level strategies such as education on waste separation will be necessary. There is a demand for extra bins to facilitate separation of waste and to reduce waste being stored in plastic bags which makes indiscriminate disposal easy. More than half of the household's waste disposal is carried out by women and as such there should be gendered-based interventions for managing waste at community level. Majority (over 90%) of household are willing to patronize private sector collection should services improve; thus, efforts must be made by both the Assemblies and Waste Companies to address citizens challenges in house-to-hose waste collection. Water and sanitation, and waste management impose major pressures on public health and productivity which is also gendered such that women and poor people tended to suffer disproportionately when there is ailment or injury. In aspects of financing, there are suggestions that the current unit pricing of waste collection is not sustainable and that more innovative approach such as financing through housing rental schemes. Therefore, sanitation and waste management are no longer the sole preserve of city authorities but also the citizenry and financial sectors which must be part of the planning process and very well informed about the types of relevant instruments that meet the needs of all stakeholders.

There is great potential for enhanced recycling, recovery, and re-use of waste to such an extent that some waste could be converted to energy, particularly to be undertaken by communities themselves. It has become obvious that it is mostly those who earn some regular income are able to subscribe to waste collection and management services hence there is need for pro-poor sanitation schemes which could economically empower those who patronize waste collection.

4.7 Probability of Flooding in Greater Accra Metropolitan Area: Implications for Flood Risk Adaptation

Increasingly, incidence of flood disasters is evident globally, notably in cities. This has the likelihood to compromise the cities' sustainability and resilience of dwellers, except appropriate adaptation actions are taken. Risk-based adaptation derived from the probability of the risks are most effective. Studies on the probability of flooding are mostly from engineering and hydrological perspectives that ignores the anthropogenic and behavioral drivers of flooding. Using the Greater Accra Metropolitan Area (GAMA) as case study, the paper examines the influences of climatic, bio-physical, anthropogenic and behavioral factors that drive the probability of flooding. Data from 1,102 households covering 42 Enumeration Areas in 14 localities from 7 Districts in the Greater Accra Region was analyzed. These data, together with rainfall data from Ghana Meteorological Agency and Digital Elevation Model were analyzed using a multinomial logistic regression model. In a stepwise analysis, we found that an increase in rainfall variation, land cover change, waste and sanitation and number of household members employed variables respectively, increases the probability of seasonal flooding, once flooding between one and two years and one flood in seven years relative to no flooding in seven years, holding all other variables constant. In contrast, an increase in the elevation of household location, and the number of household members with secondary education respectively, decreases the probability of seasonal flooding, once flooding between one and two years and one flood in seven years relative to no flooding in seven years. Institutions and flood management variables impact on the probability of flooding were mixed. We found that an inclusion of a waste disposal fee makes the impact of rainfall variation on the probability of flooding insignificant. Further, how marginal changes and relative risks ratios of these variables influence flood outcomes in GAMA were demonstrated. We recommend a blend of improvement in functional institutions on land use and flood management, optimal waste disposal fees and improved waste collection system.

4.8 Public Organizational Capacity and Integrated Flood Risk Management

Prior to 1996, there were forms of organizational arrangements in charge of all manner of disasters in Ghana. Since September 1996, in fulfilling of its obligations to international conventions, and particularly the United Nation's Declaration of 1990-1999 as the International Decade for Natural Disaster Reduction (UN/IDNDR), significant initiatives to formalize establishment of organizational structures and processes to manage disasters. The over-arching global goal for the 1990s: increase awareness, foster disaster prevention and reduce the risk of natural disasters through the widespread application of science and technology, was nationally adopted. In this study, organizations identified with direct or indirect roles related flood disaster management were multi-sectoral. The multi-organizational structure composed, dominantly, of public organizations that existed earlier, with statutory core mandates. Thus, their raison d'etre was not the day to day management of flood disasters: it was a rather marginal one.

4.9 The Climate-Smart Integrated Flood Management Framework (CSIFM)

The highly urbanized Ghana's coastal zones experience cross-border effects of global change origins, hosting to over 25 percent of Ghana's population. The Greater Accra Metropolitan Area (GAMA) of Ghana, located within a limiting coastal landscape and characterized by increasing citizenry demand for services has contributed to increased exposure to annual floods. Yet GAMA faces data paucity to respond to climatic risks, attributed mainly to (i) gaps between science and practice, and (ii) weak partnerships with city managers. Floods have strongly emerged as complex outcome of climatic risks because of the underlying multiple stresses and exposures. Although flood risks assessments using qualitative, quantitative and spatial techniques exist, loss and damage of floods continue to increase. Hence, this article aims to establish how harmonizing methodological differences for assessing flood risks within urban landscapes yield desirable outcomes for flood risk management. Systematic review of SCOPUS articles reveals (i) clear differences in approaches to flood risk assessment as a result of disciplinary divide, effort and interest and (ii) obscured link between theory and practice of flood risk reduction. Outputs of Participatory Learning Approaches (PLA), Key Informant Interviews, Household Surveys, Gender Profiling and Townhall Meetings and Tools such as Community-based Risk Screening Tool – Adaptation and Livelihoods (CRiSTAL), overlaid on Spatial and Visual techniques offered synergies for adaptation solutions towards resilience building. There is need to integrate the effects of small area estimation in detecting socio-demographic and biophysical change against flood risks and to capture heterogeneity in resilience elements across scale to minimize risks of floods. Although

the different methods did not always share common assessment denominators, they produced efficient and far-reaching interlocking outcomes, known as “Climate Smart Integrated Flood Management Framework (CSIFM)”. The CSIFM which is multifaceted and beyond business-as-usual represents strong incentive for understanding complex political economy of flood risks.

5. PROJECT METHODOLOGY

5.1 Conceptual Framework and Overview of Approach

The project emerged from and was built on the outcomes of previous studies undertaken at the Regional Institute for Population Studies (RIPS) at the University of Ghana that established that flooding was posing serious threats to different population groups, businesses and industry, settlements and infrastructure as well as the overall coastline and shorelines of Accra. Thus the previous studies have shown that flood risks come in three fold, namely heavy storms, surface runoff, and sea level rise with varied impacts on the communities in the city of Accra irrespective of social and demographic attributes of inhabitants which have been acknowledged by the Accra Metropolitan Assembly as needing further research intervention, hence demand-driven. Of the several specific impacts ranging from inundations of settlements, displacement and destruction of property, impacts on infrastructure are said to be the highest in recent times. Such impacts on infrastructure range from the collapse of buildings, bridges, drainage networks, industry, market stalls to the houses of mostly the vulnerable with severe ripple effects on economic returns in the city of Accra.

The Greater Accra Metropolitan Area (GAMA) has suffered such consequences in recent past as a result of many factors including poor planning and enforcement of laws in the city. These have been compounded by the impacts of climate change manifested through late onset of rains which are also intense and stormy yet occurring within shorter time periods and thus are able to disrupt life and businesses. Lack of climate sensitive planning modalities and failure to subject infrastructure designs to gender and climate change metrics are leading to social, economic, financial and environmental losses in the city, yet the extent of the monetary values of these losses are either unknown or underestimated due to the lack of both human and logistical supports to carry out such assessments and evaluations. The flood situation has been aggravated by the lack of collaboration and partnerships amongst various stakeholders from the public and private sectors in addition to poor policy processes.

Thus interventions to resolve flooding of the city of Accra have suffered several setbacks due partially to lack of scientific evidence and failure to engage research-into-use through relevant stakeholder participation. This has created several gaps in knowledge on how to sustainable manage floods and yet using indicators and tools that are climate sensitive through a climate smart integrated flood

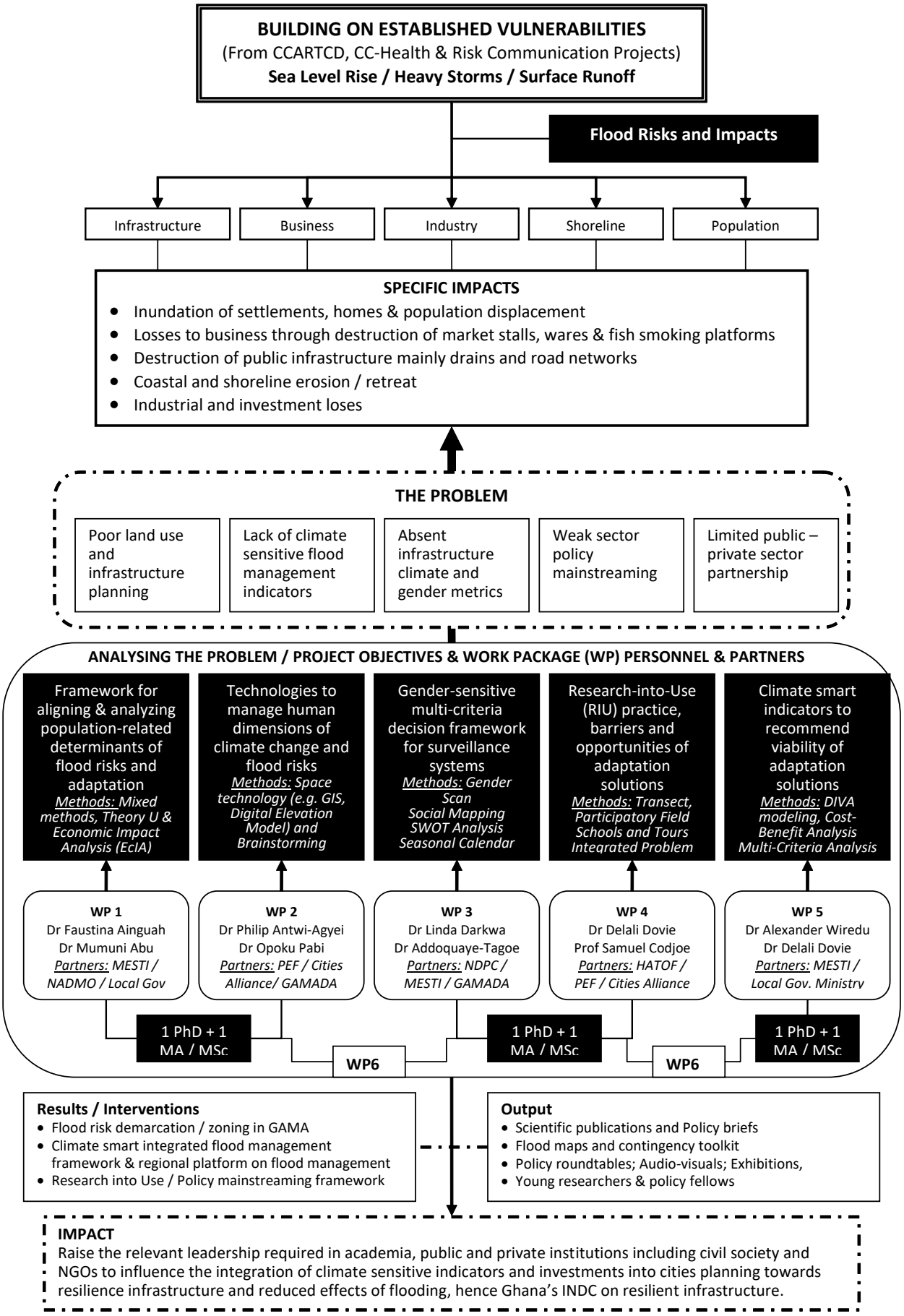
management framework which this intervention research will seek to achieve. The project will be undertaken in 6 districts within the GAMA and spread across the breadth and length of the region to represent all the issues and the adaptation solutions that have been identified. The demand-driven orientation of the project led to the segmentation of the project into soft and policy intervention measures and drawing on five objectives within six Work Packages (WPs).

There are five objectives which cut across technical issues and identified by five work packages and a sixth overseeing training and capacity building goals and dependent on the first five WPs. The WP1 seeks to use socio-demographic data from within the study areas to with expected interventions that mainstream flood response into development policy frameworks such as Ghana's Medium Term Development Plan and the National Climate Change Policy using relevant mixed methods of both quantitative and qualitative origins such as surveys, policy dialogues and the Theory U Process. The WP1 is expected to result in decision support framework that engages flood risk challenges in development planning, including barriers and opportunities, towards influencing and changing approaches to development planning that focuses on local rather than regional issues, or a mix of the two. Thus the emerging planning approach will guide flood risk mapping as integral part of medium term development planning at the local level and finally as part of the national planning process. The WP2 will impart the use technologies such as Geographical Information Systems (GIS) and economic tools (e.g. cost-benefit analysis) for creating awareness of the nexus of planning, climate change and flood risks, including understanding what resources and tools are available to managers within the local government, civil society and the private sectors to respond to future floods. The goal will be to establish zoning systems for flood risks and flood prone areas, and produce maps using space technology, participatory learning and guidelines that ultimately minimize losses and displacements that are associated with floods at homes and places of work. The WP3 focuses on building synergies between gender specific indicators and flood risk determinants using gender mainstreaming tools and approaches with the aim of coming out with flood early warnings that are sensitive to climate elements and responsive to needs of vulnerable groups such as women, children and the elderly and their environments and efforts at resilience building. WP3 is partially dependent on WP2 for GIS Application with Hydrological Models such as the Water Evaluation and Planning (WEAP) model overlaid on historical floods data using a gender sensitive seasonal calendar to launch the early warning platform. In-field based techniques such as transects and impact evaluation will underlie WP4 with the objective to analyze the extent (including barriers and opportunities) of the

adoption of existing and on-going public and private flood response strategies that have emerged as Research-into-Use to elicit investable flood adaptation options. The information will subsequently support the deployment of new investment opportunities that are climate sensitive and able to minimize flooding and its effects and emphasizing on physical planning and infrastructure management. The WP5 will focus on monetizing flood adaptation options using economic tools such as the DIVA and CBA to assess the best options available for adaptation whilst providing opportunities for knowing future incremental costs of the interventions towards protecting investments and making baseline finance inputs into national planning especially towards resilient infrastructure under Ghana's INDCs. The WP6 will serve the capacity building and training needs of the other WPs by engaging young researchers, personnel in management positions and boundary partners through formal and non-formal training as crucial change actors and pillars to facilitate change and maintaining institutional memory.

Each WP will be led by a senior scientist and supported by personnel with highly specialized skills in specific issues especially in using relevant tools and methods. It is expected that up to 3 PhDs and 3 Masters would be produced in addition to 6 policy fellows representing our partnering districts that number 6 in total. Additionally, the workshops and seminars to be ran will provide other forms of training to several development actors other than the partners already defined from the public and private sector institutions.

Subsequently the research strategy would seek to raise the relevant leadership required in academia, public and private institutions including civil society and NGOs tailored to influence the integration of climate sensitive indicators into cities planning. This will positively impact on planning for resilient societies and reduced flood impacts, whilst contributing significant baseline information and flood response model to Ghana's INDC on resilient infrastructure in aspects of policy mainstreaming, adaptation investment financing and early warning.


BUILDING ON ESTABLISHED VULNERABILITIES
(From CCARTCD, CC-Health & Risk Communication Projects)
Sea Level Rise / Heavy Storms / Surface Runoff
Flood Risks and Impacts
Infrastructure
Business
Industry
Shoreline
Population
SPECIFIC IMPACTS
Inundation of settlements, homes & population displacement
Losses to business through destruction of market stalls, wares & fish smoking platforms
Destruction of public infrastructure mainly drains and road networks
Coastal and shoreline erosion / retreat
Industrial and investment loses
THE PROBLEM
Poor land use and infrastructure planning
Lack of climate sensitive flood management indicators
Absent infrastructure climate and gender metrics
Weak sector policy mainstreaming
Limited public – private sector partnership
ANALYSING THE PROBLEM / PROJECT OBJECTIVES & WORK PACKAGE (WP) PERSONNEL & PARTNERS
Framework for aligning & analyzing population-related determinants of flood risks and adaptation
Methods: Mixed methods, Theory U & Economic Impact Analysis (EcIA)
Technologies to manage human dimensions of climate change and flood risks
Methods: Space technology (e.g. GIS, Digital Elevation Model) and Brainstorming
Gender-sensitive multi-criteria decision framework for surveillance systems
Methods: Gender Scan
Social Mapping
SWOT Analysis
Seasonal Calendar
Research-into-Use (RIU) practice, barriers and opportunities of adaptation solutions
Methods: Transect, Participatory Field Schools and Tours Integrated Problem
Climate smart indicators to recommend viability of adaptation solutions
Methods: DIVA modeling, Cost-Benefit Analysis Multi-Criteria Analysis
WP 1
Dr Faustina Ainguah
Dr Mumuni Abu
Partners: MESTI / NADMO / Local Gov
WP 2
Dr Philip Antwi-Agyei
Dr Opoku Pabi
Partners: PEF / Cities Alliance/ GAMADA
WP 3
Dr Linda Darkwa
Dr Addoquaye-Tagoe
Partners: NDPC / MESTI / GAMADA
WP 4
Dr Delali Dovie
Prof Samuel Codjoe
Partners: HATOF / PEF / Cities Alliance
WP 5
Dr Alexander Wiredu
Dr Delali Dovie
Partners: MESTI / Local Gov. Ministry
1 PhD + 1 MA / MSc
1 PhD + 1 MA / MSc
1 PhD + 1 MA / MSc
WP6
WP6
Results / Interventions
Flood risk demarcation / zoning in GAMA
Climate smart integrated flood management framework & regional platform on flood management
Research into Use / Policy mainstreaming framework
Output
Scientific publications and Policy briefs
Flood maps and contingency toolkit
Policy roundtables; Audio-visuals; Exhibitions,
Young researchers & policy fellows
IMPACT
Raise the relevant leadership required in academia, public and private institutions including civil society and NGOs to influence the integration of climate sensitive indicators and investments into cities planning towards resilience infrastructure and reduced effects of flooding, hence Ghana's INDC on resilient infrastructure.

5.2 Methods for flood risk assessment

The methods range from household surveys through participatory learning approaches (PLA) involving focus group discussions and mapping events to the combination of some elements of qualitative and quantitative techniques that engage scenarios, modelling and spatial analysis (e.g. GIS). The research Work Package 1 (WP1) investigated demographic, economic, environment, health, social, water and sanitation indicators to inform the flood vulnerability assessment using quantitative and qualitative methods (e.g. household survey, focus group discussions). Overall, WP1 activities which were on developing a decision support framework for mainstreaming the management of floods into development planning, including barriers and opportunities, generated baseline data inputs with variables relevant to the remaining work packages.

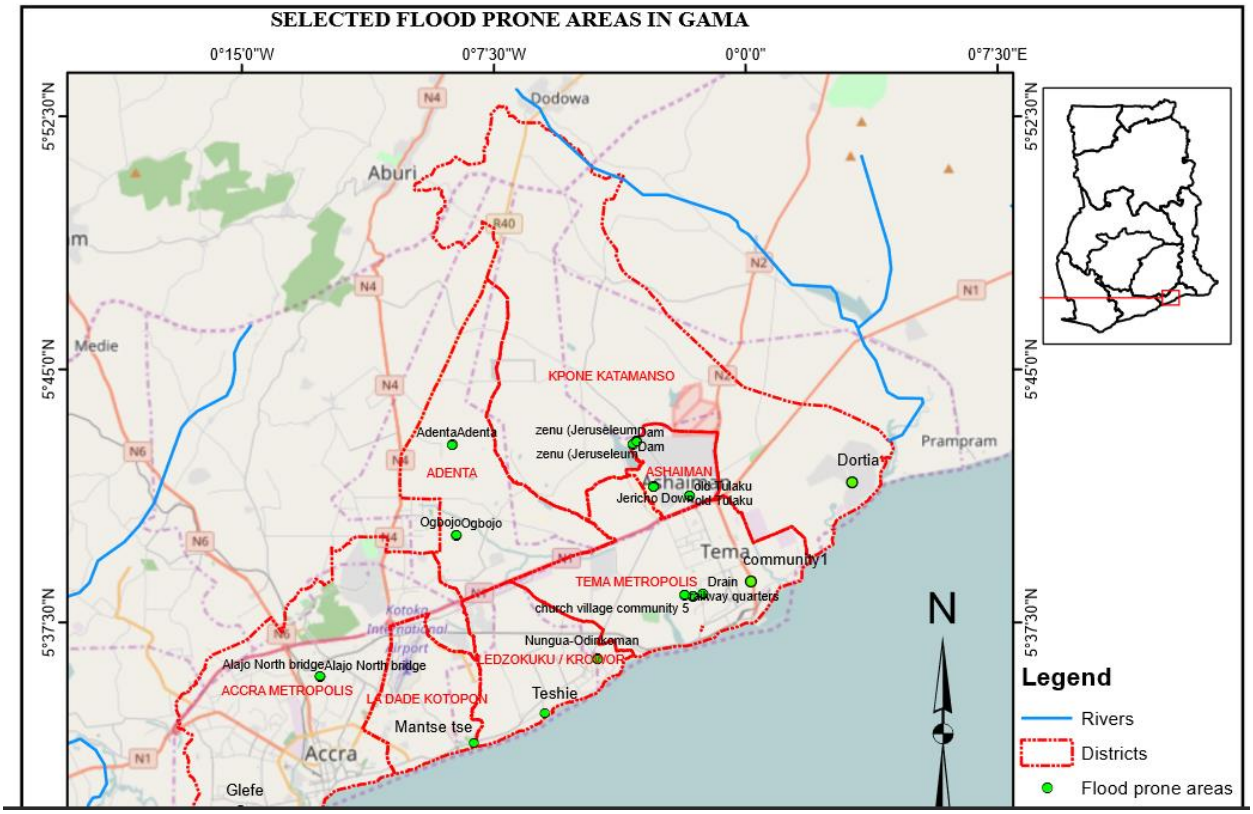
Work Package 2 (WP2) mainly engaged the use of spatial techniques such as Remote Sensing and Geographical Information Systems (GIS) in analyzing the urban landscape vulnerabilities, climate change and flood risks, and results overlaid on institutional analyses of serious concern to capacity of city managers. The WP2 established the zoning systems for flood risks and flood prone areas, and produced maps associated with floods within GAMA, and elicited the capacity of government institutions to respond to floods.

The focus of Work Package 3 (WP3) was on building synergies between gender specific indicators and flood risk determinants and the extent to which adaptation solutions were sensitive and responsive to needs of vulnerable groups such as women, children and the elderly.
The Work Package 4 (WP4) analyzed the adoption of flood response measures by communities and links with research-into-use based on in-field methods such as transects and participant observation to elicit investable flood adaptation options especially for infrastructure to assist city managers to deploy climate resilient interventions.

The Work Package 5 (WP5) focused on monetizing flood adaptation options using economic models and the Choice Experiment, building into it, future incremental costs of interventions. Halsnæs and Trærup (2009) have suggested approaches for mainstreaming economic aspects of adaptation into planning although it was not within the concurrent premise of biophysical methods as proposed in this paper.

5.3 Site selection and underlying physical vulnerabilities

Assessing flood risks in GAMA commenced with establishing the potential of floods as hazards and analyzing the physical vulnerabilities (Figure 3), using a combination of satellite and ground truthing data to select and prioritize hotspots areas. Two broad locations (i) distant from and (ii) along the coastline provided reference points for data gathering. This activity comprised of identifying key informants who joined in transect walks across communities and neighborhoods. Water marks on physical structures were observed as part of the indicators of exposure of population to floods, explained further through interaction with residents. Step-by-step specific activities were: (i) Construction of digital elevation maps to determine the low lying areas with highest exposure to floods hazards, (ii) Development of simple socio-demographic and flood hazard matrices of the ground truthing which led to the selection of seven District Assemblies (local government units), (iii) Consultation with the seven District Assemblies that confirmed the prioritization of 14 communities (within the 7 selected District Assemblies) in which the research methods were administered, (iv) Stakeholder analysis and mapping ensured greater representation of key institutions, individuals, political and policy constituents in reappraising the activities and the workplans of the WPs, (v) Consensus building with relevant institutions using the District Assemblies' structure on the planned exercise in the different dimensions of the research objectives.



5.4 Data origins and character of Work Packages

Work Package (WP) Objectives	Major Themes / Variables / Type of Data		Description of Approaches, Methods, Techniques, Tools, etc
	Quantitative	Qualitative	
WP1 Objective - Strengthen framework for aligning and analyzing population-related social, economic and environmental determinants of flood risks and provision of adaptation solutions.	• Primary data collection: • Household characteristics, employment and health, Housing characteristics and assets • Drivers of flooding • Water and sanitation • Impacts of flooding • Adaptive capacity and resilience of households	• Selection of study communities based on the same Districts and communities used for the Quantitative interviews • Stakeholder mapping	• Town hall meetings • Reconnaissance visit • Sampling and Household listing • Questionnaire administration • interviews using CAPI approach
	• Secondary data from Ghana Statistical Service • Demographics and socioeconomic situation of study area	Study areas from the quantitative study	• 2010 census data of the study area, Enumeration area or cluster maps and detailed description • Shapefiles of study area

Work Package (WP) Objectives	Major Themes / Variables / Type of Data		Description of Approaches, Methods, Techniques, Tools, etc
	Quantitative	Qualitative	
	• Population data by district and community	• Flood risk management	• Interview guides
	• Shape files of study area	• Adaptation to flooding	• Focus group discussions • Pair-wise ranking • Cross-impact matrix
WP2 Objective - Appraise capacity of managers to use technologies such as Geographical Information Systems (GIS) and Satellite Imagery alongside digitized maps and economic tools (e.g. cost-benefit analysis) to manage human dimensions of climate change and flood risks.	• Types and availability of spatial technologies and their applications • Types of institutions and agencies involved in flood risk management	Institutional structure, capacity, processes • Multi-sectoral, Integration and coordination, • Roles, responsibilities, skills • Public participation • Application of flood risk reduction • Climate change integration • Knowledge and information management, communication, technology, innovation. • Flood risk assessment • Logistics adequacy	• Focus group discussions and key informant interviews • Meetings, surveys, direct observations Purposive sampling • Checklists and interview schedules • Desk reviews
	Flood Hazard Vulnerability (exposure, sensitivity and adaptive capacity. • Flood hazard models ○ Elevation ○ Land use and land cover ○ Water bodies ○ Rainfall		• Spatial and temporal modelling, risk simulation, hazard and vulnerability variations using GIS and remote sensing. • Georeferencing of socioeconomic factors using GPS. • Integrated data analysis and processing using ArcGIS 10.4, ENVI and SAGA software
	Exposure index • Surfaces (Flow depth and speed, flooding frequency) • Vector shapes (District, Communities,	• Open-ended questions within the household survey • Focus group discussions with community	• Overlaying of demographic parameters over hazard characteristics of flow depth, speed, frequency and index of exposure integration (Depth + Speed + frequency).

Work Package (WP) Objectives	Major Themes / Variables / Type of Data		Description of Approaches, Methods, Techniques, Tools, etc
	Quantitative	Qualitative	
	enumeration areas, houses	members to highlight key exposures and stressors within the study area	• Surveys, direct observations, Population and housing census • Spatial data analysis and integration
	Flood risk assessment • Hazard index, Sensitivity index • Adaptive capacity index, exposure index		• Spatial integration of indices • Vulnerability computation • Flood risk computation • Spatial display of risk variability
WP3 Objective - Design gender-sensitive multi-criteria decision framework for resource and knowledge mobilization on surveillance systems for effective flood risk reduction.	• Gendered Household experience of flooding • Valuation of flood damage cost and losses • Gendered effects of flooding • Gender dimensions of waste management	• Knowledge and information management, communication, technology, innovation • Adaptive capacity	• Desk review • Triangulation of methods • Thematic analysis of data • Gender profiling historical mapping • Life history analysis • Focus Group Discussion
WP4 Objective - Evaluate Research-into-Use (RIU) practice, barriers and opportunities of adaptation solutions at the nexus of population growth, hydroclimatic risks and city planning.		• Structural measures on stream channels such as channelization, flood walls • Retaining rainwater where it falls • Land use management (house building codes) • Land regulation (non-development of low-lying areas) • Dams and reservoirs • Diversion channels • Flood emergency measures	• Focus Group Discussion • Pairwise Ranking • Transect Walks • Participant Observation • Key informant interviews
WP5 Objective - Analyse climate-smart indicators to recommend technical feasibility, economic efficiency, social acceptability and	• Likelihood of flooding • Elevation (using the GPS coordinates), drainage, waste and sanitation	• Flood occurrences and impacts on households	• Remote sensing and GIS application • Household surveys

Work Package (WP) Objectives	Major Themes / Variables / Type of Data		Description of Approaches, Methods, Techniques, Tools, etc
	Quantitative	Qualitative	
environmental viability of adaptation solutions for consideration for Medium-Term Development Planning.	• Household experience of flooding • Measurement of household previous flood levels • Valuation of flood damage cost and losses	• Flood impact • Adaptive capacity ratings • Household and neighborhood assets	• Household surveys • Desk reviews
	• Time and risk preference • Household and individual members' income and expenditure • Household characteristics and spending • Flood reduction, adaptation, mitigation and other related spending • Household and individual employment and expenditure • Time and risk preference		Economic Valuation • Stated Preference ▪ Contingent Valuation of Flood Adaptation ▪ Choice Experiment of Flood Adaptation Options • Revealed Preference

5.5 Town hall meetings

Stakeholder analysis and reappraisal of the research content for each of the seven District Assemblies through Town Hall meetings and dialogues brought together change actors from the communities, civil society, NGOs, developers, public officials, cooperatives and unions, etc. It was to understand the heterogeneity and complexity associated with floods that confronted each district in its unique ways, and included (i) Identification of flood hotspot issues and facilitators from within the selected research communities, (ii) Identification of change actors within assemblies called Policy Fellows, (iii) Identification of community facilitators, (iv) Reappraisal of field design and sampling (use of census EAs and identification of HHs).

5.6 Key inputs of parameters into quantitative and qualitative methods

The study applied cross-sectional approach to investigate how residents and households within the GAMA manage flood risks and to obtain in-depth information about transition to resilience within study communities to prevent, prepare, respond to and recover from flood risks. The research used the updated National Master Sampling Frame constructed from the 2010 Ghana Population and Housing Census, by the Ghana Statistical Service; to accurately select households for the surveys. The Greater Accra Region consists of 16 districts of which the seven used in this study are part of the GAMA territory which are urbanized. Two communities in each of the seven districts were purposively selected based on prior information on history of proneness to floods using flood risk prone map. The research framework also examined whether coastal communities and/or landlocked (inland) communities within the GAMA districts experienced floods in the same way and possible strategies undertaken to mitigate the emerging effects. At the first stage of sampling, three enumeration areas (EAs) or primary sampling units (PSUs) were selected randomly from each of the 14 GAMA selected communities respectively and an additional EA was adopted to capture non-response of the population. An extensive listing and map-spotting exercise of all eligible households in the selected EAs were carried out to update the list of all households of usual residence within the selected areas. The list of names and detailed addresses of all households within the canvassed EAs formed the frame for the selection of households. The next stage involved the selection of 30 households, done systematically from the ordered sampling frame, using an equal probability procedure. A total sample of 1,290 households

were selected. Of these, 1,252 households were identified for the interviews in which 1,230 households were completed using the computer assisted personal interviews, yielding a response rate of 95.3%.

Participatory Learning Actions which involved (i) Transect walks, (ii) Participant observation, (iii) Focus group discussion, (iv) Community-based Risk Screening Tool – Adaptation and Livelihoods (Cristal), (v) Pairwise ranking, were adopted.

5.7 Physical vulnerability assessment

GIS and Remote Sensing / Using Digital Elevation Model (DEM) and Digital Terrain Model (DTM), Geo-spatial technologies of GPS, Remote Sensing and GIS were innovatively deployed and leveraged as tools and approaches for data capture, data processing, modelling, integrated analysis and display. ArcGIS 10.4, SAGA and ENVI were used as the main software for spatial analysis and modelling of flood risk. Flood disaster risk was modelled as an index from the component indices of exposure, sensitivity, adaptive capacity and flood hazard. Flood hazard scenarios at basin levels were modelled and simulated using spatial models, including the rational runoff model, based on various scenario configurations of the drivers of elevation surfaces, land cover and rainfall intensities for different time periods at different basin scales.

5.8 Inputs into key informant interviews for institutional analysis

These inputs were defined at national levels to (i) ascertain effective use of technology and capacities for flood management, (ii) assess key challenges confronting these institutions and (iii) Identify gaps in existing capacities.

5.9 Public policy dialogue

This involved engaging the Theory “U” process on the process of change towards planning of adaptation solutions and resilience building. Theory U-Process, an innovative participatory approach adopted from Dovie (2017) was used to generate new and creative approaches to address the issue of climate change and flood risks within coastal urban areas.

5.10 Project Implementation and Management

A four-tier system to promote integration was used. These are

i. The Project Management Team based at RIPS led by the Principal Lead and responsible for the day to day running of the project activities including coordination component handled by a Project Coordinator.

ii. The Scientific Team which did design and conducted the research on the ground reported to the Project Management Team, making significant and timely inputs into reporting back to project districts, communities and relevant stakeholders.

iii. Public, private and civil society partnership, which ensured that the aims, objectives and relevant findings of the research was communicated to targeted audiences in languages understood by them. These partners included: National Development Planning Commission and the Planning Ministry, Ga Mashie Development Authority, Private Enterprise Foundation, the Ministry of Local Government and Rural Development, etc. By this mechanism, partners also helped to connect to other organizations when dealing with key national issues such as operationalizing the Sendai Disaster Risk Reduction Framework for Ghana, preparing for Conference of Parties of the United Nations Framework Convention on Climate Change (UNFCCC) and the Nationally Determined Contributions (NDCs), the Sustainable Development Goals (SDG), etc.

iv. Project Steering Committee, with the responsibility to provide independent oversight of the operations of the entire project. The membership also represented key areas of parties in ensuring that the findings and activities of the project make impact at various levels of governance, whilst bringing their influence to bear on key national level policy issues.

5.11 Dissemination and Post-Project Stakeholder Engagement

Project Dissemination was carried out using four major pathways as follows:

Community Level

a) Drama by community-based theater groups
b) Exhibition by basic schools in their communities
c) Policy Briefs

Local Level (Districts, Municipals, Metropolitans)

a) Direct engagement at the District Assembly level
b) District assembly Fellow interventions / activities
c) Students' Masters and PhD Degree Theses / Dissertation Reports
d) Policy Briefs
e) Training of Physical and Development Planners

Regional / National

a) Through events / activities organized by project partners
b) Newspaper articles
c) Students' Masters and PhD Degree Theses / Dissertation Reports
d) Policy Briefs

International

a) Attendances at conference and making relevant Oral and Poster Presentations. E.g. Population Association of America (PAA) Meetings, Resilient Cities Forum, International Conference on the Urban Environment (ICUH)
b) Inputs into Conference of Parties (COP) discussions of the UNFCCC, by participating in preparations of National Communications and organizing Pre-COP events
c) Organizing Large-Scale Conference Dissemination, through hosting the 2019 International Climate Change and Population Conference on Africa (www.ccpopghana.org)
d) Web postings of activities and presentations
e) Policy Briefs
f) Students' Masters and PhD Degree Theses / Dissertation Reports

6. PROJECT OUTPUTS

6.1 Organized 2 No. National Policy Dialogues on mainstreaming the Sendai Disaster Risk Reduction Framework and embedding climate smart response to floods

The project partnered with the National Development Planning Commission (NDPC) to organize two levels of stakeholder engagements to discuss the status of Disaster Risk Reduction at the local, regional and national levels and more specifically to highlight the role of partnership between academia/research and government in increasing preparedness for flood response and recovery in Ghana's cities.

The first of the policy dialogue / consultative meeting was held with officials from over 25 institutions also with media presence to review the implementation arrangement for the Sendai Framework for Disaster Risk Reduction and identify critical gaps that needed to be addressed. This was aimed at identifying and discussing critical disaster risk reduction issues in Ghana and to develop measures to reduce the risk of disaster and build resilience to existing and new disaster risks. The second of the policy dialogue was a round table discussion with high level participants mainly heads at Ministerial kevels from government, traditional leaders, private sector, disaster risk reduction in Ghana and to develop broad strategies and action plans to meet obligations under the Sendai Framework. Over 25 institutions were represented, some of which were also part of the technical dialogue and ensuring critical policy and technical mainstreaming of the framework lessons.

1. www.ghananewsagency.org/social/stakeholders-express-concern-over-population-growth-challenges-hampering-spatial-planning-147992

2. https://www.graphic.com.gh/news/general\-news/ghana-has-no-disaster-risk-plan.html
3. https://www.ghanaweb.com/GhanaHomePage/NewsArchive/Stakeholders-express-concern-over-population-growth-challenges-hampering-spatial-planning-735915
4. https://www.ghanaweb.com/GhanaHomePage/television/videos.php?ID=65394
5. www.peacefmonline.com/pages/local/news/201904/379476.php
6. http://www.ghanaiantimes.com.gh/consultative-meeting-on-disaster-risk-reduction-ends-in-accra/

6.2 High level Pre - CoP Meeting – 2017 Pre-CoP Climate Festival

In preparation towards COP 23 happening in Bonn, Germany from November 6 – 17, 2017 a Pre-CoP Climate Festival was convened in collaboration with the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), National Disaster Management Organisation, the Ministry of Finance and the Ministry of Food and Agriculture; on October 24, 2017 at the Ghana Academy of Arts and Sciences (GAAS) in Accra on the theme: "The Risks We Do Not Want". The festival was organized with the aim of providing a knowledge sharing platform to enable stakeholders to reflect and take stock of adaptation measures across climate-sensitive sectors from agriculture to water. . Especially rural population in the northern parts of the country exposed to disastrous weather events like severe droughts and precipitation-fed floods and similarly, increased frequency and intensity of flooding of cities in the south.

The high level high-level event was well attended by a total of two hundred and twenty five (225) participants beyond the 150 planned for, of which, 54 were females and 171 males. Participants represented Government Ministries, Departments and Agencies (MDAS), District Assemblies, international and local NGOs, faith based organizations, social enterprises as well as students from second cycle institutions within Accra.

1. https://www.ghanaweb.com/GhanaHomePage/NewsArchive/Canada-is-helping-Ghana-manage-flood-risk-High-Commissioner-594794
2. http://agricinghana.com/2017/10/25/ghana-stages-pre-cop23-climate-festival/
3. https://www.thefinderonline.com/feature/item/10524-ghana-holds-pre-cop-festival-ahead-of-23rd-annual-international-climate-change-gathering

6.3 District Assembly Level Communications

The communication documents represent the positions of the seven Municipals, Metros and District Assemblies within which the project was carried out. Thus they represent consensus statements of the Assemblies generated at Townhall meetings during the dissemination of the project results.

6.4 Produced 8 No. Research Papers (unpublished)

i. Spatio-Temporal Assessment of Flood Exposure Pathways
ii. The Choice of Adaptation Strategies to Flood Risk Management
iii. Determinants of Relocation Against Flood Risk in Urban Households
iv. State Of Waste Management, Sanitation And Flooding
v. An Estimate of the Probability of Flooding in Greater Accra Metropolitan Area
vi. An Examination of Households' Willingness to Pay for Flood Risks Adaptation in GAMA
vii. Public Organizational Capacity and Integrated Flood Risk Management
viii. The Climate-Smart Integrated Flood Management Framework (CSIFM)

6.5 Post-COP 23 climate change stocktaking

The project partnered with the Environmental Protection Agency (EPA), and the Africa Group of Negotiators to the UNFCCC to organize a 2017 Post-COP 23 climate change stocktaking colloquium in Accra. The Post-COP Stocktaking Colloquium brought together stakeholders and international partners who had participated in the COP 23 held in Bonn, Germany from 6th – 17th November 2017; to discuss policy actions towards some of the outcomes of the conference in relation to climate financing, investments and coordination of climate action, corporate emission cuts and government ratifications, to inform Ghana's NDCs as project's contribution.

6.6 Conference Proceedings on Cities and Climate Change

TABLE OF CONTENTS

RIPS / IDRC-Canada Cities and Climate Change Project Presentations

6.7 District Assemblies' Training

Trained 56 Physical and Development Planning Officers in 26 out of the 29 GAMA Local Government District Assemblies (i.e. Districts, Municipals, and Metros)

Session	Day 1 – Prioritizing adaptation actions	Day 2 – Developing implementation road maps
1	Welcome and introductions Aims and objectives for the workshop	Recap and Outcomes of Day 1
2	**Presentation**: Developing a Climate Action Plan compatible with the Paris Agreement: Accra's experience	**Presentation**: Mainstreaming climate change and sustainable development and Case study: Flood contingency planning and framework
3	**Presentation**: Climate hazard and risk analysis for Greater Accra: Results of IDRC / CDKN projects	**Training & Group Exercise**: Detail prioritized adaptation actions using the Road Map templates
4	**Presentation**: Defining / Downscaling Ghana's Nationally Determined Contributions (NDC) adaptation targets to areas Assembly level	**Training & Group Exercise**: Stakeholder mapping using power-interest
5	**Training & Group Exercise**: Strategy development: set a vision, translate the vision into goals and a plan	**Training & Group Exercise**: Spatial mapping of actions to identify synergies across actions
6	**Training & Group Exercise**: Prioritizing adaptation actions using multi-criteria analysis	**Training & Group Exercise**: Indicators and how to build accountability as a catalyst for change

6.8 Produced 2 No. Policy Briefs

Number 1: Learning outcomes for policy

Number 2: Project science for policy recommendation

6.9 Project Manual

Project Manual (toolkit) on Implementing Flood Risk management that is Climate Smart *

6.10 Organized one large scale dissemination of project results (CCPOP-Ghana 2019 conference)

The 2019 conference is a product of an innovative research project entitled “Climate Smart Integrated Flood Management” within seven District Assemblies in Greater Accra Metropolitan Area in responding to climate change challenges in Cities vis-à-vis urban landscapes. This is timely for emerging debates on population and development related nuances, with momentum for the Sustainable Development Goals (SDGs), the Sendai Disaster Risk Reduction Framework, and the Paris Climate Agreement. The conference theme “Transforming Cities' Resilience to Climate Change” calls for transformative and smart solutions to overcome the most dangerous effects and impacts of climate change. 100 people participated in the conference.

6.11 Produced a Communication Strategy on managing flood risks **

The Development of appropriate strategies for communicating information on climate induced flood risks are key to the overall task of managing socio-demographic change and climate induced flood risks in the GAMA. The implementation of the strategies will contribute to the successful achievement of the project goals and objectives as well as enhance the visibility of project activities and outputs.

The strategy is divided into two for successful implementation:

1. Internal Communication Strategy that identifies the internal targets and how they will share information with and among each other.

2. External Communication Strategy targets audiences outside the implementing team.

6.12 Trained 7 Graduates at the PhD and Master's degree levels in Population Studies, Environmental Science, and Economics

1. Reuben Tete Larbi: Spatio-Temporal Assessment of Flood Exposure Pathways in Two Distinct Socio-Ecological Areas in Accra Ghana using Pluralistic Methods. *PhD*
2. Emmanuel Ayine Ayimpusah: An Economic Analysis of Flood Risks and Adaptation Options in Greater Accra Metropolitan Area (GAMA). *PhD*
3. Crystal Bubune Letsa: Population dynamics, changes in land use/cover and flood risk in Greater Accra Metropolitan Area. *PhD*
4. Adwoa Bema: Assessment Of Institutional Flood Risk Management In Greater Accra Metropolitan Area. *Master's*
5. Benjamin Memeh: Socio-Demographic Drivers Of The Geophysical Resilience Of Households To Flood Risk In The Greater Accra Metropolitan Area (GAMA). *Master's*
6. Ernest Owusu: Urban household flood preparedness in Ghana: A case study of the Greater Accra Metropolitan Area (GAMA). *Master's*
7. Ekow Akyen Anderson: Flood Control And Assessment Using The WEAP Hydrological Model. *Master's*

6.13 Established a Network of Fellows at the Local Government Level within the District, Municipal and Metropolitan Assemblies.

We continued to engage Policy Fellows of the Districts in framing strategic plans for the management of flood risks in their respective district assemblies. A management team meeting was held during the period as well as motivating meetings by the individual work packages. The project team further partnered the Ga Mashie Development Agency (GAMADA) to initiate some dissemination activities with the Basic schools within the Accra Metropolitan Area (AMA) as part of the implementation of community sensitization and awareness enhancement using photo exhibition.

The development of the Policy Fellows has also included having to share some of the findings with them towards giving them the opportunity to appreciate the issues on the ground in their effort to assist in providing solutions. The Policy Fellows have also been involved in the consultative meetings organized on disaster risk reduction

7. PROBLEMS AND CHALLENGES

Partner Interests: Although the project partners have been well integrated into the operations of the project which focuses on adaptation solutions rather than mitigation, some still want to do things on mitigation once it is about cities. An example is PEF which does both adaptation and mitigation and has successfully organized an adaptation solution activity and now wants to examine the transport sector in reducing emissions. PEF has therefore been asked to use the principle of "co-benefits" by introducing flood risk issue into their transport and emission models In ensuring that adaptation becomes very visible. One way that has been suggested is the use of the concept of the Unban NEXUS that promotes synergies and benefits

Fellows: The concept of the District Assembly Policy Fellows to inform change within their jurisdictions is very relevant and on-going but needed time make the expected impact. This is because the fellows are also conferring with their colleagues who might not be available when needed, challenges of time commitments and forward looking challenges of financial resources to sustain the initiative. The project decided to strongly bring in the National Development Planning Commission (NDPC) already with influence on what happens at the District Assemblies levels. Therefore in order to manage the challenges of time constraints and availability, the NDPC made it easier by working with the fellows during the official national planning workshops organized by the NDPC for the Districts. Subsequently, some fellows have done initial work plans which include proposed officials within the district and other stakeholders who need to be engaged in the realization of the action plans.

8. ADMINISTRATIVE REFLECTIONS AND RECOMMENDATIONS

In as much as technical advice from critical project partners is crucial in effective project management, it is necessary to understand the local context within which the project is being implemented. Such consensual understanding will enable project management achieve the intended goals of the project while utilizing the unique local context of implementation as well as historical experiences of working in similar situations. Moving forward, IDRC should work with grantees to scan and document the most efficient local context within which activities could be implemented in an effective manner.

For example conditions for the last tranche of payment (hold-back funds) should be reviewed and if possible activities to service providers could be paid directly from IDRC to the service providers. The question about where to raise funds to carry out remaining activities came up strongly in this project due to new financial regulations by the University that prevented projects depending on others for support. Our experience of not being able to access the hold-back funds when we needed it most, and as an academic institution which is non-profit making, had to force us into new partnerships came at cost to the institution.

9. CONCLUDING REMARKS

9.1 Contributions to Field of Study

i. First, cities and climate change have received very little attention in the past but has strongly emerged in recent years because cities have now been accepted globally as the future of the world's development. Yet there is limited understanding of how the growth of cities provides opportunities for adapting to climate change as climate change induced disasters such as floods have risen sharply in cities. Second, floods have always been considered as geophysical dynamics than socioeconomic and demographic and placed limitations on policy responses hence the exposure units i.e. human dimensions which received little or no attention.

ii. The research showed that gender, economic, health and housing attributes of households are major drivers of floods exposure and proximate correlates of coping mechanisms that must be tackled in policy responses. Yet inappropriate governance measures due to limited capacity and policy misalignment undermine the integration of flood risk management into development planning.

iii. Subsequently, the project co-evolved the climate-smart integrated flood management framework, a participatory cyclical research and planning tool that guides decision-making in governing flood risk assessment and management whilst promoting horizontal policy integration e.g. with the Sustainable Development Goals (SDGs) and Ghana's Nationally Determined Contributions (GH-NDCs) through climate action plans (CAP) of District Assemblies.

9.2 Unintended outcomes and impact

i. Communication Strategy [*This first emerged during a project management meeting on how to timely disseminate project information / results which then informed the recommendation of a communication expert with background in Journalism to be part of the Project Steering Committee. The discussion was then intensified at a Project Steering Committee meeting in the presence of the Program Specialist which resulted in the commission of the exercise. There have been some press releases as a result which has engendered the interest of the media in the project*].

ii. Institutional Analysis paper [*This was a paper produced by the Work Package 2 with original mandate to appraise the capacity of managers on using key and emerging technologies for governing climate change issues such as floods. However, challenges of policy incoherence amongst key institutions with mandates related to flood management emerged hence the need to expand the scope of the appraisal to include the assessment of relevant resources of key institutions at the National level and cascading into District levels*].

iii. Partnership with C40 Cities – Climate Leadership Group on capacity building of District Assemblies within GAMA [*The C40 needed key data to reinforce its support of action plan on adaptation initially for the Accra Metropolitan Assembly (AMA), which it invited the Cities and Climate Change project to complement its efforts. The scope of the Action Plan was the expanded / scaled up to cover 25 additional GAMA Districts out of 29, meaning that more District Assemblies now can develop their own Climate Action Plan (CAP)*].

iv. Technical advise to the Road Ministry on flood infrastructure in Adentan Municipal Assembly (AdMA) [*The Project Steering Committee received invitation from one of its Municipalities, AdMA on policy needs assessment through which issues on the ground showed that road infrastructure was increasing flood risks hence the project officially informed the Road Ministry to take action*]

v. Photo Exhibition by Basic Schools within the AMA [*Emerged from the collaborative efforts between the AMA, Ga Mashie Development Agency (GAMADA), the Local Government Ministry and the Project Steering Committee, emphasising poor solid waste management as key to flooding. Waste bins were distributed to schools involved and presented with Cameras to continuously use photography to enhance awareness on flood risks*].

vi. Partnership with AMA on 100 Resilient Cities programme by the Rockefeller Foundation towards the Accra Resilience Strategy [*Emerged as a result of data needs for the project and the AMA has since launched the Accra resilience strategy*].

vii. Memorandum of understanding initiated between RIPS and the Ghana Meteorological Agency (GMet) [*This was after GMet recognised that community engagement and socio-demographic data were key to effective weather information and early warning, as they lacked the capacity to do so, which came up strongly during a Panel organised*

by RIPS and GMet at the project's large dissemination conference on ICT and Weather information Development].

9.3 Policy Mainstreaming and Entry Points

The National Development Planning Commission (NDPC) and more recently, the Ministry of Planning could provide the much required coordination roles that cut down duplication roles of institutions involved in flood disaster risk reduction towards a more value addition approach. Lessons from the project so far are suggesting planning challenges cutting across scales from local to national and therefore, deeper engagement with the NDPC is an opportunity for change. In the coming weeks therefore, the project will reappraise its strategies to further engage there NDPC and its sector ministry when relating to the other partners and also during the feedback sessions with the Districts.

The Sendai Framework provides the most comprehensive entry point to address flood disaster risk reduction in GAMA. This is because it involves the "building of resilience to disasters with a renewed sense of urgency within the context of sustainable development and poverty eradication, and to integrate, as appropriate, both disaster risk reduction and the building of resilience into policies, plans, programs and budgets at all levels and to consider both within relevant frameworks". Therefore the concept of the Climate-Smart Integrated Flood Management which puts climate change and socio-demographics at the center of planning fits into the Sendai framework and making this project an important national asset.

APPENDICES

Appendix 1: Research Findings

1.1: Spatio-Temporal Assessment of Flood Exposure Pathways

The Land Use and Land Cover (LULC) change analysis showed considerable increase in the built-up areas over the twenty-six years period (1991 to 2017) for both AMA and AdMA. The built-up areas increased by 6.27 km^2 (7.2 percent) in AMA and 17.51 km^2 (50.0 percent) in AdMA and are projected to have respective increase of 96.42 km^2 (3.6 percent) and 64.01 km^2 (22.7 percent) by 2030 (Table 2). Built-up areas tend to increase the level of runoff resulting in an intensification of the flood hazard (Hwang, 2017). Similarly, whilst AMA observed a 2.14 km^2 (76.4 percent) increase in water bodies including wetlands, more than half (56.7 percent) of water bodies in AdMA totaling about 7.46km^2 was lost. The percentage increase in the area occupied by water bodies at AMA could be attributed to the expansion of the sea (Appeaning-Addo and Adeyemi 2013).

AMA had 4.44 km^2 (15.8 percent) more vegetation cover while AdMA lost 14.68 km^2 (60.9 percent) of its less dense vegetation (Figs. 2 and 3). It is projected that, under business as usual conditions, whereas AMA may gain more vegetation due to urban tree planting (7.6 percent), AdMA will lose more than a third of its green spaces (37.5 percent). Though, there was an observed and projected loss in the forest cover in both districts, AdMA lost 59.8 percent of the forest cover while AMA lost 39.4 percent over the same period (Table 2). Further, AdMA is projected to lose an additional 36.6 Percent while AMA loses 22.2 percent of the current forest cover by 2030. The analysis showed that 10.68 km^2 (63.6 percent) of the open spaces in AMA was converted to settlements, and an additional 3.69km^2 constituting two-fifths of the current open space area will be concretized by 2030. On the other, the open spaces in AdMA doubled over the 26 years interval (5.30 km^2); an additional 43 percent increase is expected by 2030.

The projections for AMA show that under business as usual conditions, more than half (56.34%) of the current forest cover and 81.21 percent of open spaces will be lost by 2060

respectively. Whilst water bodies increase by over 150 percent, the built-up area will extend by 12.24 percent (Table 2). About 77.87 % of the forests cover and less dense vegetation (78.87%) in AdMA, is projected to be lost by 2060. The built-up area on the other hand is projected to increase by 96.66 percent by 2060. Open spaces in AdMA will increase by 223.87 percent in 2060 if the current situation prevails. Finally, it is observed that 74.94 percent of water bodies in AdMA will be lost by 2060.

The DEM shows that AMA is located at a very low elevation area (Fig. 2). This predisposes the community to runoff from concretized higher elevation communities and districts including AdMA which is located at a relatively higher elevation. AdMA is however also predisposed to the runoff from communities and districts located at higher elevations (Fig. 3).

Land use types	1991	2017	1991-2017	2030	2060
	Area/ **km²** (%)	Area/ **km²** (%)	Area change/ **km²** (Δ %)	Projected change / **km²** (Δ %)	Projected change / **km²** (Δ %)
		AMA			
Forest	5.48 (3.9)	3.32 (2.4)	-2.16 (-39.4)	-2.58 (-22.2)	1.45 (-56.3)
Open spaces	16.79 (12.0)	6.11 (4.4)	-10.68 (-63.6)	-3.69 (-39.7)	1.15 (-81.2)
Water bodies	2.80 (2.0)	4.94 (3.5)	2.14 (76.4)	6.56 (32.8)	12.63 (155.7)
Built-up	86.83 (62.0)	93.11 (66.5)	6.27 (7.2)	96.42 (3.6)	104.51(12.2)
Less dense vegetation	28.05 (20.0)	32.48 (23.2)	4.44 (15.8)	34.95 (7.8)	41.39 (27.4)
Total	139.96 (100.0)	139.96 (100.0)			
		AdMA			
Forest	1.12 (1.4)	0.45 (0.6)	-0.68 (-59.8)	-0.29 (-36.6)	0.10 (-77.9)
Open spaces	5.12 (6.6)	10.42 (13.3)	5.30 (103.5)	14.87 (42.7)	33.75 (223.9)
Water bodies	13.16 (16.8)	5.70 (7.3)	-7.46 (-56.7)	-3.75 (-34.2)	1.43 (-74.9)
Built-up	34.66 (44.3)	52.17 (66.8)	17.51 (50.5)	64.01 (22.7)	102.60 (96.7)
Less dense vegetation	24.09 (30.8)	9.41 (12.1)	-14.68 (-60.9)	5.88 (-37.5)	1.99 (78.9)
Total	78.15 (100.0)	78.15 (100.0)			

Table 2 Land use/ land cover change for AMA and AdMA, 1991 and 2017 and projected change for 2030 and 2060

Computed from the LULCC class detection statistics

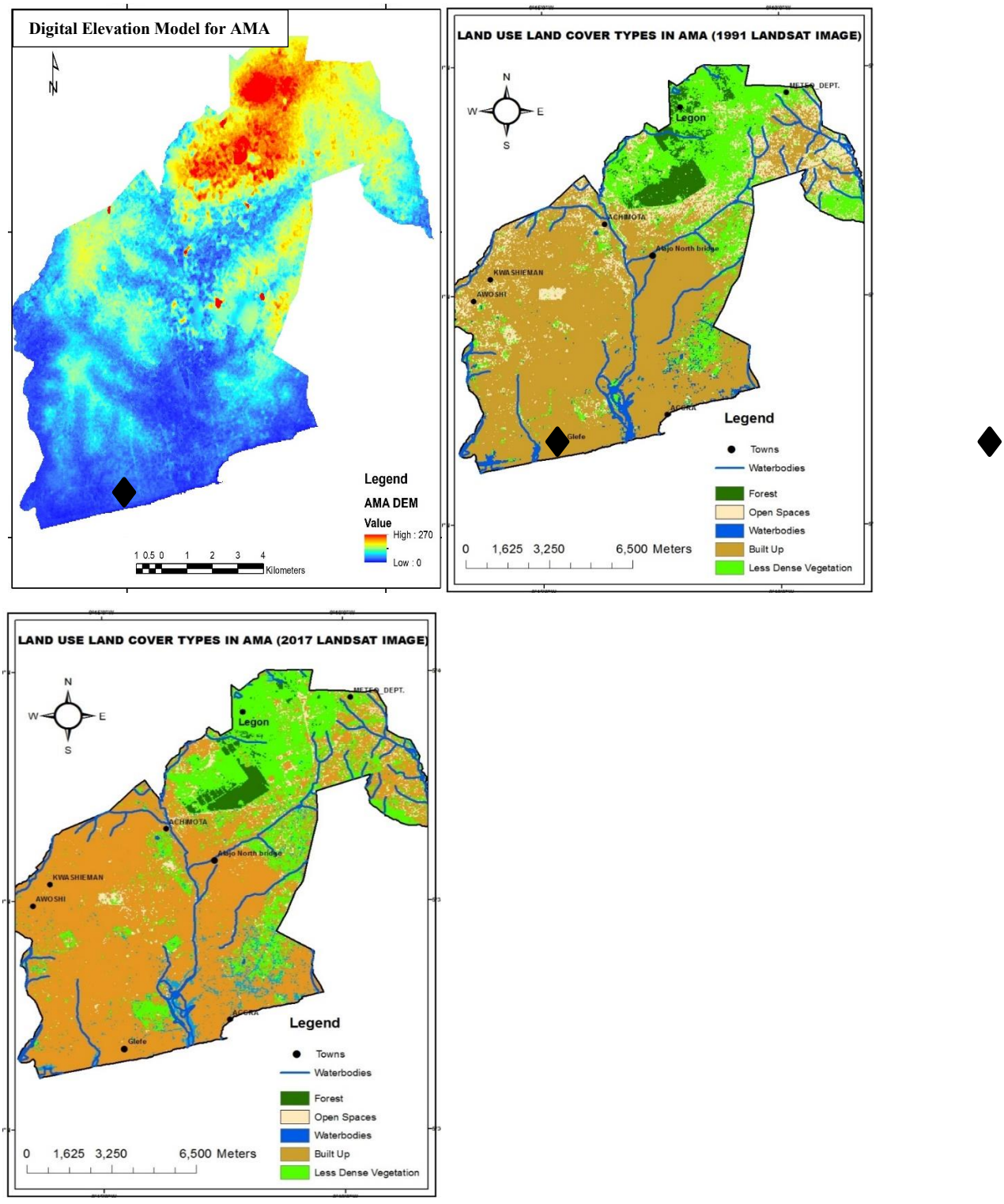


Fig. 2 Digital Elevation Model, and Land Use/ Land Cover Change in AMA for 1991 and 2017

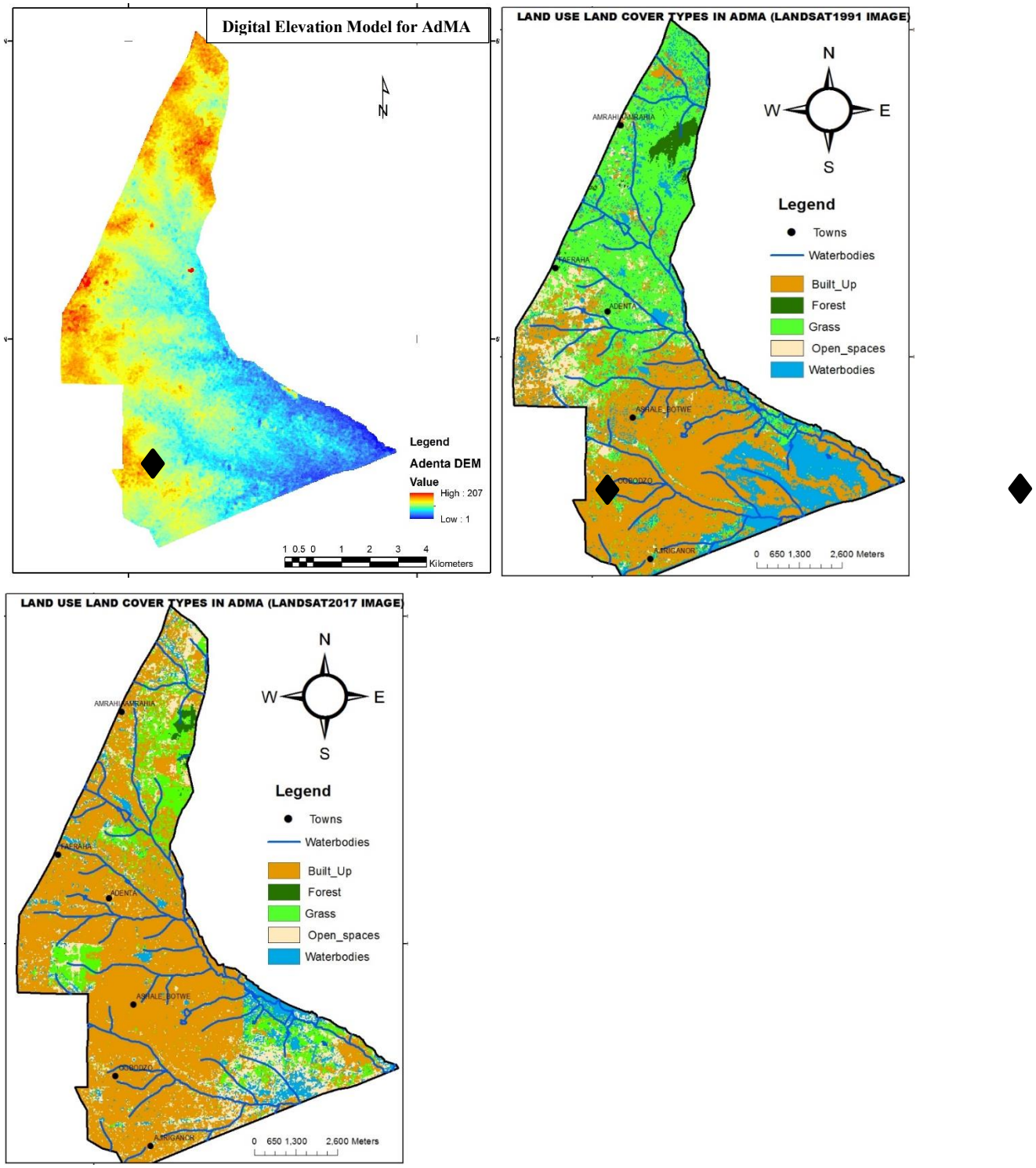


Fig. 3 Digital Elevation Model, and LULCC in AdMA for 1991 and 2017

The rate of concretization in AdMA is about four times that of AMA (see gradient of trendlines in Fig. 4). The projections show a continuous rise in impervious surfaces under the prevailing conditions. Figure 4 shows a sharp rise in built up areas in AdMA, which is a rapidly expanding and urbanizing compared to AMA. This is because all the previously rural and sub-urban communities in AdMA are rapidly urbanizing compared to AMA which has no rural communities.

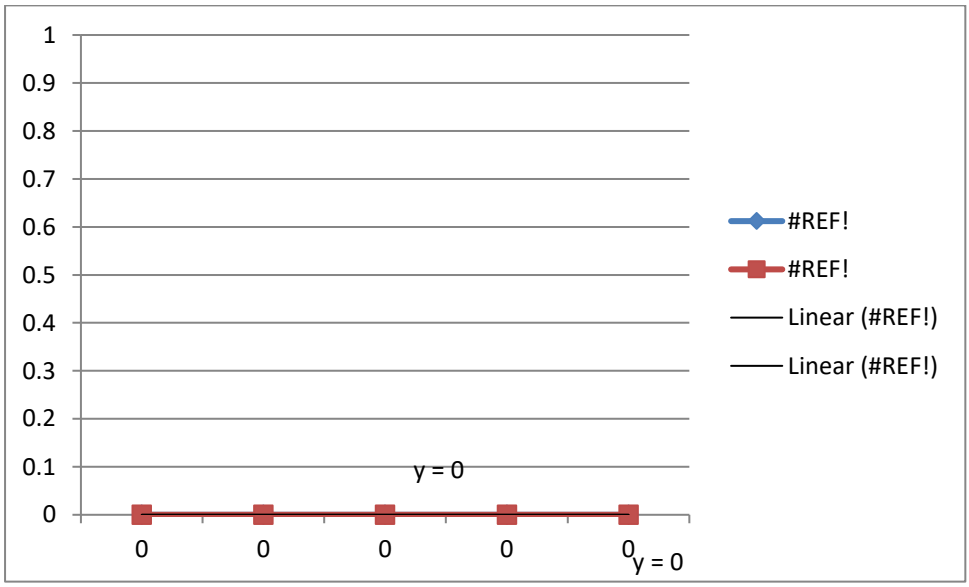


Fig. 4 Trends in built up areas in AMA and AdMA

Explanations of causes of exposure to flooding from participatory methods

Data from participatory methods corroborate and complement findings from the remote sensing/GIS analysis (Table 3). All participants of the townhall meetings, FGDs and in-depth interviews mentioned the role of physical location of buildings on the production of flooding. The physical location of infrastructure such as buildings and kiosks, tend to obstruct the flow of water causing diversion into settlements. Sample quotes include

> *You should also break down all the buildings on water ways. Many people have built their houses on the water ways! And that is what is causing the entire flooding problem!* (Male adult Townhall meeting, AMA).
>
> *… all these houses are on the water ways. This was a major street, but now, even a bicycle cannot pass there! And they have walled their houses, so the water passes here [pointing to the direction] to disturb innocent people* (key informant, AdMA).

Other participants explained that the lack of interregional planning causes the development of flood management infrastructure in one district to transfer flood risk to other districts. Some explanations were given as

> *One of our major problems is the Weija Dam. This part of the community gets flooded whenever the Weija Dam is opened* (Community leader in-depth interview, AMA).
>
> *All the rainfall at East Legon (nearby community) ends up in this community…so with the slightest rain, all this place gets flooded* (Male Adult FGD, AdMA).

Community members explained that rapid runoff from built up areas on higher elevations overwhelms drainage systems in lower elevation regions where drains exit or worse, when there are no drains.

In addition, poor waste management and the indiscriminate disposal of waste in drains was mentioned as the major cause of flooding in all participatory methods in both districts. Some explanations were given as

> *People dispose their household waste into the drains. When you talk about it [indiscriminate waste disposal], they will ask you if the gutter is your property. They will insult you! Those of us in the Community Police fight crime such as theft in the community, but not inappropriate waste disposal (*Male youth and member of the Community Police in FGD, AMA).
>
> *The main cause of the flooding is the big gutter down there. It is very choked with solid waste; once you desilt it the flooding will cease* in this community (Male youth during transect walk, AMA).

As mentioned by participants in the qualitative data, we observed during transect walk that the water-holding capacity of many drains had reduced due to accumulation of solid waste. This causes water to overflow and cause flooding in both districts.

Intuitively, rightly engineered flood management infrastructure would prevent or abate the frequency and intensity of flooding. Uncompleted or poorly designed drainage systems on the other hand sometimes worsened the flooding conditions. These conditions was explained in the participatory methods as

Ever since the street and drains were constructed, we hardly experience flooding at this side of the community. It is those down there [pointing to the sea shore] who experience flooding during high tides and when the entrance of the drain is clogged with sand (Female Adult in FGDs, AMA).

Before they constructed the drain, we were better off! They have not completed the drains so all the accumulated water from East Legon [next town on a higher elevation] is discharged here. *I wish you were here last week to see how all the houses here were submerged* (Female Adult, AdMA

The temporal dimension of increased flood exposure was a dominant theme in the narrative of community members as it showed in the land cover change analysis. Though flooding in Accra has historical precedence, the frequency and intensity has risen in the past few decades. Respondents attributed recent observations to the prevailing land use and other changes.

We have lived in this community for years. We used to experience flooding once a while when the Ogbodzo Stream overflows its boundary. But ever since those buildings were constructed on the waterways, the slightest rain causes flooding in the neighborhood because the path for the water is all blocked (Male participant Townhall meeting, AdMA)

Another explained the conversion of water bodies to settlements and the implications on exposure to flooding.

I was born in this community. When we were children my father used to fish in the lagoon. The lagoon was good enough for washing and cooking. But it is now full of garbage and has no purpose. This place we are sitting used to be part of the river. You know, no one can cheat nature; anytime it rains, people living in this neighborhood are unable to stay in their homes. (Female Adult, FGD, AMA)

The changes in land cover observed in the image analysis was confirmed by community members. The limitation in attributing exposure to flooding to observed changes in land cover was addressed by narratives from community members.

1.2 The Choice of Adaptation Strategies to Flood Risk Management

We begin by assessing the correlation between the independent variables in order to avoid multicollinearity using the Pearlman correlation coefficients. Results from the Pearlman correlation estimation. indicates that the correlation between all the variables in all the models is less than 0.80, suggesting that the variables do not suffer from high correlation as argued by Bryman and Cramer (1990).

Results of the basic model that included only the relevant PMT variable is presented in column 1 while that of the extended model that include the barriers and socio-economic factors are presented in Column 2 of Table 2. For the basic model, only threat appraisal influences protective responses as households who felt that there were still some flood risks, although decreased in the past five years, are more likely to undertake protective response. This is consistent with the PMT that flood perceptions influence protective responses. For the extended model, we find evidence that threat experience appraisal, threat appraisal, barriers and socio-economic factors influence protective response. We are thus unable to establish the importance of coping appraisal in influencing protective response among residents in flood-prone areas in GAMA. Under threat experience appraisal, we observe that households that had previously suffered flood damage related to asset loss, water pollution, disease or loss of life seemed more likely to do nothing about flooding. While this result seems counterintuitive, it may arise when an individual resorts to non-protective responses from a feeling of helplessness and wishful thinking that damage will not occur again. In both models, decreased risk perception is found to be associated with protective actions under threat appraisal. An explanation could be that previous responses are leading to decreased risk perception which is facilitating protective action.

Both public and private precautionary actions in the past are found to facilitate private protective actions as the construction of drains in the past five years are positively associated with private protective actions. Also, households that had in the past five years modified their house structures or erected physical barriers were more likely to undertake protective actions against flooding. Furthermore, those who received information on floods and storms were

less likely to undertake protective actions. The feeling of helplessness or wishful thinking that the average Ghanaian associates with public flood information may explain this occurrence.

In terms of socio-economic characteristics, education, the status of household head as an indigene are associated with the likelihood of protective action against flooding.

Table 1: Logistic regression of determinants of protective response

VARIABLES	(1) Protective response	(2) Protective response
Threat experience appraisal		
Flood exposure	-0.001 (0.026)	-0.007 (0.029)
Flood damage	-0.747 (0.518)	-0.983* (0.508)
Flood intensity	0.000 (0.003)	0.000 (0.004)
Threat appraisal		
Increased risk	0.596 (0.521)	0.428 (0.509)
Same risk	0.668 (0.524)	0.410 (0.507)
Decreased risk	1.150** (0.496)	0.929** (0.474)
Predict flood	0.191 (0.219)	0.124 (0.244)
Coping appraisal		
Helpless	-0.410 (0.347)	-0.322 (0.399)
Info prep meeting	-0.030 (0.285)	-0.082 (0.310)
Barriers		
Community drain construction		0.854*** (0.287)
Community sea defence		0.323 (0.513)
Community desilt		0.043 (0.231)
Community demolish buildings		-1.123* (0.624)
Community waste disposal		0.028 (0.285)
Household after flood support		0.265 (0.218)
Log monthly income		-0.036 (0.056)
Modified building		0.659*** (0.223)
Erect barrier		0.620***(0.227)
Flood info		-0.667***(0.246)
Socio-economic		
Primary		0.879**(0.436)
Basic		0.831**(0.346)
Secondary		0.728*(0.408)
Tertiary		0.745*(0.387)
Female		0.038(0.253)
Age		0.001(0.008)
Married		0.081(0.237)
Indigene		0.683**(0.285)
Homeowner		-0.003(0.211)
Household size		-0.016(0.049)
Constant	0.268(0.323)	-0.498(0.708)
Districts	Yes	Yes
Observations	608	608

Source: RIPS's Survey, 2017

Notes: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

To examine factors that influence the decision of households to undertake a particular protective response as against taking no action, we estimate a multinomial logit model with the base category being non-protective response. Results of the basic and extended models are presented as Tables 3 and 4 respectively.

Under threat experience appraisal, persons who have experienced some flood damage are more likely to do nothing than reinforce their houses, suggesting that flood damage experience may be associated with wishful thinking or a sense of helplessness that leads to non-protective responses of households. This is consistent with findings by Richert et al. (2017) and Osberghaus (2015). Bubeck et al. (2012) note that risk perceptions may mediate experience with flooding in such a way that it mitigates the likelihood of taking precautionary actions against flooding. The influence of flood experience also wanes with time.

Risk perceptions under threat appraisal are associated with both protective and non-protective responses. While increased, same and decreased flood risk perceptions are associated with reinforcing houses rather than doing nothing, increased risk perception is associated with doing nothing than relocating. Also, households that can predict floods are less likely to do nothing than use sandbags but more likely to reinforce their houses than doing nothing. Contrary to the mixed impact of threat appraisal in our study, studies such as Richert et al. (2017) have found risk perceptions to influence protective responses positively. Generally, empirical evidence on the effect of risk perception is not strong (Bubeck et al., 2012). Understandably, risk perception may not always elicit fear leading to protection, but fatalism.

Under coping appraisal, helplessness was found to be associated with non-protective action rather than reinforcing one's house against flooding. Persons with a low coping appraisal are less likely to undertake flood mitigation actions compared to those with a relatively high coping appraisal (Richert et al., 2017). It is, however, possible for persons with high coping appraisal to undertake protective responses especially if they have taken sufficient actions in the past.

Table 2: Multinomial logit estimates of Base Model

VARIABLES	Sandbag	Reinforce	Clear drains	Relocate
Threat experience appraisal				
Flood exposure	0.032(0.039)	0.009(0.031)	-0.022(0.037)	-0.077(0.073)
Flood damage	-0.357(0.871)	-1.277*(0.720)	-0.972(0.687)	2.300(1.430)
Flood intensity	-0.007(0.005)	0.000(0.003)	0.004(0.005)	0.009(0.006)
Threat appraisal				
Increased risk	0.865(0.863)	1.416**(0.708)	-0.100(0.720)	-2.733*(1.409)
Same risk	1.256(0.852)	1.432**(0.714)	-0.376(0.742)	-1.539(1.206)
Decreased risk	1.321(0.814)	1.883***(0.690)	0.591(0.663)	-0.892(1.003)
Predict flood	-0.631*(0.338)	0.493**(0.240)	0.249(0.331)	-0.037(0.599)
Coping appraisal				
Helpless	0.450(0.458)	-1.081**(0.507)	-0.503(0.512)	0.430(1.160)
Info prep meeting	0.051(0.439)	-0.280(0.342)	0.255(0.402)	0.201(0.849)
Constant	-2.169***(0.568)	-0.553(0.391)	-0.615(0.469)	-3.075***(1.178)
Districts		Yes		Yes
Observations	608	608	608	608

Source: RIPS's Survey, 2017

Note: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

For the extended model (Table 4), we find evidence of threat experience appraisal, threat appraisal, coping appraisal, barriers and socio-economic factors explaining protective responses of households with the results of threat experience appraisal and coping appraisals being consistent with the base model. The threat appraisal results, however, differ in the extended model as only decreased risk is associated with the likelihood of reinforcing houses over doing nothing, suggesting that risk perceptions matter in the choice of response for residents in flood-prone areas of the GAMA.

Table 3: Multinomial logit results of Extended Model

VARIABLES	Sandbag	Reinforce	Clear drains	Relocate
Threat experience appraisal				
Flood exposure	0.027(0.042)	0.002(0.033)	-0.025(0.040)	-0.075(0.084)
Flood damage	-0.868(0.934)	-1.465*(0.784)	-0.989(0.740)	2.093(1.620)
Flood intensity	-0.007(0.006)	-0.003(0.004)	0.005(0.005)	0.004(0.007)
Threat appraisal				
Increased risk	0.972(0.909)	1.192(0.765)	-0.360(0.761)	-2.378(1.624)
Same risk	1.244(0.899)	1.105(0.765)	-0.791(0.780)	-1.485(1.435)
Decreased risk	1.422(0.864)	1.573**(0.742)	0.166(0.704)	-0.712(1.264)
Predict flood	-0.715**(0.364)	0.350(0.268)	0.243(0.362)	0.266(0.659)
Coping appraisal				
Helpless	0.357(0.503)	-1.064*(0.553)	-0.452(0.577)	1.058(1.453)
Info prep meeting	-0.144(0.480)	-0.437(0.376)	0.331(0.439)	0.356(1.009)
Barriers				
Community drain construction	1.061**(0.415)	0.385(0.356)	1.473***(0.368)	0.379(1.242)
Community sea defence	1.450**(0.707)	0.310(0.577)	-0.218(0.752)	-13.574 (1,024.508)
Community desilt	-0.379(0.362)	0.142(0.270)	0.350(0.323)	0.295(0.769)
Community demolish buildings	-0.606(0.981)	-1.295(0.965)	-1.012(0.883)	-13.423 (1,237.457)

Community waste disposal	-0.328(0.438)	0.181(0.322)	-0.033(0.378)	-1.095(1.281)
Household after flood support	0.417(0.321)	0.475*(0.260)	-0.074(0.319)	0.868(0.690)
Log monthly income	-0.169**(0.083)	0.029(0.068)	-0.013(0.081)	-0.117(0.185)
Modified building	0.451(0.349)	1.218***(0.271)	-0.011(0.348)	-0.623(0.838)
Erect barrier	0.358(0.355)	0.809***(0.270)	0.519(0.352)	0.410(0.825)
Flood info	-0.964**(0.408)	-	-0.299(0.340)	0.057(0.691)
Socio-economic				
Primary	0.692(0.686)	0.586(0.529)	1.441**(0.621)	1.317(1.476)
Basic	0.769(0.580)	0.754*(0.422)	0.834(0.542)	1.797(1.284)
Secondary	1.048	0.514	0.602	1.648
	(0.657)	(0.496)	(0.633)	(1.498)
Tertiary	0.860(0.658)	0.895*(0.476)	0.039(0.642)	2.287(1.453)
Female	0.005(0.395)	0.033(0.296)	-0.161(0.362)	0.937(0.867)
Age	0.003(0.012)	0.003(0.010)	-0.004(0.012)	-0.004(0.027)
Married	0.636*(0.370)	-0.008(0.282)	-0.253(0.343)	0.470(0.867)
Indigene	0.698*(0.409)	0.549*(0.323)	1.118***(0.387)	-0.858(1.168)
Homeowner	-0.051(0.310)	0.163(0.247)	0.084(0.305)	-1.970**(0.865)
Household size	0.024(0.073)	-0.029(0.060)	-0.022(0.076)	0.012(0.160)
Constant	-3.000**(1.179)	-1.881**(0.894)	-0.878(1.063)	-4.704*(2.714)
Districts		Yes		Yes
Observations	608	608	608	608

Source: RIPS's Survey, 2017

Note: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Barriers have mixed effects on private precautionary response. Both private and public flood mitigation measures in the past influence current private protective response as the construction of drains are associated with the likelihood of sandbagging as against doing nothing and clearing drains rather than doing nothing. Also, the construction of sea defence is associated with the likelihood of using sandbags rather than doing nothing. This is consistent with findings on the effect of public precautionary measures on private precautionary measures (see Reynaud et al., 2013; Poussin et al., 2014), although studies such as Grothmann and Reusswig, (2006) find evidence to the contrary. Also, households that have undertaken precautionary actions in the past five years are found to take further steps to attenuate the impact of floods as those that have modified their house structure and erected barriers in the past five years are more likely to reinforce their houses as against doing nothing. Furthermore, households that had in the past received some form of support after flooding were more likely to reinforce their dwellings as against doing nothing, suggesting that the provision of support after flooding does not promote non–protective responses.

Rising income is associated with the likelihood of non-protection as against sandbag use in flood mitigation. One possible reason could be that high-income earners have already undertaken some flood mitigation measures. For instance, TMA is the industrial and harbour city of Ghana with the highest average income. Despite the susceptibility of most parts to

flooding, many areas are well laid out which means flood waters recede quite quickly. The likelihood for residents to, therefore, resort to private flood mitigation is quite low.

Also, receipt of flood information is associated with the likelihood of non-protection against sandbag use and reinforcing premises largely attributable to the cynicism with which weather forecast information are received. This finding is also consistent with Botzen et al. (2009) although studies such as Miceli et al. (2008), Thieken et al. (2007) establish a positive but weak relationship between information about flooding and the adoption of precautionary responses.

Under socio-economic factors, various levels of education are associated with protection against non-protective behavior consistent with Richert et al. (2017), Poussin et al. (2014). Being married and being an indigene are also associated with undertaking a protective response against non-protective behavior while homeowners are less likely to relocate than do nothing. This is consistent with Poussin et al. (2014).

1.3: Determinants of Relocation Against Flood Risk in Urban Households

Descriptive statistics

The descriptive statistics presented in Table 1 indicated that the age of household head ranged between 19 and 99 years, with an average of 43.3 years. Regarding house ownership, the survey revealed that about 41.5% of households owned their houses with the rest (58.5%) renting the premise they occupy. This to an extent compares favorably with the work of GSS (2013) that reported that in the GAMA, about 35.2% of households own their houses while 41.0% and 23.1% are renting and having rent-free occupancy respectively. The remaining (0.7%) are either perching or squatting.

Table 1: Descriptive Statistics

Variables	Values	Min	Max	Average	Std. Dev	Exp. Sign	References
Relocate	1 if will relocate and 0 otherwise	0	1	0.2896	0.4539	-	Odilon and Lokonon (2016), Bukvic et al. (2018), Landry et al. (2007)
Independent							
Age	Continuous	19	99	43.2958	13.9157	+/-	Odilon and Lokonon (2016), Shah et al. (2017)
Age Square	Continuous	361	9801	2067.932	1383.089	+/-	
Indigene	1 if born in community and 0 otherwise	0	1	0.1869	0.3901	-	Landry et al. (2007)
Length of stay in community	Less than five years (Yes =1, No =0)	0	1	0.2252	0.4180	+/-	Odilon and Lokonon (2016), Landry et al. (2017), Bukvic et al. (2018)
	Between five to ten years (Yes =1, No =0)	0	1	0.2005	0.4006		
	Ten years and above (Yes =1, No =0)	0	1	0.5742	0.4947		
Education	No formal Educ. (Yes =1, No =0)	0	1	0.0903	0.2869	+/-	Shah et al. (2017), Landry et al. (2007)
	Basic Educ. (Yes =1, No =0)	0	1	0.5606	0.4966		
	Secondary/Technical Educ. (Yes =1, No =0)	0	1	0.2277	0.4196		
	Tertiary (Yes =1, No =0)	0	1	0.1213	0.3267		
Ownership of a house	1 if house owner and 0 otherwise	0	1	0.4146	0.493	-	Shah et al. (2017), Landry et al.(2007)

Variables	Values	Min	Max	Average	Std. Dev	Exp. Sign	References
Perception of flood risk	1 if perception of flood risk has not changed and 0 otherwise	0	1	0.5408	0.4986	+/-	Kellens et al.(2011), Liu et al. (2018)
	Increased (Yes =1, No =0)	0	1	0.1275	0.3337		
	Decreased (Yes =1, No =0)	0	1	0.3317	0.4711		
Predict flood	1 if able to predict flood and 0 otherwise	0	1	0.2537	0.4354	+	
Flood frequency	1 if flooding is frequent in community and 0 otherwise	0	1	0.7265	0.4460	+	
Adaptive measures	Continuous	0	13	3.7178	2.4945	+/-	Mabuku et al.(2018)
Home Loss	1 if lost home in previous floods and 0 otherwise	0	1	0.1052	0.307	+	Osberghaus (2017)
Income Loss	1 if lost income in previous flood and 0 otherwise	0	1	0.0928	0.2904		
Polluted water	1 if suffered from polluted water resulting from floods and 0 otherwise	0	1	0.0384	0.1922	+	
Disease	1 if suffered from disease in previous floods and 0 otherwise	0	1	0.1324	0.3392	+	
Livestock loss	1 is lost livestock in previous floods and 0 otherwise	0	1	0.0248	0.1555	+	Osberghaus (2017)
Asset loss	1 if lost assets in previous floods and 0 otherwise	0	1	0.0391	0.4883	+	Osberghaus (2017); Bukvic et al. (2018)
Material Support	1 if received material support and 0 otherwise	0	1	0.0495	0.2171	+/-	
Helpless	1 if perceive floods can be controlled and 0 otherwise	0	1	0.0792	0.2702	+/-	Wouter &Van (2012)
Flood information	1 if receives flood information and 0 otherwise	0	1	0.2129	0.4096	+/-	

Among those who owned their houses, only 13.4% indicated that they are prepared to relocate in anticipation of flooding. This indicates that a greater proportion (86.6%) of respondents who are house owners will not relocate in anticipation of flood, confirming the work of Landry et al. (2007) that, homeownership is one of the motivating factors influencing the likelihood of people not leaving their homes in Houston during Hurricane Katrina. Furthermore, about 18.7% of the respondents were indigenous, leaving the remaining 81.3% to be non-indigenes. Not surprisingly, the indigenes hardly leave the community to other places as about 92.1% of them indicated that they have stayed in the community for more than ten years. Additionally, about 4.6% and 3.3% of the indigenes have stayed in their communities between five to ten years and less than five years respectively. Among the 81.3% of the respondents that were non-indigenes almost half (49.5%) of them have stayed in their communities for more than ten years while 23.6% and 26.9% have stayed there between five to ten years and less than five years respectively

We observed that about 30.4% of the non-indigenous would like to relocate in anticipation of flood if that proposal is made to them compared to 21.2% of the indigenous. This is contrary to the work of Landry et al. (2007) that reported that indigenes were less likely to move back to their place of origin largely as a result of the trauma from the hurricanes.

In relation to education, the majority (56.1%) of the household heads have attained Basic education as their highest educational qualification while 22.8% and 12.1% have respectively attained Secondary/Technical and Tertiary education as their highest educational qualification. The remaining (9.03%) reported of not having any educational qualification. Among households that are willing to relocate, about 54.7% have attained Basic School education, 27.4% have attained Secondary/Technical education, 10.7% and 7.3% have respectively attained Tertiary education and no formal education.

With regards to the perceived level of flood risk, about 54% of households indicated that the level of flood risk has not changed or they perceive no flood risk at all compared to the past five years. Some 12.8% and 33.2% of the respondents respectively indicated that their perceived level of flood risk has increased and decreased compared to the past five years. Additionally, about 72.7% of the respondents indicated that flood is a frequent occurrence in their communities. Not surprisingly, approximately 84.2% of households that reported flood

to be a frequent occurrence in their communities affirmed their willingness to relocated should that proposal be made to them.

Respondents also alluded to the fact that over the past 5 years, measures such as construction of additional drains, cleaning of clogged gutter and deepening of existing drains to reduce flooding has been undertaken by them to reduce floods while the District Assemblies have improved waste collection, constructed sea defence walls, filled low-lying areas with sand and organized community clean-ups in order to reduce flooding.

Respondents were asked a series of questions regarding the availability of facilities like emergency responses, early warning systems, relief services, road infrastructure, post-flood alternative livelihood programmes and assistance from NGOs, among others. We use this information to construct an index- *Adaptive Measure* that measures households' perception of measures put in place by the community and authorities to adapt to flooding. A positive response was assigned a value of one and zero otherwise. The responses were assigned equal weights and summed up. In all, a total of eighteen variables were included. A higher value indicates that households perceive enough measures has been put in place to help them adapt to flooding. As indicated in Table 1, the value ranged from zero to thirteen (13), with an average of approximately 3.7 which is quite low and depicts the weak perception of households on measures put in place by the community and authorities to adapt to flooding.

The survey also brought to the fore the poor provision of flood information as only a little above fifth (21.3%) of households reported of receiving flood information from authorities. Similarly, Arrighi et al. (2019) reported that necessary information that is needed to ensure awareness, effective preparation and evacuation of flood victims is usually missing. In the absence of official information on floods, households are using indigenous knowledge to predict the occurrence of rains and consequently floods as about 25.4% of households reported of being able to predict the occurrence of flood in the community. For households that receive flood information, 32.6% indicated that they would prefer to relocate to escape the impact of flood whiles for households that can predict the occurrence of a flood, only 32.2% reported of willing to relocate as an adaptation measure.

Floods have always had a detrimental impact on both lives and properties (Kellens et al., 2011). Respondents were asked to indicate how floods have affected their households in a multiple response mode. About 39.1% reported losing some assets due to flood, 10.5% reported losing their homes whiles 13.2% reported to have suffered from flood-related diseases. Further, about 3.8% and 2.5% reported having their water polluted and losing livestock respectively. This brings to the fore the high cost of floods in recent years. Karley (2009) estimates that over US$ 6 million of asset are at the risk of flood in Accra annually while Amoako & Boamah (2015) estimate that the cost of flood damage increases by about 100 % annually. One reason for the increase in the cost of flood damage is the increased ownership of assets. Estimates from the GSS (2018, 2013) indicate that in most urban households, ownership of fans has increased by 19%, television by 24%, and fridges by 10% between 2006 and 2017.

Material support systems for victims of disaster including floods are quite weak in many countries. About 5% of households reported of receiving some material support. For households that have received material support, about 37.5% would relocate to mitigate the impact of flood if that proposal is made to them while the remaining would not.

Estimated results and discussions

The estimation results from the probit model and the marginal effects are represented as Tables 2 and Table 3 respectively. The results show that age has a quadratic effect which is convex on the probability of relocating as a mitigation measure against flood. This means that as individuals grow, they are less likely to relocate. However, at later ages, they will be willing to relocate if that proposal is made to them. This result is in line with the findings of Lokonon (2016) who reported a convex relationship between age and urban households' attitude towards flood risk in Cotonou. One probable explanation could be that, as individuals get old, they perceive to be more vulnerable to the negative impact of flood compared to when they are in their youthful stages.

Table 2: Factors Explaining the Likelihood of Relocating (Probit Model)

Dependent Variable: Decision to relocate	Coefficient
Age	-0.0397* (0.0204)
Age Square	0.000365* (0.000205)
Indigene	-0.1271 (0.1549)
House Owners (Reference: non-owners)	-0.8222*** (0.1207)
Predict flood	-0.1278 (0.1293)
Flood Information	0.3335** (0.1241)
Feeling Helpless about Flooding	0.3777* (0.1947)
Flood Frequency	0.3783** (0.1306)
Adaptive Measures	-0.04914**(0. 0211)
Length of Stay (Reference: 10 years and above)	
5-10 years	0.2730* (0.1386)
Less than 5 years	0.3937** (0.1443)
Education (Reference: No education)	
Basic	0.2487 (0.2049)
Secondary/Technical	0.4029* (0.2237)
Tertiary	0.1445(0.2488)
Perception of Flood risk (Reference: not changed)	
Increased	0.4470 ** (0.1705)
Decreased	0.111 (0.1278)
Damage from Previous Floods	
Home Loss	0.2865 (0.185)
Income Loss	0.3769** (0.1694)
Polluted Water	0.0776 (0.3291)
Disease	0.1935 (0.1653)
Livestock Loss	-0.1621 (0.3354)
Asset Loss	0.3363** (0.1207)
Material Support	0.1121*** (0.2202)
Constant	-0.2166 (0.5412)
Observations	808

Source: Authors' estimation from survey, 2017
Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Households that dwell in their own premises are less likely to relocate compared to those who are not owners as expected. The marginal effect results indicate that there is about 23.1% probability of homeowners not relocating compared to tenants. This result is in line with that of Landry et al. (2007) which reported that homeowners in Houston were about 21% likely to return to their previous dwelling after Hurricane Katrina. According to Yiannakoulias et al., (2018), the incentive for homeowners to procure various protections against flood loss is higher compared to non-homeowners, as such, they may prefer other means of adapting to floods such as elevating the ground floor, compared to relocating. The remaining (334) reported of resorting to measures like reinforcing their houses, clearing their drains, using sandbags and barricades as protection measures. This finding supports the result of Shah et al. (2017) who indicated that in Pakistan, households living in their own houses

have much freedom in choosing flood strategies and mostly opt for elevated ground floor, foundation strengthening and construction of a house with reinforcing materials.

The results further indicate that households that receive flood information are more likely to relocate when such a proposal is made to them by authorities. From the marginal effects, there is approximately 9.4% higher probability of those that receive flood information relocating compared to those that do not receive any flood information. In Namibia and Zambia, Mabuku et al. (2018) reported that early warning systems formed a crucial component of households' preparedness against flood since it alerts people of the possibility of its occurrence. Similarly, in his study Lokonon (2016) observed that providing households with flood information about their locations prior to their settlement reduces the probability of not relocating. In this study, information gathered revealed that approximately 84.7% of the respondents were not aware that their locations were prone to flooding prior to their settlement. This is disturbing and calls for a comprehensive flood map for the different localities to ensure that people are aware of the flooding situation of the places they decide to reside.

Households that feel helpless, that is, think nothing can be done to minimize flood in their communities are more likely to relocate. According to the marginal effect results, these households are about 10.6% likely to relocate compared to households that feel something can be done to minimize the rate of flooding in their communities. In their study, Wouter and Van (2012) observed that households that view flooding to be exogenous to human control are less likely to procure flood insurance as a hedge against flood. This helps us to offer an explanation to our results that for such individuals, relocation might be the best option compared to the other alternatives adaptation methods.

Table 3: Results of Marginal Effects

Dependent Variable: Decision to relocate	**Coefficient**
Age	-0.0111* (0.0057)
Age Square	0.000102* (0. 0000571)
Indigene	-0. 0357 (0.0433)
Ownership of House (reference: non-owner)	-0.2308*** (0.0308)
Predict flood	-0.0359 (0.0363)
Flood Information	0.0936** (0.0342)

Dependent Variable: Decision to relocate	Coefficient
Feeling Helpless about Flooding	0.1060* (0.0542)
Flood Frequency	0.1062** (0.0361)
Adaptive Measures	-0.0361**(0.0058)
Length of Stay (Reference: 10 years and above)	
5-10 years	0.0774* (0.0404)
Less than 5 years	0.1145** (0.0432)
Education (Reference: No education)	
Basic	0.0656 (0.0509)
Secondary/Technical	0.1104* (0.0579)
Tertiary	0.0370 (0.0631)
Perception of Flood risk (Reference: not changed)	
Increased	0.1338 ** (0.0529)
Decreased	0.0310 (0.0359)
Damage from Previous Floods	
Home Loss	0.0804 (0.0516)
Income Loss	0.1058** (0.0469)
Polluted Water	0.0218 (0.0924)
Disease	0.0543 (0.0462)
Livestock Loss	-0.0455 (0.0941)
Asset Loss	0.3094** (0.0333)
Material Support	0.0315 (0.0618)
Observations	808

Source: Authors' estimation from survey, 2017
Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

It is evident that households' perception of the responsiveness of authorities and the community to flood disasters such as the provision of relief services, ambulance services and security will influence their willingness to relocate or otherwise. Expectedly, the probability of relocating decreases with an increase in adaptive measures. A unit increase in adaptive measures, reduced the probability of relocating by about 1.4%. This could crudely indicate that, before people decide to reside in flood-prone areas they take into consideration the availability of measures to help them escape the adverse effect of floods should they occur. Indeed, information from the survey indicates that out of the small number of households (approximately 15.6%) that reported of being aware that their communities were prone to flood prior to their settlement, 61.4% of them had a perception of available adaptive measures being above the average of 3.7. This result is in line with the findings of Mabuku et al. (2018) who reported that in Namibia and Zambia, higher sense of community and self-efficacy is associated with higher levels of flood preparedness. Thus, in communities where good neighborliness exist and they believe that each other's need will be met through the community commitment, community members may feel more prepared to flood. By

implication, such households will be less willing to relocate in anticipation to flood, confirming the findings of this study.

Regarding the length of stay, the results indicate that households that have stayed in their communities for less than five years or between five to ten years are more likely to relocate if that suggestion is made to them, compared to those that have stayed there for more than ten years. From the marginal effect results, the probabilities stand at approximately 11.4% and 7.7% for those that have stayed in their communities for less than five years and between five and ten years respectively. These values are not surprising, as it is evident that the longer a household stays in a community, the lower their probability of relocating in anticipation of flood occurrence. A probable reason could be that, as people settle in a community, they build ties and organize their economic activities around them. Under such conditions, it is less likely that they would be prepared to relocate in anticipation of floods. In an interview conducted by Lokonon (2016) in Cotonou, households expressed much concern about the negative impact of relocation on the education of their children who will be obliged to change their schools and friends. Similarly, Mabuku et al. (2018) reported that in Namibia many people that have lived in flood plains for almost all their lifetime have a feeling of belonging and emotional attachment to these places and have learnt to live with the flood. Such people may also be less likely to relocate from the communities if that proposal is made to them.

Compared to household heads without education, the results indicate that household heads that have attained secondary/technical education have a higher probability of relocating. This probability stands at approximately 11% looking at the marginal effect results. We found no significant difference between the probability of those with Basic and Tertiary education relocating compared to those without education. This mixed result is not surprising since similar results have been found by Shah et al. (2017). In their work, they observed that whiles higher educational level has positive effect on adopting foundation strengthening as an adaptation strategy, it is negatively associated with the options of elevated ground floor, construction of houses with reinforced material and precautionary savings. Furthermore, Landry et al. (2007) reported that there is about 7% likelihood of households with at least college education adapting to post Hurricane Katrina.

Furthermore, households that perceived flood risk to have increased over the past five years are more likely to relocate compared to those that perceived flood risk to have remained unchanged. We found no significant difference between households that perceive flood risk to have decreased and those that perceive it to be the same regarding their readiness to relocate should such a proposal be made to them. Generally, people with higher flood risk perception will prefer to relocate as elaborated by Burnside et al. (2007) and Liu et al. (2018). Overall, one can conclude that if there is a perception that flood risk has increased, people may be willing to relocate if there is a comprehensive relocation scheme.

The results further elaborate that for households that perceived flood occurs frequently in their communities, there is a higher probability of such households relocating compared to those that perceived that flood occurrence is not frequent in their communities. Specifically, the marginal effect result indicates a percentage of approximately 10.6%.

Regarding losses, households that lost income and assets from previous flood are more likely to relocate compared to those that did not lose income and assets. The marginal effects results indicate that households that have been impacted by previous floods and suffered losses in income and assets are respectively 10.6 % and 9.4 % more likely to relocate compared to those who have not suffered such losses. This to some extent confirms the work of Osberghaus (2017) that households that have been affected by floods have the motivation to relocate in order to reduce vulnerability to flooding.

1.4: State Of Waste Management, Sanitation And Flooding

Waste Management within the Accra Metropolitan Assembly (AMA)

The Government of Ghana through the Ministry of Local Government and Rural Development has been responsible for solid waste management and sanitation services in Ghana, and the District Assembly Waste Management Department (WMD) and Metro Public Health Department (MPHD)) in Accra until private sector introduction in the late 1990s[1]. A Canadian firm (City and Country Waste – CCW) was given a monopoly to provide waste collection from 1999 yet the contract did not last and attributed to failure to meet targets.[2] The emphasis was primarily on collection, transportation and final disposal, without value addition such as recycling.

Waste management and sanitation form part of the core functions of the Accra Metropolitan Assembly (AMA), mandated by Local Government Act 1994 (ACT 462) and implemented through bye-laws of both MLGRD and the Assembly. However, the Environmental Protection Agency Act 490 gives the Agency a regulatory oversight of the standards and procedures for solid waste disposal[3]. Until the late 1990 to 2000, because the AMA solely implemented all activities relating to solid waste management in the city of Accra it spent majority of its development budget on managing solid waste only[4].

Figure 1 illustrates the Current solid waste management value chain in Accra, showing household, community, institutions and industrial waste collection, under the private sector-led management. Apart from industrial waste that is directly sent to landfills, all other wastes from the remaining source are sent to the transfer stations. AMA utilizes three transfer stations located in Teshie, Kokomlemle and Achimota, which in turn feed two landfill sites (Kpone Engineered Landfill near Tema is sited 90km turn-around travel time, and Nsumia at

[1] Owusu-Sekyere et al. (2015); CHF International / Global Communities (2012); AMA-WMD (2010); Huober (2010); World Bank (1996)
[2] Oteng-Ababio M. Private sector involvement in solid waste management in the Greater Accra Metropolitan Area in Ghana. Waste Management & Research. (2009).
[3] Owusu-Sekyere (2015) and Huober (2010)
[4] AMA/WMD (2010)

Nsawam 75km turn-around). Waste recycling may take place at the household collection level and is sent to the recycling facilities in the city. At the community level and institutions, sorting is not done hence recycling not carried out as the waste proceeds to the transfer station.

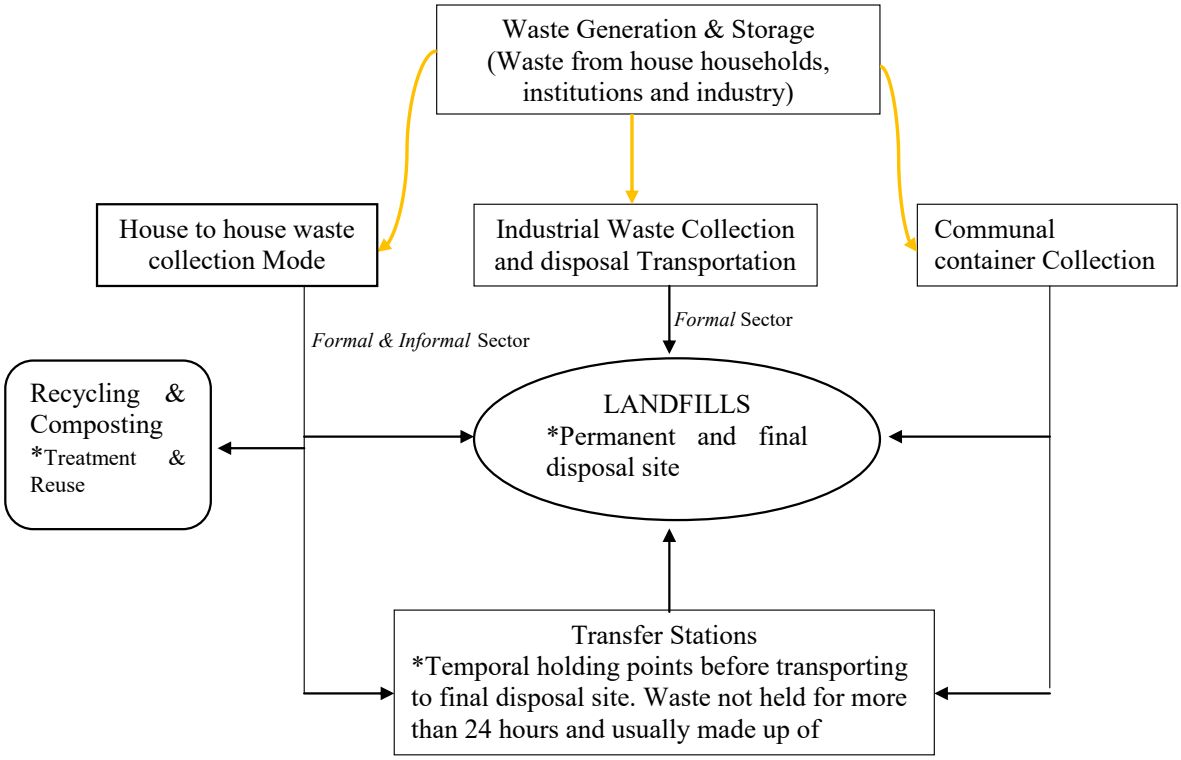


Figure 1: Current value chain of Waste Management in Accra

Institutionalizing solid waste management in AMA

Accra is currently divided into 16 waste collection zones each contracted to different waste management firm responsible for collecting and disposing solid waste. The two main sectors from which groups originate to undertake solid waste management within the AMA based on desk analyses and key informants at the Waste Management Department of AMA are (i) Formal and (ii) Informal sectors. The formal sector is made up of private contractors as well as government agencies such as the AMA itself that provide direct waste collection, transportation and disposal services to the public at the community level and often using skips which are central container collection, doing up to 15% collection. During the period 2014-2017, the AMA allocated GHS1,000,000.00 to the WMD towards the provision of dust bins, and regular collection of waste and education on proper disposal towards improved

sanitation with funds coming from the Metro Public Health Department[5]. The private sector contractors are accountable to the AMA, so they are required to produce monthly and annual reports for monitoring and evaluation purposes according to the literature. Also, they often work within specified zones (sub-metros) and operate within a regulatory framework and as such do not go beyond their jurisdictions or described task (linked to expected outcomes)[6]. Only a few residences which are a cluster of high income low density neighborhoods further inland away from the coast are covered and up to 20% of the population receiving weekly house-to-house collection. Residents are charged a fee for the service and an additional fee to lease the garbage containers and about 70% of this population pays these charges.[7]

On the other hand, the informal sector is made up of individuals and/or companies that are not accountable to the AMA and operate outside their regulatory framework/system. They are unregistered and unregulated and consist of tricycle riders, hand-pushed-carts, scrap dealers, scavengers and recyclers. The sector can be classified as indigenous but where recycling companies are large and capital intensive, classifying them under informal becomes problematic. It is postulated that the informal sector also to some extent contributed to the Assembly's strategies and activities towards the Millennium Development Goals (MDGs) such as goal 1 (eradicate extreme poverty and hunger) and 7 (ensure environmental sustainability)[8].

There is a growing reliance on the informal sector, particularly by low-income residents, since they can meander through the unplanned landscape where access by waste trucks is restricted yet it is not known how much of residents they cover. This is because their activities generally overlap with the AMA's own collection that uses central containers placed at designated points for households to deposit their domestic waste for most of the population that lives in low-income areas, representing 80% of the population. The informal sector collectors would often empty their wastes at the containers rather than going to the transfer centers. Trucks are supposed to collect the containers as needed but because these collections are less lucrative and less reliable service is variable. A variety of pay-as-you dump

[5] Accra Metropolitan Assembly 2014-2017 Medium Term Development Plan (MTDP)
[6] Pimpong and Bi (2016)
[7] Available at: http://www.modernghana.com/newsthread1/115456/1/.
[8] Owusu-Sekyere et al. (2015)

initiatives (posting a person near each central collection container to collect fees as residents and informal sector collectors dump) have not been sustained as residents simply avoided the central collection containers. They would rather illegally choose non-specified locations as dumping sites such as drains, water channels and ditches which have compounded the flooding situation in Accra. Also, recycling and re-use activities within the metropolis can be observed and are said to be on the increase yet there this has not been quantified. There are suggestions that only 2% of the solid waste is recycled and practiced informally as households in low income areas do not dispose of plastics, bottles, paper, cardboards and cans readily[9]. In high income areas, these materials are sold to middlemen to instead of disposing them along with the other refuse. The most common recyclable materials collected are plastics (Polyethylene Terephthalate, Polypropylene and High-density polyethylene), metals (aluminum, copper, zinc, etc.) and glasses. Nevertheless, the city of Accra has no formal waste recycling program or policy to reduce waste disposal at dump / landfill sites, as opposed to national level plans and strategies which are broad and non-targeted.

According to the AMA-WMD, in 2017 the informal sector collects 495 tons of solid waste per day, whereas the formal collects 716 tons per day. Although the well organized legal and operational framework including fee structure of solid waste management system in the city favors the 'formal' private waste collection service providers, the informal also play an active role by reaching inaccessible communities and are cost-effective[10]. Thus, fees are mostly low and negotiable compared to the formula based on several factors such as volume, weight, specific location, etc. In effect, informal waste collectors generally complement the works of the formal at the AMA level by working in inaccessible communities where the formal waste collectors are not often allocated because they may be having communal dump sites such as the containers and reducing the significant volumes of waste converging at disposal sites within limited time periods, thereby reducing the total amount of waste received at landfills and lengthening its lifespan.

[9] Global Project – Accra, Ghana. Mega-cities Project Website
[10] Oteng-Ababio et al. (2013)

Generally, both sectors lack the needed support through regulation and enforcement, access to capital[11] and adequate skills to efficiently and adequately manage the city's waste.[12] Formal waste collection companies are not operating at their peak because of inadequate funds and operational breakdowns.

Whilst formal waste collection services among high- and middle-income residents seem to have performed well, collection in low-income areas are very low or absent. Some informal sector waste collectors have intruded zones assigned to formal private waste collection companies by the Assembly due to mobility and timely waste collection. Table 1 shows the differences between both the formal and informal sector based on selected indicators.

Table 1: Formal and Informal Sanitation Sectors in Accra

Sector	Indicators						
	Registration / links with AMA	**Ownership**	**Payment / Agreement with citizens**	**Coverage / Accessibility**	**Frequency of Collection**	**Monitoring and Evaluation**	**Type of Contract**
Formal (companies selected through biding)	Registered & operate under a policy / regulatory framework	Companies	Fixed amount	Assigned sub-metros	Specified /Agreed days	Monthly, Quarterly, Annually	Specified duration (varies)
Informal (Tricycles, hand-pulled-carts and head pans)	Unregistered and do not operate under policy (unregulated).	Small companies and Individuals	Based on size or weight of waste	No demarcation	Anytime but dependent on residents' preference	None	None

Operationalisation of dump sites

Generally, solid waste in Accra is managed through economic instruments, landfills, incineration, recycling or reuse. Poorly maintained equipment and inefficiencies in road design and urban settlement have drastically affected the AMA's capacity to collect waste, at all the various levels (sorting, collection, transportation, and disposal). Thus, there are disruptions that threaten the environment and public health partially due to inadequate

[11] Pimpong and Bi (2016), Owusu-Sekyere et al (2015)
[12] Owusu-Sekyere et al. (2015)

financial, technical, planning and managerial resources to maintain particular standards[13]. Residents and communities close to Accra are unwilling to offer lands towards developing new landfills because of known environmental and health hazards associated with poor management as majority of Accra's physical land space no longer exist. Accra depends on neighboring districts for final waste disposal collected from citizens. Table 2 shows details of closed landfill sites within the AMA's jurisdiction. Whilst there are official closures of the landfill sites (Table 2), there are still dumping going on within the premises of these old landfill sites especially by the informal collectors attributed to lack of law enforcement.

Details of closed landfills under AMA

	Closed Landfill Sites				
	MALLAM 1	**OBLOGO 1**	**OBLOGO 2**	**MALLAM SCC**	**SARBAH**
Start Date	July 1991	January 2002	July 2007	February 2009	December 2009
Closed Date	May 2001	July 2007	September 2009	December 2009	Missing data
Area	16.06 acres	3.20 acres	1.40 acres	1.20 acres	10.45 Acres
Average Depth	20.6 metres	35.54 metres	Missing data	14.00 metres	30.00 metres
Estimated amount of waste Deposited	2,698,570 Metric tons	2,378,390 Metric tons	860,000 Metric tons	400,000 Metric tons	Missing data
Density of Waste	1.045 tons/m^3	3.6 tons/m^3	Missing data	Missing data	Missing data
Geological Condition	Rocky Old stone Quarry	Rocky Old stone Quarry	Rocky Old stone Quarry	Rocky Old stone Quarry	Rocky Old stone Quarry
Bottom Lining	40% lined with clay	60% lined with clay	Not lined	Not lined	40% lined with clay

Source: *AMA/WMD 2010*

One major aspect of managing the decommissioned sites is to be able to contain both the liquid and gaseous products of the landfills because of their potential harmful effects to the

[13] Ghana Environmental Protection Agency Website

neighboring environment as they pose pollution and health hazards. The data presented by the Waste Management Department of AMA, showed no Side Lining or Leachate[14] and Gas collection and treatment was not being done in any of all 5 landfill sites. Except for $Oblogo_1$ (Entire surface capped with about a metre of laterite at a depth of approx. 25m), the remaining 4 landfill sites were not capped. This confirms fears that landfills in Ghana fall short of the legal standards required for ensuring public health and environmental quality[15]. About 18% of households in greater Accra region (mostly low-income households) burn their waste and leachants from burned refuse can enter the groundwater, especially from household products such improperly disposed batteries in all forms, and during the rainy season. Many neighborhoods are situated in low-lying areas, used shallow wells and are susceptible to floods, as well as subject to surface water contamination. Informal sector collection is very difficult to monitor so one is unsure if they appropriately disposed waste they collect and looking at the tones of uncollected waste (Table 3), not finding ways to consciously engage the informal could worsen the waste pile up, extending pollution and blockage of water channels and the attendant floods.

Table 3: Major profile of solid waste, generation and management within AMA

Key Information on Solid Waste Management in AMA	
Estimated total solid waste generation	*1,730 MT per day (or 631,450 MT per year)*
Formal collection	*716 tons per day*
Informal collection	*495 tons per day*
Municipal collection	*120 ton per day*
Uncollected	*449 ton per day*
Formal Private Contractors (working in 9 sub-metros)	*J.S.O* *Asadu Royal* *Metropolitan & Allied Waste* *Tropical Waste* *Meskworld* *Yafuru Waste*

[14] Leachates are substances that drain from land or stockpiled material, and composition may depend on age of landfill. Leachate collection and removal is necessary to prevent pollution of soil, subsurface and groundwater. Liners must be impermeable over the life of the landfill. Capping system reduces precipitation infiltration as well as control leachate and gas migration.
Sources: siteresources.worldbank.org; Wikipedia;
http://www.waste360.com/mag/waste_landfill_containment_top;
[15] Owusu-Sekyere et al. (2015)

	ABC Waste *Platinum Waste* *Zoomlion Domestic* *Jekora Ventures* *Liberty Waste*
Current Disposal Sites	*Kpone Landfill Site* – Kpone *Nsumia Landfill Site* – Nsumia *Accra Recycling & Compost Plant* – Adjei-Kotoku *ZoomPark Transfer Station* – Achimota and Teshie-Nungua Old Compost Plant *Kokomlemle Mini Transfer Station* – Kokomlemele *Mobile Transfer Station* - Korle Gonno Ecological Restoration Project (KLERP)
Collection Fee – Commercial / Industrial (per month)	*1,100 litres – GH ₵600.00* *3,200 litres – GH ₵1,400.00* *1,200 litres – GH ₵1,218.00*
Collection Fee – Door to Door (per month)	*1st Class Residential Area – GH ₵110.00* *2nd Class Residential Area – GH ₵70.00* *3rd Class Residential Area – GH ₵30.00*

Compiled from: *AMA/WMD Data; Oduro-Appiah et. Al., 2017 and Local Government Bulletin for January 5, 2018.*

Citizens Perception on Waste Disposal and Related Challenges

The Accra Metropolitan Assembly (AMA)'s vision is to effectively manage waste and sanitation issues in the city to ensure safety and quality of life of citizens, as well as environmental sustainability. This section shows waste disposal situation in Accra obtained from a household survey and Focus Group Discussions (FGDs) conducted by the Regional Institute for population Studies (RIPS) in two major flood prone areas (Alajo and Glefe) within the AMA based on enumeration areas of Ghana's census protocol. Households in Glefe were generally within the poor wealth categories and closer to the coast and further low-lying compared to Alajo which had a combination of all wealth categories. The data was collected between November 2017 and February 2018. From the survey, about eighty-six percent (86%) of waste generated by households are made of mixed materials whereas 11% is made up of plastic (Rubber) only, as shown in Figure 2. The mixed waste is usually made up of

organic materials and indicting that those communities are clearly not affluent and were concerned about household rather than industrial consumption.

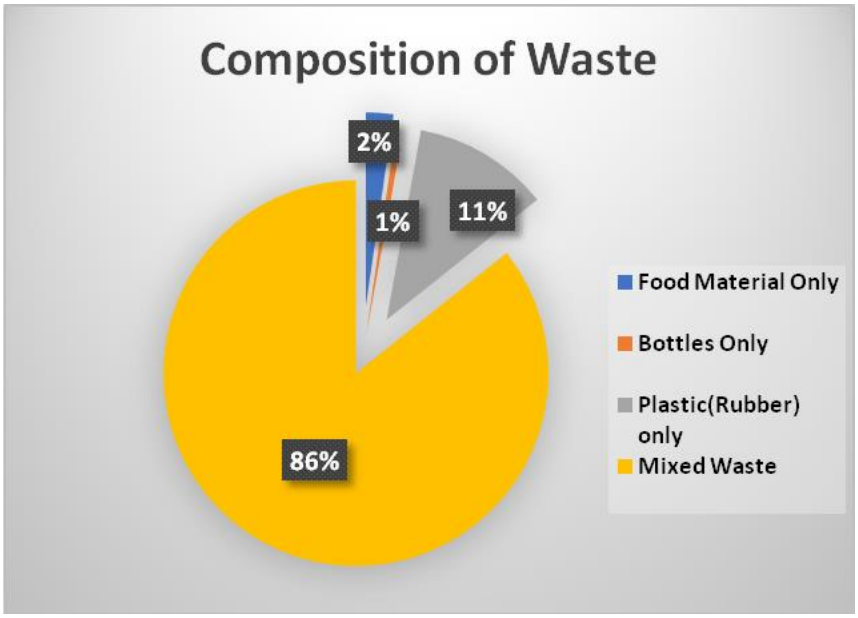


Figure 2: Composition of waste generated by Households in Accra

Out of the 175 citizens interviewed, forty-four (44%) separated their wastes. Separation of waste is done by placing plastics materials into different container and usually carried out by adult females in the household. More than half of the households interviewed separate their waste (particularly plastic / sachets) with the aim of selling it or giving it out freely to be recycled. For households that do not separate their waste, their reason included one or more of the following:

- Waste of time / no time to separate waste
- Burning of waste generated
- Lack of containers for separation
- Unnecessary to separate waste
- No knowledge of waste separation
- Double charge
- Nothing gained
- Delay in collection by recyclers

Thus, it can be said that there is general apathy towards waste separation. Whilst majority of respondents revealed they do not have the time to do the separation, very few did not have any knowledge about waste separation and the benefits. About 44% of households store their waste in plastic bags before disposal, whereas 29.4% store in bins provided by the household. Cumulatively, this shows that majority (87.43%) of the homes interviewed provide their own means of waste storage before disposal as indicated in Figure 3.

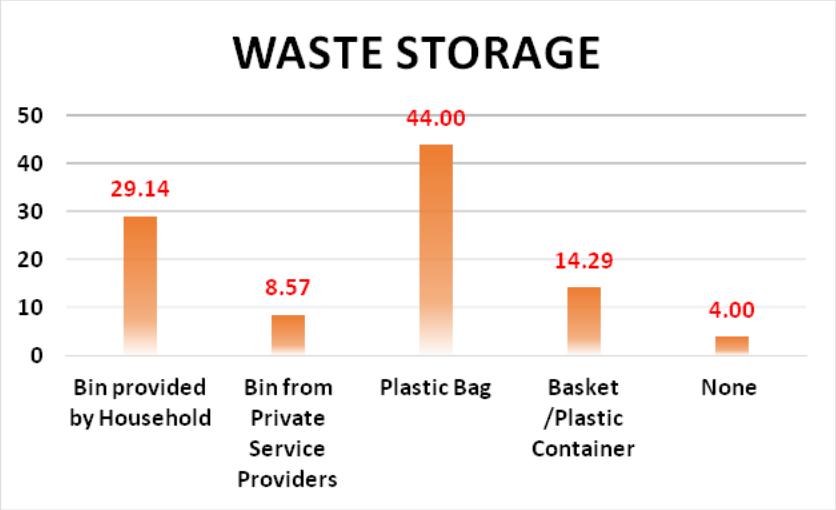


Figure 3: Waste storage by households before disposal

Only 8.57% of households have bins provided by the private waste management companies such as Zoomlion in their community. The sizes of the containers used for storage ranges from small to medium and large. About 45 percent of households store their waste in small containers or bins. With regards to the frequency to which they dispose of the solid waste, 63.43% households dispose their solid waste on a weekly basis (i.e. once or twice a week) whiles 34.29% does so daily. The study revealed that cumulatively, 36.57% of the households depend on the private services (registered companies and Kaya Bola) for waste collection and disposal (Figure 4). This observation may be as a result of the extent to which the households could be far from a community waste container or dump site. It may also be related to the income levels of the households as generally regular income earning households tend to pay for such service.

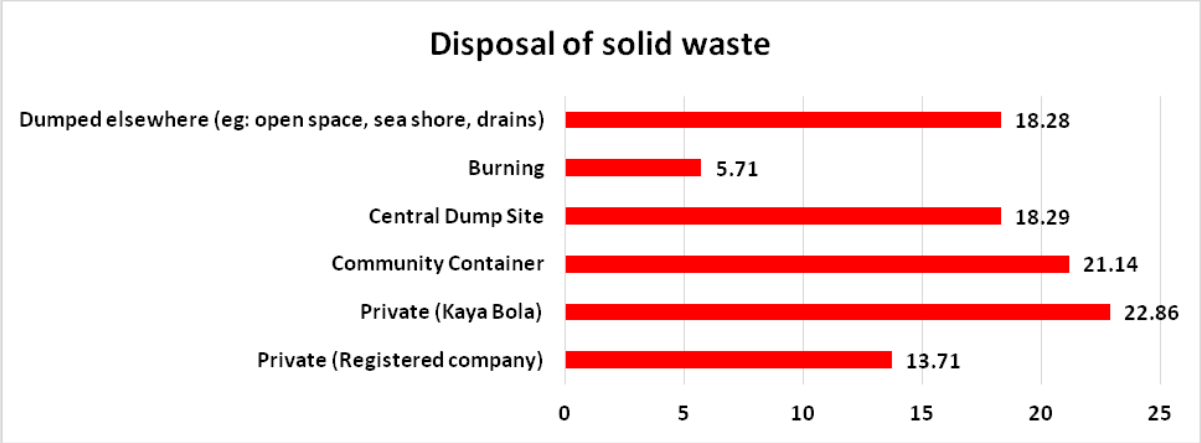


Figure 4: Household solid waste disposal methods

Fewer households (18.28%) dispose of solid waste in open spaces, drains, sea shore, etc., whereas very few (5.71%) burn their waste (Figure 4). Community containers and Central public dump site serves as a waste disposal option for 39.4 percent of households. Distance from homes to waste disposal grounds range from 5 to 1,500 metres. However, majority (89.17%) of households have their waste disposal grounds less than 160 metres away. This is suitable because the literature establishes that residents are more likely to find an alternative and illegal place to dump their waste when beyond 200 metres[16]. Although more than quarter of the households (32.43%) revealed waste is collected from the collection point daily, almost the same proportion (34.23%) say waste is not collected. For greater number of households (53%), solid waste disposal is the direct responsibility of the mother or an adult female. This somewhat depicts the role of women in waste management at the household level and as such intervention programmes can be gender sensitive to ensure greater impact. The frequency of collection and cost of service are reasons many (44.74% and 39.47 respectively) chose a waste collection service provider. For the very few, it was either imposed by the landlord or the only available option.

A greater portion (78.42%) of households pay for the waste collection option they use, and it ranges from 0.50 to 80 Ghana Cedis a month depending on the quantum of waste generated and measured by weight, size or number of bins. About 72.48% of households that engaged the services of waste collectors perceive the price of waste collection as affordable, and not

[16] Oteng-Ababio (2010) and Ali (2010).

all households. Thus, it is possible that revenue could be generated from the few households to help manage wastes from poorer households.

Close to half of households stated that there were challenges with solid waste collection in their neighborhood. About 44.59% and 31.08% indicated the untimely collection of waste and unavailability of dumping site within the community, respectively, as the main challenge for solid waste management in their neighborhood. Other challenges were:

- Irregular collection from disposal point
- Insufficient disposal sites and collectors
- Closeness to dump site to homes which poses as a health risk
- Cost involved and willingness to pay
- Dumping of waste in the drains and other open sites
- Other environmental hazards

Majority of households (93.24%) were willing to utilize the services of waste collection service providers if they were to be available in their communities.

Generally, more than 40% of households perceived plastics, metals and wood/twigs solid waste to be useful because they are able to re-use them as way of promoting self savings or even sell them off to make additional income, whiles more than 70% perceived cardboards, glasses and food solid waste as items they might not put any uses possibly because of lack awareness of their benefits (Figure 5). Households sell metal waste to scrap dealers, who in turn use them in making products such as coal pot, etc. Wood/twigs waste are used as firewood, and the plastics recycled to produce useful goods such as bags, containers, etc. These dealers often are not based in the communities and may come from long distances hence the final point not often known but could be within 5 – 8 km of the collection points. Notwithstanding, a considerable proportion of households (74.86%) would want to recycle waste if there were recycling plants readily available in their neighborhoods or communities.

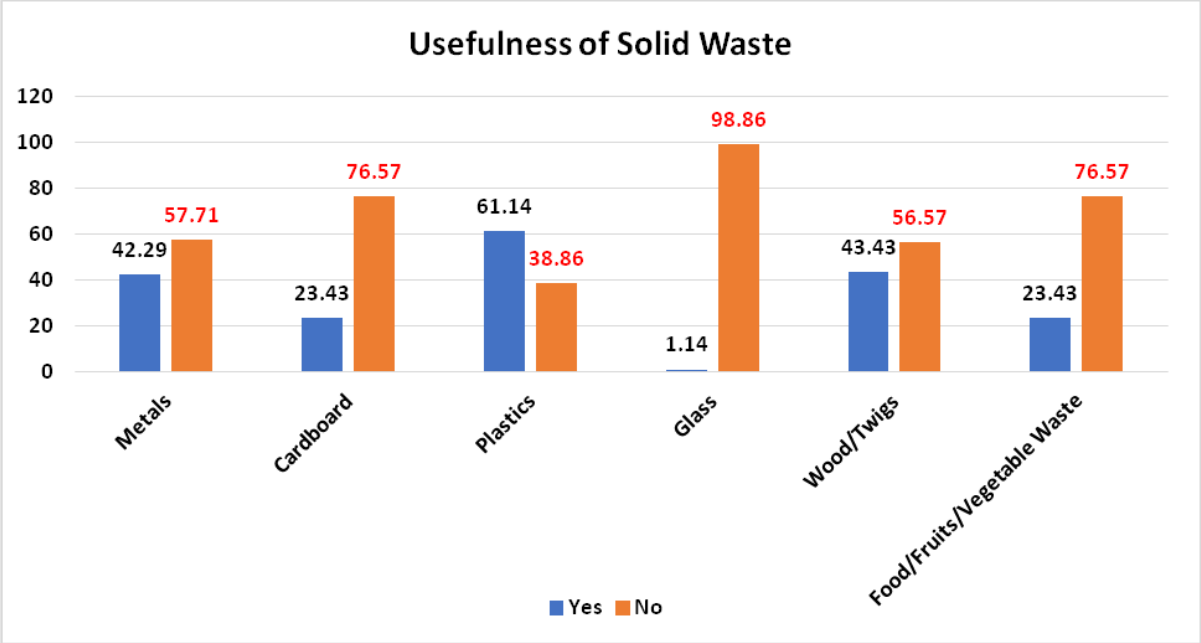


***Figure 5*: Perception on the usefulness of solid waste generated by Households**

The nexus between solid waste and Accra's floods

Water pollution is an important potential outcome of inappropriately managed waste. Unregulated remnants and debris from refuse near waterways increase the exposure of the city residents to urban flood risk. The impacts of urban floods are heightened when drainage systems and other storm control devices overflow because of waterway blockages attributed to solid waste. In the last decade, floods have become part and parcel of both social and economic development within Accra and rated as one of the main shocks that threaten the sustainability and resilience of the city of Accra. Indiscriminate dumping and refuse overflow at centralized community containers especially when close to smaller network of drains can become sources of drainage blockage. Poor communities often located further downstream suffer the consequences of floods in Accra, because such communities mostly have poor drainage infrastructure. The impacts of floods in Accra has come through varied ways such as

- Death in the case of flash floods and coastal floods, fatal injuries, minor injuries occurring during the evacuation or cleanup exercises. Injuries consist of small cuts or puncture wounds from glass debris or nails, and electric shocks can also occur
- In the short-term, the impact of floods on the transmission of communicable diseases is limited, although there is definitely an increased risk for water-borne and vector-borne

diseases such as cholera which is characteristic of Accra often following floods as a result of poor sanitation and improper waste disposal

- Flooding has damaged lifeline systems, such as the water and sanitation infrastructure, and interrupted water supply and sanitation services
- Water sources get contaminated during flooding. Latrines and shallow wells get flooded, representing a major health hazard and toxic chemicals could contaminate water sources during flooding, but this has not been adequately documented to date.
- Where rubbish has been heaped in places of work such as markets, floods have become severe occupational health hazards.
- The AMA in its 2014-2017 Medium Term Development Plan (MTDP) stated that the AMA did not experience serious flooding and no deaths were recorded for the period 2010-2013 and attributed to a total of 39.6km of storm water and road side drains were that were desilted twice every year. The total cost of this intervention was GHc 620,000.00 which was generated from its internally generated revenue.[17] In eliminating floods in the metropolis, the AMA took the following steps in its MTDP or the period 2014-2017:
- Identify All Flood Prone Areas within the Sub-Metro estimate at GHS2,000.00 from the Central Administration with NADMO as the implementing entity.
- Complete storm drains at Nima-Mamobi (Ayawaso East) and Nima East/West, Mamobi East/West and Kwaotsuru at a cost of GHS2,000,000.00 from and Urban Roads Department, and implanted by the Metro Roads Dept involving constructing drains in various communities

Perception of the causes of flooding, causes and related challenges

The perception of households about flooding has been analyzed for the same households and communities where waste issues were analyzed within the same time period. The proportion of households that agreed that there were frequent floods in their neighborhood was 50.29 percent. Of this proportion, 44.32% and 45.45% affirmed that floods occur on a yearly and seasonal basis, respectively (Figure 6). Hence there was total agreement that flood was a threat to their neighborhoods. The experiences of floods depend on several factors and

[17] Accra Metropolitan Assembly 2014-2017 Medium Term Development Plan (MTDP)

mostly the assets of households to cushion the effects or the impacts. These assets may come with diversified livelihoods where households engage in alternative activities to enable them to overcome the impacts and reducing their vulnerabilities extensively. Again, depending on households' definition or perception of floods, many of those households which experienced floods had to go through it one to four times within the season.

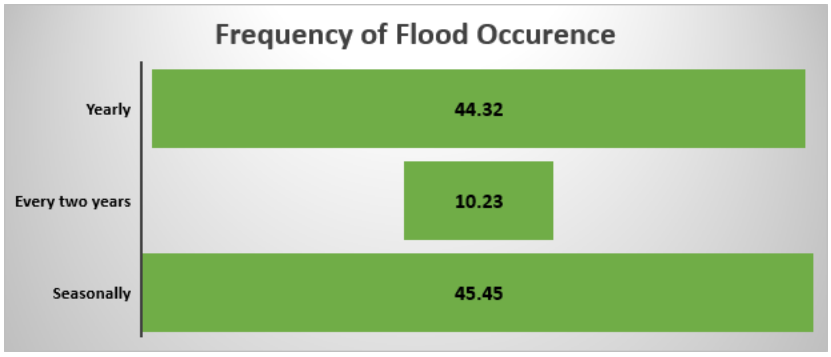


Figure 6: Frequency of flood occurrence in the last 5 years

There was consensus amongst households that chocked drains, building in water ways, poor settlement planning, poorly constructed drains, lack of drains and heavy storms are the probable causes of flooding. However, respondents selected more than one option as the causes of flooding. Within the options selected, few households (19.43%) disagreed on waste as major cause of floods but confirmed the other options as stated above, yet more than half (53.14%) affirmed that waste disposal to a great extent contributed to flooding as shown in Figure 7. This is very relevant to the discussion as those closer to drainage networks often witness at first hand how solid waste and surface runoff battle for space within the drains that tend to result in the overflow.

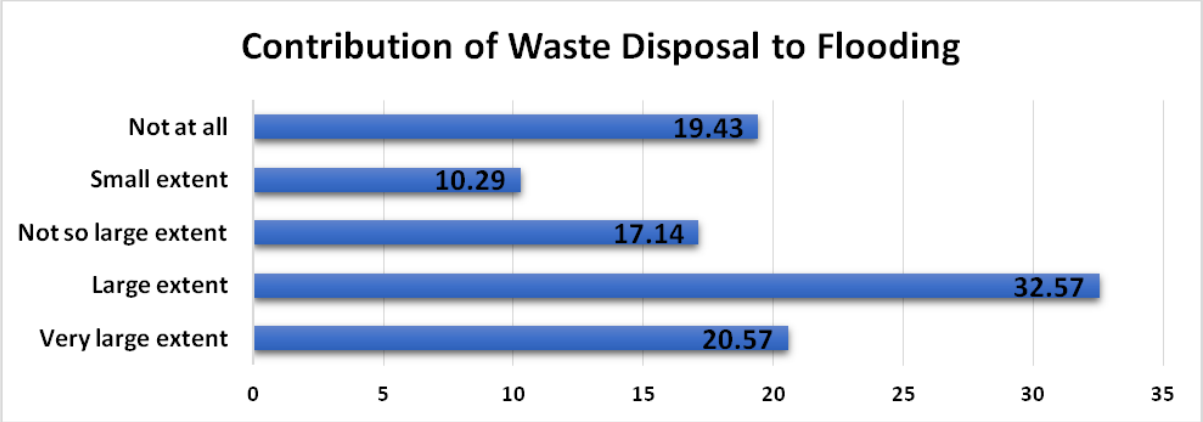


Figure 7: Perception on the extent of the contribution of waste disposal to flooding

According to more than half of households (52%) that were engaged, loss of property or asset is one of the effects of flooding in their neighborhood. Other effects are diseases (e.g. cholera) and destruction to homes and their belongings. In comparison to the last 5 years, 70 out of 95 households perceived that the frequency of flooding had reduced in their neighborhood, also because the effects must have been transferred to other neighborhoods due to poor landscape management elsewhere or improvement in drainage networks. It could also be associated with interventions by the household or other bodies/institutions to help cope with or reduce the effects of flooding. In spite of this, a minority thirteen (13) households disclosed that flooding situation had increased in the last 5 years.

Generally, 68.42% of households are unable to predict the occurrence of floods especially in the absence of any citizenry engagement platform to support them to do so. The 31.58% of households that have afore knowledge of eminent flooding depends on indicators such as intensity and duration of rainfall, as well as the rate at which the drainage channels get filled up. Preparation for floods includes reinforcement of homes, clearing of drains and packing/rearranging valuable items. Most (83.91%) households were unaware of the flooding situation in their neighborhood before settling. This shows the need for change to proactive management by identifying the risk and developing strategies to reduce that risk with the community, backed by creating policies and programmes to put the strategies into effect which the National Disaster management Organization (NADMO) has not been able to achieve. About 56% of households interviewed knew an individual or household affected by

flooding in their community, of which the majority described the situation of the affected individual/household as serious (Figure 8).

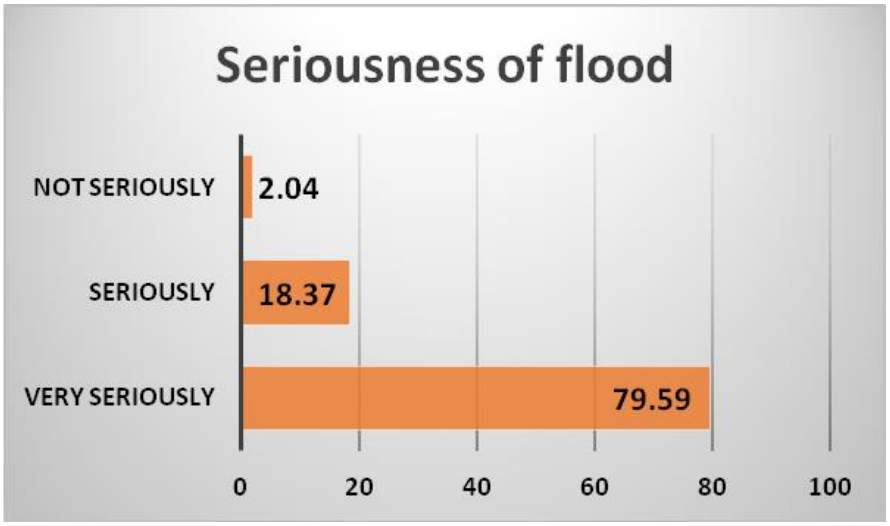


Figure 8: Seriousness of flood on affected individual/household as perceived by respondent

A significant proportion of households (50%) attributed the seriousness of flooding on the affected individual / household to loss of household assets. Almost all households disagreed to the floods as having benefits. Of the fewer households that agreed that floods have benefits, their perception was about what they receive from outside whenever there was flood, such as relief items that include food, clothing and beddings given to flood victims. More than 50% of respondents disclosed that they do not receive information from government institutions on flooding and storms of which NADMO was particularly pointed at yet the new mandate of NADMO proves them with the opportunity to pursue risk reduction activities including doing contingency plans with the communities.

Many households (87.18%) believe flooding can be minimized in their neighborhood through interventions such as construction of additional drains, widening/deepening existing drains, cleaning clogged gutters and enhancing waste collection. Over 40% of households were unaware of measures being undertaken in the communities to minimize flooding in the last 5 years, whereas few mentioned construction of sea defense and filling low lying areas. More (70%) residents interviewed are unaware or have not seen any steps being taken by the AMA in response to floods in their communities, whiles sea defense and cleaning of choked gutters

were listed by a few hence an entry point for the AMA to engage in sustainable dialogues with the residents towards enhanced community level solutions.

Majority of households indicated that no organization had taken part in solving the flood problems in their community, although a few (20.51%) mentioned NADMO. Others include the Red Cross Society and Area Development Committee. Interventions undertaken by these organizations include:

- Distribution of relief items such as blankets, mattresses, mosquito nets, rice, oil, etc.
- Money
- Cleaning of chocked gutters
- Demolition
- Sensitization programs

Only 30.77% households are willing to relocate from the flood-prone communities in which they live, whiles 12.82% were not sure of their decision. Studies have shown that those with little or no cultural attachment will be willing to relocate than those high with. For others, it is simply because they lose assets every season yet they do not have the means to find a better place in terms of finances and proximity to their places of work. The remaining 56.41% are unwilling to relocate despite the flooding challenges within the community. About 11.11% were willing to relocate to their home towns outside Greater Accra region, with the remaining 88.89% willing to relocate to areas such as Abelemkpe, Accra Newtown, Amasaman / Pokuase, Dworzwulu, East Legon, Madina, Odorkor, Ablekuma, Dansoman, McCarthy Hill in Greater Accra region and Kasoa in the Central Region These are relatively higher grounds, so it is understandable that they are safer havens for floods.

Most households (84.57%) were living in their communities during the June 3, 2015 floods which claimed many lives and properties in Accra. Since the 2015 flood, 37.14% of households stated they have experienced any other flood. However, the severity of these floods is unknown and therefore no measurable conclusion could be drawn from this figure. For some 50.77% households, most experienced flood in the month of June to August, whiles few (36.92%) is in September to October. There are overlaps and that there some that experience it all year round. Almost half of households (47.69%) had experienced flooding during the

2017 rainy season and it took between 1 to 8 days for water to recede. The water levels on the walls of homes were significant exhibits which ranged from 1 to 120 centimeters from the ground level hence are critical hotspots for flood waters.

Very few households (7.8% and 2.86%) had challenges with their source of water and toilet facility during the last flooding event that affected their homes (Figure 9). Public tap/stand pipe, sachet water and rain water harvest were the source of water households depended on during and after the floods. [For about 33.14% of households, the question regarding effect of toilet facility and flood was not applicable to them].

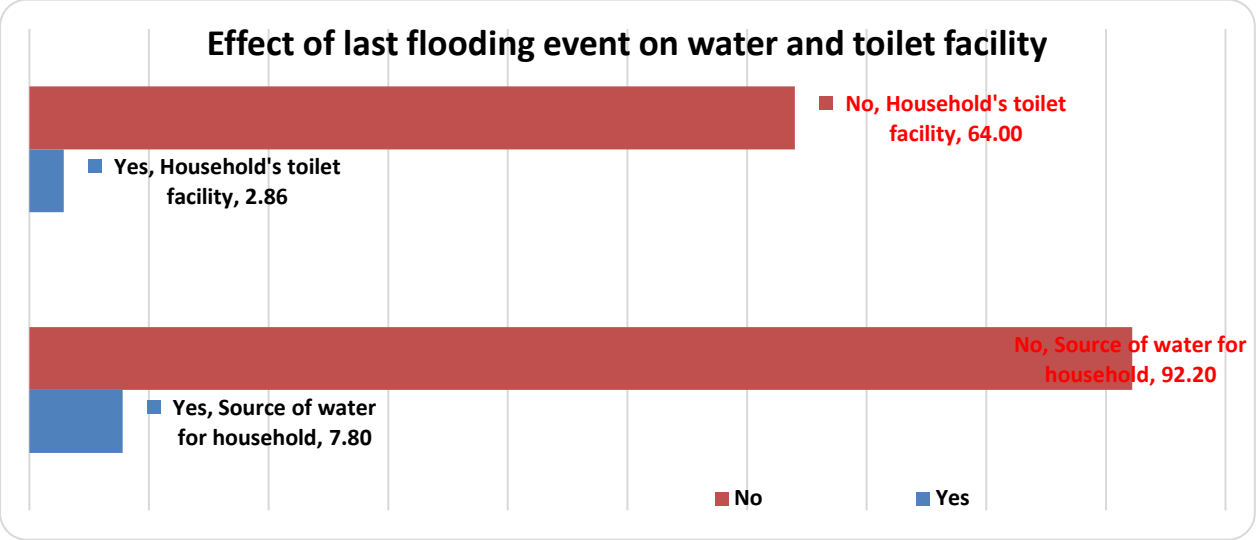


Figure 9: Effect of the last flooding event on household's water source and toilet facility.

Some households had their toilet facilities damaged, and for others their septic tanks filled with water during the flooding event, which raises environmental health and hygiene concerns of neighborhoods. In terms of vulnerability to flooding, about 42.86% of households believe all groups of populations are vulnerable, whilst 11.43% believe children only are most vulnerable. Very few (11.43%) believe women, children and the aged/elderly are most vulnerable. This tend to suggest that floods do not discriminate and could affect both the wealthy and the poor depending on where one is located and at what time or period. About 53% of households prevent floods in their community by desilting/cleaning the gutters and not dumping waste into the gutters, whereas few (13%) construct water channels (Figure 10). This means that there is opportunity for the AMA to partner the communities in finding lasting solutions to the flood menace and at the same time addressing the challenges of waste

disposal which the AMA concedes that most drainage systems have experienced waste blockade.

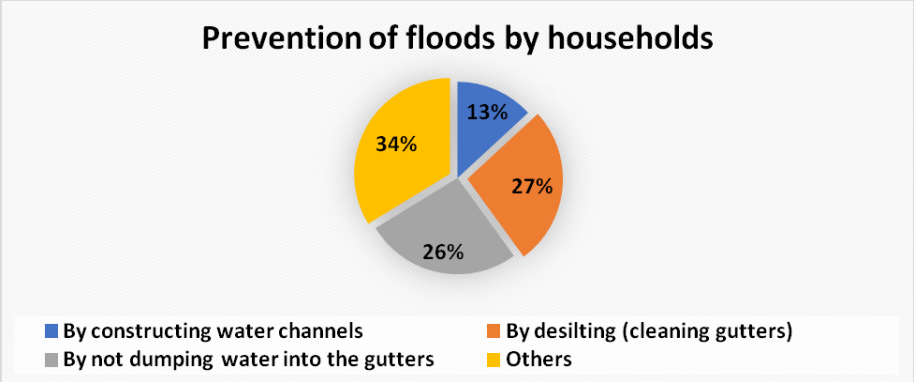


Figure 10: Ways of preventing floods by households in their communities.

Very few households (10.86%) perceived women as having specific ways of preventing floods from occurring in their neighborhood. These specific ways include avoiding dumping waste in gutters, cleaning chocked gutters and filling low-lying areas with sand bags. Similarly, about 17.14% of households believe men also have specific ways in which they prevent or minimize floods and it includes the construction of water channels and joining/supervising the women in cleaning/desilting choked gutters. Therefore, focus on gender differences is of particular importance with regard to hygiene and sanitation initiatives, and gender-balanced approaches should be encouraged in plans and structures for implementation.

In order not to impose external solutions on the communities, communities were given the opportunity to come together in different groups through Focus Group Discussion (FGD) where they listed the possible interventions that they believe will reduce the flooding challenges within their communities. Most pressing interventions were:

- Construction and widening of gutters/drains
- Construction of storm drains
- Law enforcement
- Desilting of lagoon and dredging of drains
- Road construction
- Provision of waste bins
- Demolition of wrongfully sited buildings

Challenges and vulnerabilities to waste management and floods

According to the Ghana Statistical Service (2013) and UNDP (2015), the challenges facing access to improved sanitation including solid waste disposal in cities such as Accra include:

- Poor development planning/poor infrastructure (rapid population growth outweighing waste management efforts)
- Inadequate funding for resources such as logistics, infrastructure and landfills
- Citizens attitude towards sanitation
- Ineffective coordination of sanitation delivery agencies at the regional and district levels
- Low investment in sanitation delivery
- Weak environmental sanitation monitoring and enforcement system
- Unavailability of accurate and timely data on sanitation

Although the private sector can boast of good qualities such as efficiency, innovation, economic management, low political influence and dynamism, they are faced with an array of challenges in the solid waste management and sanitation services. Low patronage of the services of formal private waste collection contractors can be attributed to unreliability of services provided, which often leads to burying, burning and indiscriminately disposal of waste in poor communities as shown in *Figure 4* above. There is a perception of increased costs to residents as a result of the unit pricing program being used although it offers residents greater control over the cost of collecting their waste. Therefore, there is need for a public outreach that is effective in addressing this perception in addition to building public consensus around the low patronage[18]. It is documented that about 20 to 30% of solid waste generated in Accra daily are not collected. This can be ascribed to one or more of the following reasons;

Limited vehicular access to some middle- and low-income densely populated communities in the city. Thus, many roads in poor neighborhoods cannot be traveled by sanitation trucks

[18] A cost benefit analysis of pay as you dump waste management programme by the Kumasi metropolitan assembly (Darku 2015)

without exposing those trucks to potentially damaging road wear-and-tear. Even for the informal sector operators, the distance from the point of collection to the central community containers / skips can be problematic when using handcarts.

Heavy street traffic condition has a significant impact on travel time and operations of waste collection companies

- Distance to landfill site and queuing. Accra has no landfill site and land acquisition challenges related to construction of landfill sites is eminent since communities are aware of hazards (health and environmental) related to poor management procedures and engineering. There are delays in clearing piled refuse along drains, market places, streets and other public spaces, along with inadequate waste containers at vantage sites. With little rainfall, the uncollected waste often finds its way into drain channels and other reservoirs in the city. Regarding informal house-to-house waste collectors, there is a challenge of lack of the needed mechanism to appropriately off-load waste without indiscriminately disposing off.

Some mini-trucks/tricycle fall over, thus emptying the content in the middle of nowhere. Where this waste is not cleaned up from the street corners, it also ends up choking drains and filling up reservoirs.

Institutional challenges related to solid waste management and its related impact on flooding is listed in Table 4. The challenges were identified based on an institutional capacity assessment conducted by RIPS using key informant interviews and participatory learning approaches as well as desk analysis to match the physical vulnerabilities of flood risks using GIS and Remote Sensing techniques. The research, which was conducted in June 2017, was aimed at identifying specific waste and flood management related responsibilities and to understand the key challenges confronting the selected institutions. This was done at the national level and included Land Use and Spatial Planning Authority (LUPSA), MLGRD, EPA, Ministry of Works and Housing, NADMO, Ministry of Lands and Forestry and National Development Planning Commission (NDPC). Overall, inadequate resources (i.e. human, logistics and capital) remain a challenge that cuts across all sectors such that major institutions at the national level require capacity building in areas of science and technology to enable them to improve on their performances. Majority of the challenges were described as severe and often linked to political economy factors. For example, privatization is described as a political capital linked to the political party in power whilst staff positions, jobs, and contracts are often also associated with party in power hence often disrupting that management of public services from changes made to leadership. Therefore, there is diminished institutional memory and deficit in skills for flood management leading to a reactive rather than a proactive approach.

Table 4: Challenges and drivers related to Solid Waste Management

	Drivers			
Challenge	**Less Severe**	**Severe**	**Most Serve**	**None (N/A)**
Sprawled development / improper settlement – close to drains, river/stream channel, across water courses			**X**	
Increase in the creation of slums		**X**		
Erosion and sedimentation due to untarred roads		**X**		

Depletion of vegetative cover and paved roads resulting in impermeability			**X**	
Limited waste collection and disposal		X		
Land acquisition for public waste disposal (Landfills / dump sites) challenges			X	
Low investment in sanitation delivery and recycling.			X	
Lack of sustained public awareness and education	X			
Weak enforcement of spatial planning regulations and development control			X	
Inadequate and inefficient drain network		X		
Flawed designed drain channels (Undersized, non-connected, etc.)			X	
Financing and implementation challenges – inadequate support from government / limited budget allocation			X	
Inadequate law enforcement waste disposal			X	
Lack of collaboration and cooperation among MMDAs and other institutions		X		
Low / inadequate technical capacity		X		
Overlap of responsibilities/mandate among government agencies		X		
Lack of citizenry participation/engagement			X	
Attitude of citizens towards waste disposal		X		
Delays in clearing piled solid waste			X	
Lack of political will and dedication (floods)			X	
Data collection challenges and data discrepancies		X		
Excessive bureaucracy		X		
Political interference and Corruption		X		

Links Between Citizens, Waste Management And Flooding

The floods-waste management nexus has become more than social and economic problem in Ghana and have taken on political dimension hence there is need to harmonize the efforts of key institutions and one way to do that is to first understand their capacities and jurisdictions (Table 5). It means that duty bearers should become closer to the people than ever in managing flood risk and emerging flood disasters and the associated waste challenges and closing that apathy gap with society.

Table 5: Institutional Actors Responsible for Waste Management, Sanitation and Floods

Institutional Actors	**Waste**	**Sanitation**	**Flooding**	**Capacity Gaps**
Government				
NADMO – national & District	-	-	• Coordinating agency for managing flood and other disasters in the country • Pre- and Post-flooding engagements (flood prevention)	• Inadequate resources (human and funding). • Weak coordinating capacity • Political interferences
Ministry of Works & Housing / HSD	-	-	• Coastal protection. • Operational hydrological.	• Poorly maintained and flaw designed drains • Poor protection / monitoring of wetlands and lagoons
MLGRD	Oversight responsibility over the MMDAs and plays a coordinating role.	• Coordinating all urban projects in the country. • Mandated to ensure environmental sustainability	Mandated with the governance aspects of flooding.	• Lack of enforcement of environmental regulation and bye-laws. • Lack of coordination between MMDAs and NADMO. • Inadequate human capacities, logistics, technology and funding

Institutional Actors	Waste	Sanitation	Flooding	Capacity Gaps
LUPSA	Physical planning of towns and cities	Physical planning of towns and cities	Physical planning of towns and cities	• Different governments/political authorities have different focus. • Poor environmental considerations, all flood retention ponds reclaimed for building or silted, Buffers on lands but not acquired and All green belt gone. • No flood maps for planning available • Challenge with Land tenure arrangements and ownership and landfill construction • Poor planning enforcements and implementation • No development controls • Inadequate human and budgetary allocation/Funding
MESTI / EPA	Provide standards and procedure	Provide standards and procedure	• Coordinating institutions for adaptation to flooding in the country • Built environment	• Lack of respect for due process, stern monitoring and enforcement of flood regulation and laws • The particular interests of politicians at the local level struggling for power might take away their attention on what matters most or capitalizing on projects they have not initiated undermine the process of flood management • Haphazard development and Inadequate drainage systems

Institutional Actors	Waste	Sanitation	Flooding	Capacity Gaps
NDPC	broad framework guidelines for the MMDAs	broad framework guidelines for the MMDAs	broad framework guidelines for the MMDAs	Policy planning done in isolation of other sectors
Ministry of Lands and Forestry	-	-	• Involved through the provision of green spaces in the city • Plan geological and forest risk management planning and flooding • Tree planting • Catchment enrichment	• Lack of environmental friendly land use policies • Lack of coordination amongst various sectors and ministries • Poor appreciation of their role in flood risk management
Individuals / Private				
Environmental Services Providers Association (ESPA)	Delivery of solid and liquid waste management services including recycling, support and initiate research programs for technology and management techniques		-	Business model approach
Coalition of NGOs in Water Management (CONWAM)	-	Influence policies remove barriers and promote access to potable sanitation and improved hygiene	-	-

Policy Coherence On Waste Management And Flooding

The fast-growing population that is accompanying urbanization in Accra is a source of continued pressure on the city's fragile landscape. Thus, the growing population is now a major area of waste management concern. The proportion of the population that has access to improved sanitation falls far below the proportion with access to safe drinking water as these two must be at par, hence it suggests that sanitation is in crisis. Similarly, although more solid waste is generated, the quantum that is properly disposed remains very low within AMA. Among the major challenges of waste management are the need for increased investment in waste and sanitation control structures at the local metropolitan level, upgrading and maintaining small-scale waste collection facilities and waste treatment. Uncontrolled industrial development means that monitoring indicators have not been adequately engaged to understand the extent to which industry would pollute the type of waste and the mechanisms of disposal due to lapses in regulatory measures observed under the institutional analysis. Thus, it is not possible to quantify which components of industry waste would require recycling, recovery, re-use and reduction, and which strategies are available to engage communities to participate in safe management of garbage and sewage from industry, also as source of income. Ghana continues to face significant infrastructure deficits in waste management such that water channels and drainage systems have become preferred place of disposal by many in the city, thus increasing exposures to floods which in turn result in human displacement, occupational hazards, pollution and poor sanitation, having consequential health and wealth implications. Whilst in practice, the convergence between poor solid waste disposal and flooding has been established, there is no known policy document that attempts to harmonize these and often treated as single separate entities, a huge gap undermining the cities-flood disaster management nexus. Issues of sanitation and especially waste management can be identified under different policies and plans from national cross-cutting to specific sectors and institutions.

The combinations of the missions, goals and objectives of the policies that follow cover all aspects of environmental health, including excreta disposal and solid waste management, setting out responsibilities for the various stakeholders, from individuals through community organizations to the MLGRD, Metropolitan, Municipal and District Assemblies (MMDAs),

Ministries of Environment Science and Technology, Health and Education, housing and the private sector. Herewith existing policies, plans and strategies of different sectors which are in any way related to waste management, sanitation and floods are scoped and implications for best practice within the AMA outlined:

Ghana shared growth and development agenda (GSGDA) (2014-2017) - The GSGDA sought to promote the education of the public on the effects of improper waste disposal; strengthening regulatory environment to provide sufficient deterrent for sanitation and pollution offences whilst investing in infrastructure for waste management through Public-Private Partnerships (PPPs) as part of the medium-term development. Thus, the AMA draws its development plans ad strategies from the GSGDA and he pursuance of the privatization of waste management meets the requirements of the PPP and subsequently this framework should help strengthen AMA's resolve to rid the city of waste. Yet AMA's deterrent measure has not gone far mostly because of the failure to engage the residents in the process.

Environmental Sanitation Policy (ESP) (2010) - The document referred to the components of environmental sanitation as the development and maintenance of clean, safe and pleasant physical and natural environment in all human settlements. It comprises of the provision and maintenance of sanitary facilities, the provision of services, public education, community and individual action, regulation and legislation. Whilst this definition applies to national level issues, there is a need to properly mainstream the elements into holistic management of waste that has positive outcomes for floods in the city. The principal components of environmental sanitation include:

- Collection and sanitary disposal of wastes, including solid wastes, liquid wastes, excreta, industrial wastes, health-care and other hazardous wastes;
- Storm water drainage;
- Environmental sanitation education;
- Inspection and enforcement of sanitary regulations;
- Monitoring the observance of environmental standards.

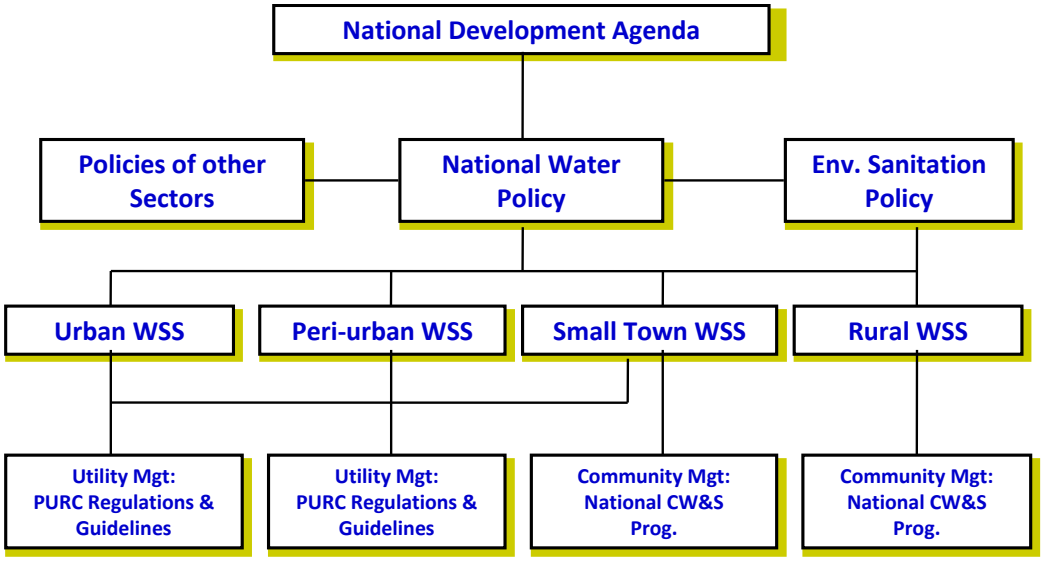


Figure 11: Conceptual Framework for WASH in Ghana

National Water Policy (2009) - The national water policy is the premise of Integrated Water Resources Management (IWRM) which uses problem-based approach in managing water in all its forms. Accra therefore has the opportunity to adopt IWRM from the angle of waste and sanitation management to enable better citizenry engagement. Integrated Water Resources Management (IWRM), in the simplest application, is a common sense logical and appealing concept for water resources management. The fundamental understanding of IWRM is that the many different uses of water resources are inter-dependent. Contaminated municipal and industrial wastewater pollutes rivers and threatens ecosystems. There are many examples of the basic theme that unregulated use of scarce water resources is wasteful and inherently unsustainable. Thus, the current sanitation and education programmes of the AMA could be better catered for under the principles of IWRM and minimizing duplication of efforts. The NWP consolidates three existing policy/strategy documents, prepared separately by CWSA, Ghana Water Company Ltd (GWCL) and the Water Resources Commission (WRC), into one policy framework (Figure 11). While the main focus of the NWP is on water supply, it does refer mention sanitation. The National Water Policy of Ghana is intended to provide a framework for the sustainable development of Ghana's water resources. It is targeted at all water users, water managers and practitioners, investors, decision- makers and policy makers within the central Governmental and decentralized (district assemblies) structures, non-Governmental organizations and international agencies. The policy also recognizes the various cross-sectoral issues related to water-use and the links to other relevant sectoral

policies such as those on sanitation, agriculture, transport, energy etc, such as impending water governance crisis; Securing water for people; Securing water for food production; Protecting vital ecosystems such as the Korle Lagoon; Water flow management e.g. the Odaw; and Taking gender disparities into consideration.,

Health sector medium term development plan (2014 -2017) - The health sector strategies are based on the Government's long-term vision as captured in the Ghana Shared Growth and Development Agenda (GSGDA). In this regard, the health sector adopts the thematic goal "To improve access to quality, efficient and seamless health services that is gender and youth friendly and responsive to the needs of people of all ages in all parts of the country". Subsequently, it mentions sanitation as part of the National Development Goals by (i) expanding access to potable water and sanitation, health, housing and education, and (ii) tackling weak linkages between the health sector and broader development processes which includes water and sanitation. The analysis in this report identifies with health issues especially during flooding as reported by a number of households. Well-being generally goes beyond diseases to encompass physical and mental health and not surprising that sizeable proportions of households were ready to leave their environment to newer areas because floods and the associated impacts.

National Housing Policy (2015) - The bearing of housing with waste management and flooding issues cannot be understated because of the link with space occupancy. For Accra with limited landscapes, the types of housing in no doubt have influenced waste and sanitation negatively. The main objectives of the Policy are: (i) To promote greater private sector participation in housing delivery, (ii) To create an environment conducive to investment in housing for rental purposes, (iii) To promote housing schemes that maximizes land utilization, (iv) To accelerate home improvement (upgrading and transformation) of the existing housing stock, (v) To promote orderly human settlement growth with physical and social infrastructure, (v) To make housing programmes more accessible to the poor (Social Housing), (vi) To involve communities and other non-traditional interest groups in designing and implementing low-income housing initiatives, and (vii) To upgrade existing slums and prevent the occurrence of new ones. The Policy generally recommends the following measures and activities for

implementation at the local level hence the need for the AMA to identify with and complies with these activities when managing waste and floods

- Develop engineered landfill sites in major urban and metropolitan areas with adequate equipment and operational funds to support waste management activities.
- Enforce building code and regulations which includes water and sanitation
- Mainstream and scale up the on-going flood disaster mitigation measures by removing properties situated in flood plains and obstructing water courses to minimize the frequency of disasters arising from such illegal blockages.

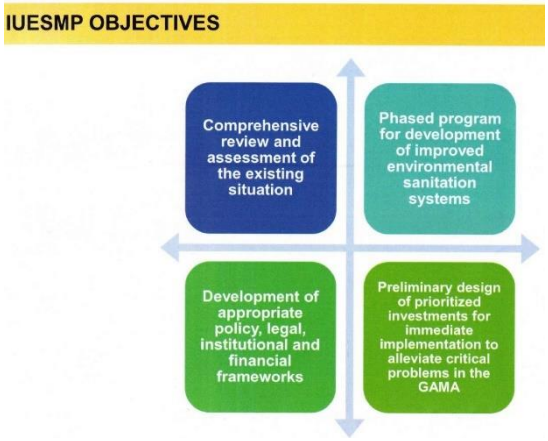
National Disaster Management Plan (2010) - The objectives of the National Disaster Management Plan (NDMP) are (i) To strengthen the Institutional capacity of NADMO and its stakeholders to perform effectively, (ii) To implement disaster management programmes at national, regional, district and zonal levels, (iii) Pursue the vision and goals of disaster management, (iv) Create a cohesive and well-coordinated programming framework incorporating Government Agencies and Departments, Non-Governmental Organizations and the Private Sector, (v) To develop the capacity of communities on Prevention, Preparedness, Response and Recovery from disasters, (vi) Restoration of the environment, disinfection of water bodies and environmental sanitation, (vii) Mapping of flood prone areas and preparation of Flood Insurance Risk Maps (FIRM), and (viii) Geographical Distribution of Hydrometeorological Disasters. The AMA has a NADMO office and should be able to engage in dialogue to ensure that this mandate which is more proactive than before is implemented to the latter. The allocation of budgets to NADMO as indicated earlier in report to embark on education and awareness campaigns on floods is appropriate and in line with the policy.

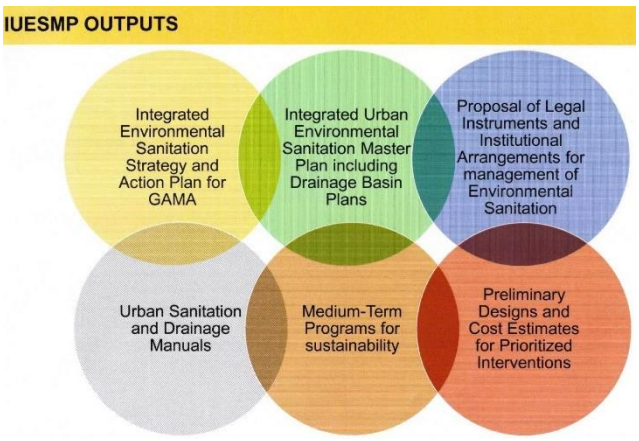
National Environment Policy (2014) - The document refers to waste management under various topics and aimed at ensuring that management of waste is inclined towards minimizing the generation of waste at source. It urges government, metropolitan, municipal and district assembly administrations to practice recycling, separation at source, waste-to-energy practices and safe disposal of unavoidable waste.

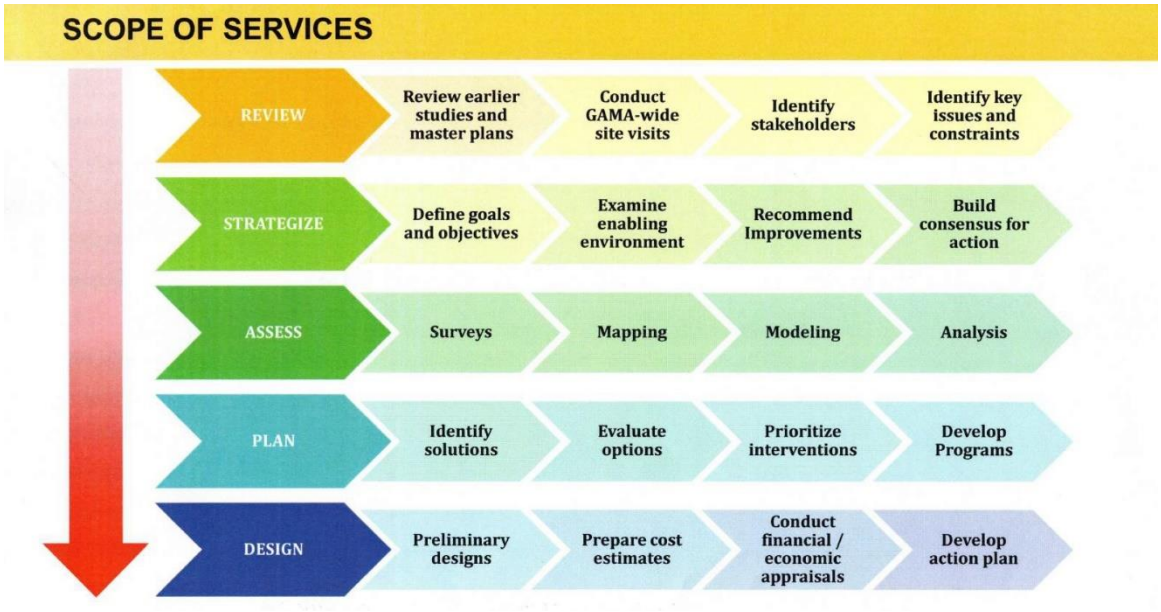
On sanitation, the policy emphasizes government's enhancement of the capacity of front-line actors in the environmental sanitation sector, especially environmental health staff, and the

private sector given urgent attention to be able to lead the application of technologies such as bio-reactor landfills. The policy further called for the reduction and management of waste generated in urban areas as a result of residential and economic activity, regulate and monitor waste production, enforce waste control measures and consolidate waste management under metropolitan, municipal and district assemblies. The AMA draws on almost all its environmental standards from the EPA including the siting of waste disposal sites.

Integrated Urban Environmental Sanitation Master Plan (IUESMP) – The IUESMP which is being implemented by the Ministry of Sanitation and Water Resources will provide for safe and effective management of environmental sanitation, including solve existing environmental sanitation and drainage problems, and provide guidance for the implementation of future environmental sanitation and drainage improvements. The AMA must foster closer collaboration with the Ministry so as to maximize returns of the project, and benefits trickling to the population in support of waste and sanitation management.







Policy Gaps

- Lack of coherency between sanitation plans (including waste management) and other sector plans (e.g. spatial planning, water resources planning, etc.)
- Other sectors' policies that touch on sanitation together with waste management are shallow and they do not influence any elements of waste management
- Waste prevention as a key strategic element that could provide the synergistic effects on other sectors' waste policy is missing. Thus, existing national policies such as the national Environment Policy does not address cross-sector approaches to planning waste management. Therefore, cross-sector waste prevention initiatives are not identified and should address not only the industrial sector hinged on cleaner technology, but also awareness of domestic and private households.
- Waste prevention and waste minimization are not clearly differentiated in policy documents and whilst waste prevention involves zero pollution at production, waste minimization entails value addition in order to reduce the amount that is generated hence these two are not synonymous and hinged on process and technological variations.
- The planning process for waste management and sanitation as a whole appear to alienate the waste generators and the involvement of the various stakeholders and the wider public could be said to be not comprehensive, reflecting lack of cultural traditions and political organization.

- Policies have not been able to keep pace with demand for water and sanitation services including waste management
- Existing sanitation and waste management plans and policies are still at the national level and have not been able to translate into regional and MMDA levels hence it appears that they are wholesale and not locally site specific.
- Policies lack coherence between drainage systems to manage storm water, and water supply and sanitation
- Policies, plans and strategies are not yet aligned to SDG 6 - Ensure availability and sustainable management of water and sanitation for all, SDG 11 - Make cities and human settlements inclusive, safe, resilient and sustainable and SDG 12 - Ensure sustainable consumption and production patterns, both related to waste management

1.5: Probability of Flooding in Greater Accra Metropolitan Area (GAMA): Implications for Flood Risk Adaptation

Drivers of Flood Frequency in GAMA: Climatic/Meteorological Factors Measured by Rainfall Variation

The average annual rainfall over the seven years were fairly stable. The estimates of rainfall variations were statistically significant positive driver of the probability of the occurrence of floods once between every one and two years, and a negative driver of the probability of flood occurring once in 7 years relative to no flood occurring. On an average, a standard deviation change in rainfall variation (about 195mm per year) significantly decrease the probability of flood occurrence once in 7 years by 5.8% and increases the probability of flood occurring once between 1 & 2 years by 6.0%, all other variables held constant. As such more floods occur as more rainfall occurs. However, an inclusion of waste disposal fees makes this relationship statistically insignificant. Thus, directly linking rainfall to flood occurrence through waste effect, given all other things are held constant.

Bio-physical Factors (measured by Elevation of household dwelling above sea level, and Land use and Land cover change).

Estimates of elevation of household dwelling above sea level was a statistically significant positive driver of the probability of the occurrence of floods once in 7 years relative to no flood occurring, whilst a negative driver of the probability of the occurrence of floods once between every 1& 2 years and floods occurring every rainy season. On an average, standard deviation (15ft) increase in elevation of a household's dwelling above sea level statistically increases the probability of flood occurring once in 7 years by 22.5%, whist decreasing the probability of frequency of flood once between one and two years and seasonally by 11.8% respectively given all other variables are held constant. As it were, higher elevations provide safer ground against the risks to flood.

The land use and land cover changes measures of the degree of land surface permeability, the soil water retention capacity, vegetation and water reservoirs changes that can possibly contribution to the development of heat islands and local climatic conditions within the city.

Land cover change is influenced by the uses the land is put into (land use). These were measured using the District as a proxy and as a categorical variable since there would be biases directly combining the household and district level variables. The districts are observed as discrete and separate units. A district land cover change was estimated as percentage change in the land cover change per classification. This land cover change estimation was made between 2000 and 2017 using Landsat 7 images with supervised classification using maximum likelihood method. These were classified into built up area, bare ground, water body, wetland and forest land cover types for the 7 districts. AMA was used as the reference category. This was due to AMA being "overly" recognised as the district with most flood occurrences within GAMA. The results show that Adentan, KKD and LaDMA experience more seasonal flood occurrence than AMA relative to no flooding in the 7 years. Also, Adentan, KKD, LaDMA and LeKMA experience more flood occurrence once between every 1&2 years than AMA relative to no flooding in 7 years. Further, TMA experience less one flood occurrences in 7 years than AMA relative to no flooding in 7 year.

A discrete change from AMA to TMA results in statistically significant decrease in the probability of flood occurring once in 7 years by 24% all other variables held constant. In other words, floods occur more frequently in TMA than in AMA. A discrete change from LaDMA as against AMA results in a statistically significant decrease in the probability of flood occurring once in 7 years by 26.9% and increase the probability of flood occurring once between every 1 &2 years by 27%, given that all other variables held constant. Similarly, A discrete change from LekMA as against AMA saw a statistically significant increase in the probability of flood occurring once between every 1 &2 years by 16.1%, all other things held constant. Also, a discrete change from Adentan as against AMA observe a statistically significant decreases the probabilities of no flood occurring and flood occurring once in 7 years by 15.0% and 47.4% respectively whilst there is an increase in the probability of flood occurring once between every 1 &2 years by 46% given all thing being the same. Of all the effect of discrete change of the various District vis a vi AMA, Adenta shows the greatest change in probability of flooding relative to AMA. These different experiences are as a result of the proportion of the land cover changes type and a spill-over effects from the districts they respectively share boundaries with. Other factors such as population density and settlement planning could further account for these effects.

i. Institutions and Flood Management

Institutions within this context refer to the organs, rules, and regulations that governs the behaviour of economic agents to reduce transaction cost and eliminates behaviours that encourage or stimulate flood risks. Whereas, flood management is conceived as the actions and decisions that seek to minimize the risk of flood occurrence. These could be actions and decision of individuals, households, community or government; local or national. These were classified into three (3); investments in soft flood management measures, investment in flood prevention infrastructure and household and community resilience activities. An interaction was created for all the three. These three (3) variables were each made up of several factors (variables) including; law enforcement building regulations and codes, construction of drainage infrastructure, desilting of drains and given weather warning and participation in reliance activities among others. A Principal Component Analysis (PCA) technique was used to reduce the dimensions of these variable to eliminate multicollinearity and to facilitate their use to the regression analysis.

The Estimates of investments in soft flood management measures and investment in flood prevention infrastructure were both statistically significant in driving the probability of seasonal flood occurrence relative to no flooding in seven years but in opposite directions. These were on a prior basis expected to reinforce each other to reduce the frequency of flood occurrence. Rather, the investment in soft flood management measures are observed here to increase the probability of the occurrence of seasonal flooding relative to no flooding in 7years whilst investment in flood prevention infrastructure decreases the probability of the occurrence of seasonal flooding relative to no flooding in 7years. The results show that on an average, a standard deviation increase investment in soft flood management measures (about 1, that is additional investment) will result in a statistically significant increase in the probability of seasonal flood occurrence of by 4.1% and decrease the occurrence of one flood in seven 7 years by 4.9% all other variable held constant. In effect, the results suggest that there will be more occurrence of floods if investment in soft flood management measures increase. As stated earlier, this is the verse of the expected outcome. But this is probably so because of the weak institutions that exist with which actors (bureaucrats, law enforcement agents and politicians) are somewhat complicit in actions that provide incentives for maladaptation, haphazard building on wetland and water ways, unreliable and inaccurate weather warning and some official lack of appropriation of the spill-over effect of

flooding(these views were confirmed during the feedback from findings dissemination fora at the various Assemblies). On an average, a standard deviation increase investment in flood prevention infrastructure decreases the likelihood of seasonal flood frequency by 4.1% and increases the likelihood of the frequency of flood occurring once in 7 years by 3.1% relative to no flood occurrence in 7 years. This is expected. As such investments in flood prevention infrastructure provide that needed outcome. However, it is costly to provide and usually such investment are done through contract awarded at the national level outside the control of the assemblies. Also, on an average a standard deviation increases in household and community resilience activities result in a statistically significant increase in the probability of occurrence flood once between every 1 & 2 years by 4.0% and decreases of seasonal flood occurrence by 3.0%, all other variables held constant.

ii. Waste and Sanitation

This existence of waste and sanitation problem in a locality results in a statistically significant increase in the probability of the occurrence of flood once between every 1 & 2 years by 15%, decrease no flood occurring in 7 years by 4.3% and decreases the probability of one flood occurring in 7 years by 9.4%, all other variables held constant. This increase frequency of floods in the presence of waste and sanitation problems are largely due to clogged drains and siltation caused by waste materials, largely plastics. These waste turns to be public good (bad). An implementation of public waste and sanitation levy may reduce the waste problem. On an average, a standard deviation (GH₵8.87, about US$2 at 2017 exchange rates) increase of a waste disposal fee by will result in a statistically significant increase in the probability of no flood occurring in 7 years by 4% and decreases the probability of one flood occurring in 7 years by 4. 9%. As it were, an appropriate price or environmental levy will help reduce or eliminate the waste and sanitation effect on flood occurrence in two ways. First, it will be an incentive to discourage public indiscriminate dumping. This must be strictly enforced to overcome free riders who will dump illicitly whilst providing appropriate sites temporal waste disposal off locations closed to drains. Secondly, the levy will also provide incentives to profit making firm to engage in waste collection in return for income from the proceeds of the levy. The results suggest that an optimal amount of the levy should be GH₵38.06 (about US$4.29 at 2017 exchange rates) per month. As stated in the results from the climate variable, specifically rainfall variation, the introduction of an optimal waste disposal fee is sufficient to

reduce if not eliminate the effect of rainfall variation on flood occurrence. In applying this pricing or levy system, a non-transferrable exemption provision should be made for poor and vulnerable households in other not over burden such households.

iii. Mode of Household Waste disposal

Waste disposal was treated as a categorical variable with the use of the private waste companies that are registered with the district assemblies (for example, Zoomlion). The use of private non registered waste service (kaya bola) as against the private registered waste company results in a statistically significant increase in the probability of no flood occurring in 7 years by 6.3%, all other variables held constant. The use of the services of Kaya bola is due to the timely collection of the waste from the households and the "pay as you give" system of payment. In this payment system, the kaya bola is paid as she/he collects that waste. No advance or arrears of payments for service exist. Whereas the use of centralised Community containers as against private registered waste company shows a statistically significant increase in the probability of no flood occurrence in 7 years by 9.7% and decreases the probability of one flood occurring in 7 years by 13.7%, all other variables held constant. Also, the use of central public dump as against private registered waste company shows a statistically significant increase in the probability of flood occurring once between every 1 & 2 years by 17.3%, all other variables held constant. Further, burning waste as against private registered waste company show a statistically significant decrease in the probability of no flood occurrence in 7 years by 11.5% and decreases the probability of one flood occurring in 7 years by 22.3%, all other variables held constant. As such, this mode (burning) will lead to more frequent floods. Burning of waste also has some negative environmental effects including the generation of carbons into the atmosphere and possible global warming when the incidence become rampant. The use of burying as mode of waste disposal as against private registered waste company shows a statistically significant increase in the probability of no flood occurrence in 7 years by 53.9%, decreases the probability of one flood occurring in 7 years by 39.2% and decreases the probability of flood occurring seasonally by 19.9%, all other variables held constant. This mode is best supported if the waste is degradable and can be used as compost. However, the limited availability of land and open space turn to limit the use of this mode of waste disposal. Household's dumping elsewhere as against their use of private registered waste company show a statistically significant increase in the probability of

no flood occurrence in 7 years by 12.3%, all other variables held constant. Dumping elsewhere include dumping into the sea, lagoons other places other. Also, dumping into the drains as against the use of private registered waste company probability of no flood occurrence in 7 years by 7%, all other variables held constant. See table 1 for details. These modes (Dumping elsewhere and dumping into the drains) are illicit waste disposal methods and should be discouraged. This behaviour could be economic and influenced largely by the none existence of incentive schemes (including reward and punishment) to discourage the illicit behaviours. Other possible incentives may be the lack of waste disposal site, infrequent collection of waste at the central dumping site and a pure free riding behaviour as most centralised waste disposal site charge a fee on disposal. Even though fees were charged at public dump site, no incentive is vigorously enforced in all assemblies to discourage noncompliance.

Household Socioeconomic Characteristics

Estimates of household members with at least secondary education are statistically significant negative driver of the occurrence of seasonal flooding, negative driver of the occurrence of flood once between every 1 & 2 years and, a negative driver of the occurrence on flood in 7 years. On average, a standard deviation increase (about 1 member) household members with at least secondary education, increases the probability of no flood occurrence in 7 years by 2.0%, increases the occurrence on flood in 7 years by 3.9% and decreases the probability of the occurrence of flood once every 1 & 2 years by 4.7% given that all other variable are held constant. This may be due to the fact that higher levels education makes the household either flood risk adverse or at least risk conscious. Also, estimates of number of household members employed is a positive driver of flood occurring seasonally, once between every 1 & 2 years and one flood occurring in years. As it were, on an average, a standard deviation increase (about 1 member), significantly decreases the probability of no flood occurring in 7 years by 3.6% other things held constant. This may be due to the quest of proximate place of dwelling to place of work in order to minimize cost of commuting and afford accommodation.

Policy Recommendations

i. Non-structural adaptation options should be encouraged.
ii. There should be an implementation incentive schemes to support lawful waste disposal and timely waste collection from disposal sites.

iii. Empowerment of Assemblies in flood management; contracts and procurement processes should be reviewed to support investment in flood mitigation
iv. Ensure a consistent implementation of National Climate Change Adaptation Strategy [NCCAS] to avoid Maladaptation in flood prone areas and wetland.
v. Flooding in GAMA should be treated as an externality with collaborative actions
vi. A design of a national flood policy and flood insurance with targets to the poor
vii. Relocation of the Nation's Capital and/or some Business Districts out GAMA. *This will aid decongestion the cities and decrease occupation of flood prone areas*.

Way Forward

i. Assess household preferred flood adaptation option based on these findings
ii. Assess their willingness to pay or contribute for the flood adaptation solutions in their communities.

Table 1: Marginal Effect (Change) on Flood Outcomes

Dependent Variable: *Flood frequency* *(Effect of Standard Deviation/Discrete Change in the Independent Variable on the probability of the Flood frequency)*	**NO FLOODING**	**FLOODS ONCE IN 7 YEARS**	**FLOODS ONCE BETWEEN 1 & 2 YEARS**	**FLOODS SEASONALLY**
Meteorological				
Rainfall Variation	-0.009	-0.058**	0.060*	-0.011
Bio-Physical				
Elevation (Topography)	-0.011	0.225***	-0.118***	-0.118***
District				
LaDMA vs AMA	-0.075	-0.269***	-0.270***	0.075
LeKMA vs AMA	-0.082	-0.065	0.161**	-0.015
AdMA vs AMA	-0.150*	-0.474***	0.460***	0.165
Ashiaman vs AMA)	-0.039	-0.005	0.030	0.014
TMA vs AMA	0.095	-0.240**	0.056	0.089
KKD vs AMA	-0.110	-0.167	0.106	0.170***
Institutions and Flood Management				
Investment in Soft Flood Management Measures (SFMM)	-0.011	-0.049***	0.019	0.041***
Investment in Flood Prevention Infrastructure (IFPI)	0.009	0.031**	0.002	-0.041***
Household & Community Resilience Activities (HCRA)	-0.000	-0.009	0.040***	-0.030**
Waste and Sanitation				
Sanitation Management Problem (Yes vs No)	-0.043*	-0.094***	0.150***	-0.014
Waste disposal fees per month	0.040*	-0.049**	0.013	-0.004
Mode of Household Solid Waste disposal				
Private (kaya bola) versus private registered waste company	0.063**	-0.087	-0.015	0.039
Community container versus private registered waste company	0.097**	-0.137*	-0.036	0.075
Central public dump versus private registered waste company	0.020	-0.009	0.173**	0.162
Burning versus private registered waste company	-0.115*	-0.223***	0.116	-0.008
Burying versus private registered waste company	0.539*	-0.392***	0.052	-0.199***
Dumped elsewhere versus private registered waste company	0.123*	-0.129	-0.095	0.102
Dumping in the drain versus private registered waste company	-0.070***	0.021	-0.081	0.130
Other (specify) versus private registered waste company	0.175	0.159	-0.137***	-0.107*
Household Socioeconomic Characteristics				
Household weekly Income	0.020	-0.006	0.012	-0.026
Members with at least Secondary Education	-0.020*	0.039***	-0.047***	-0.012
Number of household members employed	-0.036***	-0.006	0.026	-0.016
Years Household Head lived in location				
Lived in location for more than 10 years versus all his/her life	-0.092**	0.046	0.045	0.001
Lived in location for 5 to 10 years versus all his/her life	-0.093**	0.024	0.054	0.014
Lived in location for 1 to 4 years versus all his/her life	-0.129***	0.113**	0.025	-0.009

*** p<0.01, ** p<0.05, * p<0.1

1.6: An Examination of Households' Willingness to Pay for Flood Risks Adaptation in GAMA

The willingness of citizens and residents to contribute resources for the provision of a public good is premised on the assumption that they (the contributors) trust that the recipient will and is capable and able to use the resource for the intended purpose that maximizes their welfare. The study found that the respondents have about 39.7% trust that the Government of Ghana will effectively implement the flood adaptation project if given the resources. They expressed 38.9%, 43.5% and 56.8% trust in Private Sector Profit Making Organisation, Private sector Non-Profit Making Organisation and International Development Agency respectively that given the resources, they will respectively see to the effective implementation of the flood adaptation project in the communities. This therefore suggest that the respondents have less trust in the government to implement flood adaptation project even if given resources.

Willingness of Households to contribute labor and cash

From Table 2, 89.63% of the respondents expressed their willingness to contribute either labor, cash or both to implement the flood adaptation project.

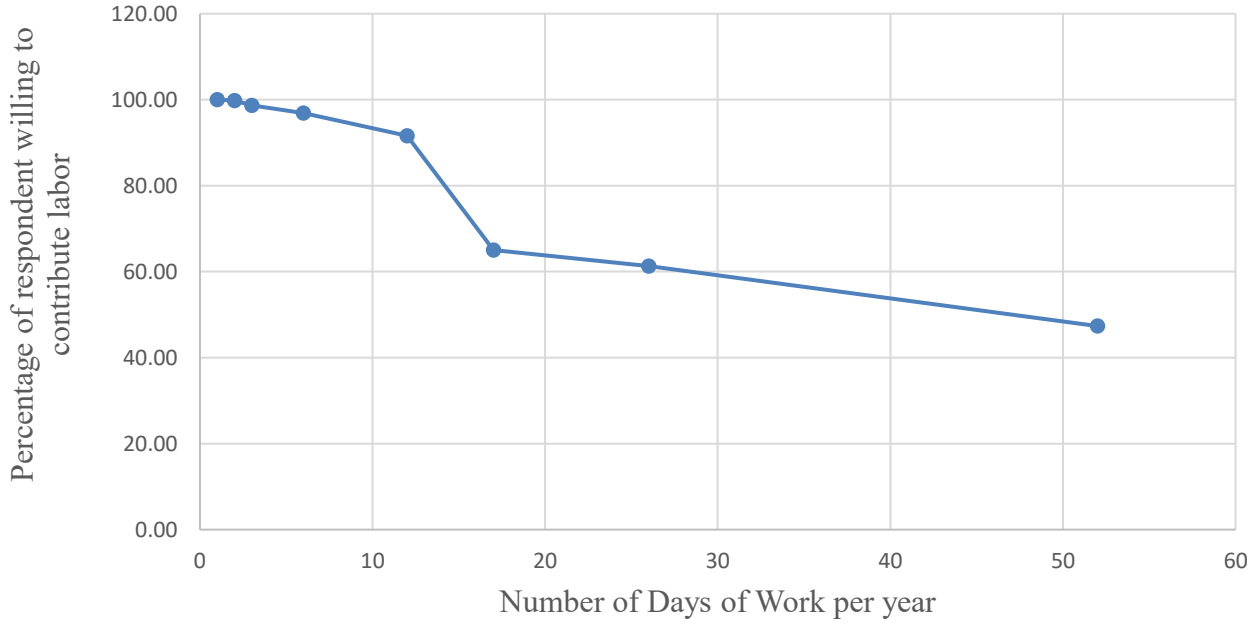
Table 2: Respondents willingness to contribute cash and/or labor for the project

Respondents	Freq.	Percentage	Cum. Percentage
Not willing to contribute to the project	64	10.88	10.88
Willingness to contribute Labour only to project	401	68.20	79.08
Willingness to contribute Cash only to project	65	11.05	90.13
Willingness to contribute both Cash and Labour to project	58	9.87	**100**
Total	**588**	**100**	

Willingness to contribute Labor

Respondents were more than 80% certain that they make the contributions. 70.41% of the respondents expressed their willingness to contribute at least 8 hours a month for the implement of the project. 68.7% of respondents were over 80% certain that they will contribute at least 8 hours a month. See Figure 1. This amount to, at least, about Gh₵38.01 per day. This amount is far in excess of the daily minimum wage of Gh₵9.68 as at 2018. About 8.2% of the respondents indicated their willingness to contribute between 8 labor hours once per week and once per year inclusive for the implementation of the project. This amounts to cash equivalent of between Gh₵38.01 and Gh₵1,976.52 per household per year.

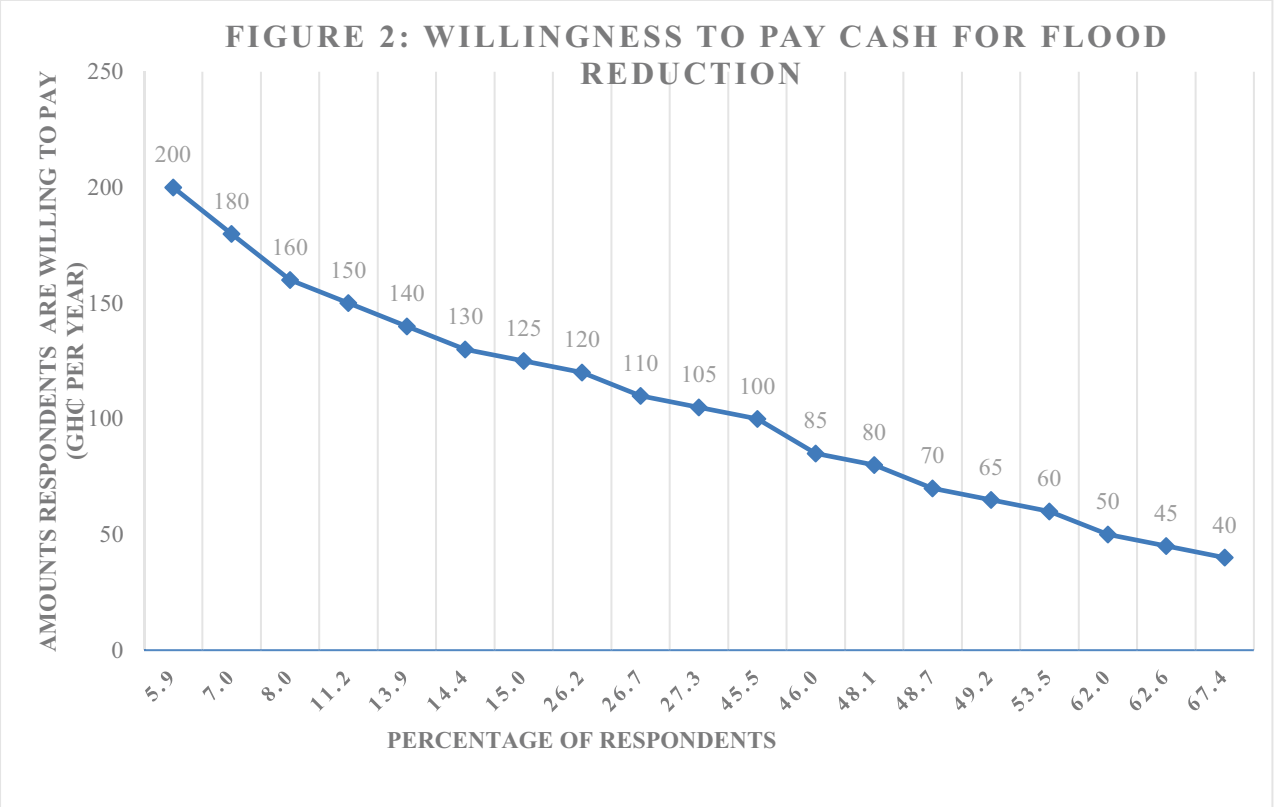
Figure 1: PERCENTAGE OF RESPONDENTS WILLING TO CONTRIBUTE LABOUR



Cash Contribution

For respondents willing to pay cash, 14.46% of all respondent households indicated their willingness to pay (WTP) more than GH₵100 a year for the implementation of the project. Out of these households, 14.12% and 3.53% indicated their WTP more than Gh₵100 monthly and every two years respectively. Whilst the remaining 82.35% were WTP a one-off contribution. About 10.88% of the respondent households indicated a zero WTP for the implementation of the project. The stated reasons they provided among others include; our household do not

experience flooding, it is the responsibility of the government to development the communities, we are poor and we are not strong to provide labor.



Households' Preferences for Flood Adaptation Options: An Attribute Base Approach

Based on the choice sets, the households were willing to contribute between Gh₵25 and Gh₵150 (inclusive) per year for finance 93.17% of their preferred choice sets. 84.97% of the choices on drainage infrastructure preferred at least few (minimum) drainage infrastructures. The provision of limited number of minor drains with no major drains in the neighborhood with limited capacity to contain rain runoff. This could reduce rain water over flow to 20% (1 flood in every 5 years). 65.76% of the choices on Sanitation and Sewage preferred at least the neighborhood being moderately clean. That is, a little improvement in the waste and garbage collection that reduces the chocking of rain water runoff. 3 large waste disposal bins are provided for the neighborhood waste collection. Fewer illicit waste and garbage damping issues still exist. 36.31% of the choices on land use practice preferred an improved regulation changes in land use practices in the neighborhood. where policies on low and wetlands, pavement and forest are implemented and enforced. Hence water ways are cleared, increase

rainwater seepage, improves rain water runoff and reduces flooding. 29.56% of the choices on Weather Warning preferred Very accurate weather warning: 99% accurate as an option for flood adaptation. Overall, 6.84% of all the households' choices indicated a preference for their status quo.

Variable	Obs	Mean	Std. Dev	Min	Max
Drainage Infrastructure	9,408	1.821535	1.067677	0	3
Sanitation and Sewage	9,408	0.9961735	.8252076	0	2
Land Use Practices	9,408	0.9552509	.8769372	0	2
Weather Warming	9,408	.8770196	.8361397	0	2
Cost Price	9,408	75.12224	45.25257	0	150

Conclusion

The Analysis of the willingness to pay for the flood adaptation and the attributes of the adaptation options, incorporation household risks and time preference and the households' predicted flood risk probabilities are yet to be computed

1.7: Public Organizational Capacity and Integrated Flood Risk Management

Organizational structure and coordination

Some identified institutions and organizations with direct and indirect stake in managing flood risks are listed in Table 1.

Table 1: Key organizations in flood disaster management

i.	District / Municipal Assemblies (MMDAs)
ii.	Ministry of Local Government and Rural Development(MLGRD)
iii.	Ministry of Environment, Science, Technology and Innovation(MESTI)
iv.	National Disaster Management Organization(NADMO)
v.	Environmental Protection Agency(EPA)
vi.	Town and Country Planning Department (TCPD)
vii.	Hydrological Service Department (HSD)
viii.	Ghana Meteorological Agency (GMA)
ix.	Ministry of Works and Housing (MWH)
x.	Ministry of Interior
xi.	National Planning Development Commission (NDPC)
xii.	Water Resources Commission (WRC)
xiii.	The Universities and Research Organisations

A national public organization, the National Disaster Management Organization (NADMO)- under the Interior Ministry, was established by an ACT 517 of 1996, with the exclusive and sole mandate to manage and coordinate all manner of disasters in Ghana, including flood (NADMO, 2010). It is structured vertically and horizontally to enable representations at the national to the zonal levels. The other state organizations that were co-opted to make technical inputs for managing flood disasters in Ghana were assigned roles related to their core mandates NADMO (2010). NADMO has established DRR and CCA national platforms, composed of civil society organizations, national finance and planning institutions, key economic and development sector organizations.

According to NADMO officials, inadequate resources challenged their ability to prepare and implement plans and programmes. Regular inter-organizational committee meetings which

are initiated by NADMO to address issues on disaster management were usually hampered. There was inadequate networking and sharing of information among stakeholders due to were weak horizontal and vertical corroboration between and within organizations. Communication between the national and the lower administrative bodies was poor. Decisions taken at the higher levels were scarcely communicated to the lower levels. Some organizations were not adequately informed of their roles in flood disaster risk management. In times of disaster events, response actions of different organizations overlapped due to poor coordination. These weaknesses affected the delivery of expected goals (Newig and Fritsch, 2009). Apart from NADMO, representation of public organizations at the regional, district and zonal levels was poor since they were not fully decentralized. Hence, any coordinating role of NADMO, effectively, existed at the national level. The role of NADMO at the local government level was rather weak, as meetings was held at the instance of the district, municipal, or the metropolitan chief executives, by virtue of being the de jure head of the security arrangements at these levels. Typically, these are political appointees whose interests were political and governance rather than flood disaster risk management.

ORGANIZATION	ROLE
Ministry of Local Government and Rural Development (MLGRD)	• Formulation and implementation of policies • Coordinating of activities MMDAs under decentralized system
Ghana Meteorological Agency (GMet)	• Meteorological data gathering and dissemination, weather and climate forecasting.
Town and country Planning Department (TCPD)	• Preparation of layouts and land use schemes for settlements and infrastructural development. • Promotion of sustainable human settlements development.
Ministry of Environment, Science Technology and Innovation (MESTI)	• Environmental policy formulation and implementation, e.g. climate change policy
Environmental Protection Agency (EPA)	• Awareness creation of the importance of ecological sensitive areas that regulate and control flooding. These include wetlands. • Adoption of an ecosystem approach in relation to flood management. • Provision of technical advice planning and other relevant stakeholders when issuing out of permit for large scale development projects.
Ministry of Works and Housing (MWH)	• Constructing and maintaining of primary drains • Coastal protection, desilting of water receptacles such as wetlands, lagoons
Ministry of Lands and Natural resources (MLNR)	• Establishing of green belts, protection of watershed catchment, wetlands protection.
National Disaster Management Organization (NADMO)	• The main organization established in 1996 to manage disasters as part of the UN Yokohama strategy for a safe world recommended strategy for all countries in 1994. Responsible for the management and coordination of all disasters, including flood disasters in Ghana.
Hydrological Service Department	• Responsible for engineering services by identifying and conducting hydrological and hydraulic analysis for flood prone areas

Management Processes: Integration, participation and enforcement

There was a diversity of socio-economic, environmental, administrative and cultural systems spreading across different basins of rivers and streams. These structures and processes formed a complex socio-ecological system. For instance, within the GAMA area, different local government areas share common river basins (Figure 2). Different land-use activities of different administrative areas influence flood disaster regimes of low lying areas in GAMA. Within GAMA, different segments of the population were subjected to different levels of flood risk. Yet, these were not identified to address their specific concerns. Flood risk assessment is not conducted to inform targeted decisions. Different decentralized sectors carried out activities whose objectives might conflict with flood disaster risk objectives. In Ghana, traditional authorities are empowered to dispose of lands within their traditional jurisdictions for all manner of land uses. They would usually do this without recourse to existing physical planning schemes created by public organizations. These traditional authorities may also not be directly involved in urban land use planning.

Existing situations prevailing scenarios necessitate the need for a stronger and wider partnership and collaboration among different sectors and administrative regions, districts and, even national ones (UNISDR 2015). A basin-wide, integrated and participatory processes in flood disaster risk management has also been recommended (IPPC 2012; Hyogo UNISDR, 2005; (WMO,2008) UNISDR, UNISDR, 2015a). In practice, though, public organizations do not initiate and facilitate collective decisions process that is collaborative, participatory, integrated, and with a basin-wide management framework. Sectional decisions are made that may transfer flood risk from one section of the basin to the other (ref). Pahl-Wostl et al. (2012) have shown that IFRM systems with the highest performance show high resilience and are characterized by polycentric governance, the distribution of power, and effective coordination. Effective FRM system should allow for active stakeholder involvement that enable individual and collective learning, building a sense of ownership and improving in compliance (Özerol, 2012). This may often mean a change in culture, which can only be brought about by relevant professionals and major stakeholders (Ashley et al., 2012).

Enforcement is another weaker cultural link in the management process of flood disaster risk, a view passionately expressed across the organizations. Where legislations and policies existed, they were usually flouted with impunity. Laws were scarcely enforced: only reactive remedial measures were taken, usually with limited effect at very high cost (White, 2010). Typically, regulatory policies on wetlands, green belts, buffer zones around water bodies, etc. in GAMA were reactively rather than proactively enforced. Buildings in waterways and wetlands would occasionally be demolished by officials of public organizations after disastrous and costly flood disaster events. According to the TCPD and Environmental Protection Agency, Ghana (EPA) officials, wetlands and retention ponds in GAMA that are designated to control flood were being silted, or deliberately filled for construction. Even, a RAMSAR wetland with international ecological significance has not received adequate protection from public organization: it was under severe threat of encroachment.

Knowledge and technology applications

The national disaster management plan of Ghana (NADMO, 2010), identifies disaster risk reduction as overarching management paradigm in Ghana. However, no specific documented plan exclusive for flood disasters existed. Only sections of the general plan are devoted to flood disaster management. It identifies tasks that cover all aspects of disaster management, namely: prevention, mitigation, preparedness, emergency response, relief and recovery. The need for disaster awareness creation, public education, training, technology transfer, research and development, capacity building etc. are articulated in the plan (NADMO 2010).Obviously, these are requirements for IFRM (Johnson and Priest 2008; Hartmann and Albrecht 2014), and in principle, evidence awareness of contemporarily knowledge perspectives and global recommended approaches on flood disasters risk management approaches(Sayers et al 2010, Cook et al., 2016 ,UNISDR, 2009; IPCC, 2012; Lane, 2014).

However, this study revealed a striking mismatch between the disaster plans and actual practice. Many officials of the organizations contacted lacked adequate knowledge and the capacity for operationalizing IFRM processes for sound strategy formulation and implementation. Many of those consulted could hardly decompose flood disaster risk into the

various dimensions of vulnerability and flood risk. This agrees with earlier observations that institutional failures may be due to uneven evolution of knowledge and application of DRR (Briceño, 2015). They could hardly distinguish between flood disaster risk and flood hazard: have poor and, sometimes wrong understanding of disaster risk. Hence, the organizations have exaggerated focus on managing flood hazards rather than risk. For instance, under the Community Resilience through Early Warning (CREW) project commissioned in 2013, through the collaboration of the UNDP and Government of Ghana (GoG). The CREW project was implemented by NADMO in a few out of more than the 270 districts in Ghana. Hazard rather flood risk was mapped. Yet, many instances it was designated as flood disaster risk. Seasonally, flood hazard events were keenly anticipated, with high investments in preparation for response efforts. There are limited investments in preventive measures as recommended by international policies, conventions and protocols(UNISDR 2015b). Similar observations have been made by Kreft and Eckstein (2013), and others (Sammuels 2010, WMO 2009).

Largely, public officials were aware of climate change implications for flood hazards and disaster risk intensification. Some officials of sectoral organizations that were expected to provide technical assistance did not know specifically how their organizational strategies were linked with flood management. Thus, their capacity to mainstream and proactively apply the principles and strategies to reduce and prevent flood risk was doubtful. An Early Warning Application by CREW that was intended to manage flood risk has not seen any practical success due to technical and data challenges. In fact, climate information: current and projected have not been incorporated into a comprehensive city land-use planning.

Increasingly, geo-spatial information technology adoption and deployment of their functionalities are recognized as crucial for flood disaster risk management (Köhler and Wächter 2006; Parker et al. 2007; Pattusamy et al. 2014). Geo-technology was first adopted in Ghana in the mid-1990s (Pabi 2007).However, mainstreaming geo-spatial technologies for actual applications in integrated flood disaster risk management was a challenge. There were only limited applications. Many organizations were aware of the technologies: others such as NADMO, EPA and TCPD have these facilities. In some of the organizations, the use was limited to map making. At the time of this study, the GIS facility of TCPD had insufficient human

resource and logistical problems. The processes of developing geospatial land use planning was heavily reliant on consultancy services. Data unavailability was a serious drawback.. Largely, management have limited knowledge of flood applications of geo-spatial technology: their view was more technocentric. The local government structures lacked these technologies, with the exception of AMA. Linking institutional objectives to applications was a challenge, which has created a problem of sustainability of geo-technology facilities. This observations were also reported by Pabi (2007).

FLOOD DISASTER STRATEGIES

Prevention

Largely, there was limited actions that promotes effective prevention by minimizing hazard intensity and exposure. Land-use planning that allocate space for waterflow and move people and development from water ways and maintain flood-related regulatory ecosystem functions was virtually non-existing. Only basic physical plans for settlements were available for parts of GAMA. Largely, planning of actively developing areas lagged behind actual development, which has led to haphazard developments. There was weak enforcement of land planning regulations. Wetlands, retention ponds and green belts have been encroached upon, degraded or replaced with built-up areas. The buffer zone policy was not enforced. Water Catchments were not managed to reduce run-off. Flood risk assessment is key for identifying priority areas for preventive, preparedness and response actions to minimize flood risk. However, one that allows for effective implementations did not exist.

Preparedness

Over the years especially, with the intensification of flood disasters and increasing cost to life and property, preparatory activities have incorporated the principle of living with and managing flood risk by providing space for water ((Rodríguez et al. 2014). Thus, sections of river channels in the GAMA

are regularly desilted. Yet, the effort is largely defeated by heavy inflows of silt and solid waste during rains. An effective role of the Ministry of Sanitation and allied institution would have been more effective. At the onset of rains, Ghana Meteorological Service usually make forecast as part of the preparatory activities to ensure that exposure to floods is minimized.

Response and Restoration

Response is the dominant strategy by NADMO in the GAMA area, and normally carried out when flood disaster events have occurred,. Aside rescue and attending to flood victims, the main activity is the sharing of relief items. Thus, NADMO as the main coordinating public organization related to flood disasters, is known by this activity. This disproportion attention to response may have led to reduced emphasis on preventive efforts and reported as the cause of high rate of flood incidents and cost to life and property (Sammuels 2010, WMO 2009). Kreft and Eckstein (2013) have observed that developing countries pay limited attention to risk reduction, which is attributable to limited attention to flood prevention and preparedness as opposed to response and relief efforts.

Public perception of the performance of public organizations

The public shared a variety of experiences, accumulated knowledge and perceptions of the institutions respecting flood disaster risk management in GAMA. This was in relation to their knowledge of the existence of the public organizations, their activities related to flood disaster management and the effectiveness of their performance.

Awareness of existing public organizations among the public varied from individuals and according to location. In Alajo, where flood disaster is very common, the proportions of respondents who were aware of the existence of public organizations are as follows: NADMO (40%); HSD (0.9%), DA (25.9%) and AMA (33.0%).In Glefe, 37.3% of respondents were aware

of NADMO, AMA (37.3 %) and DA (25.4%). The respondents did not know of the other public institutions. With the provision of early warning signals, the majority (50%) did not receive any early warning signals from the Ghana Metrological Agency (GMET). However, 24.5% were positive of their performance. The remaining were neutral about the provision of warning signals from GMET.

The respondents had sought assistance during flood disaster events. In Glefe, the majority had contacted NADMO(40.5%), MLRD (2.2%), DA (16.8%) and AMA (24.3%). Individuals in Glefe had contacted other bodies such as GTV and churches(16.2%). In Alajo, 47.5% said they have sought assistance from NADMO, MLGRD (1.1%), DA (11.6)and AMA(39.5 %).There has been a disproportionate emphasis on flood disaster response, where relief items are distributed by NADMO-with as high as 78% and 66% respondents having received assistance from Glefe and Alajo respectively(Sammuels 2010, WMO 2009). The crises management of flood disaster management, rather than a long term risk reduction approaches is at variance with the principles and international policy framework recommendations (Eckstein (2013; UNISDR, 2015a).

The communities have benefited from the organizations, before and after floods: Alajo (66%) Glefe (78%). In Alajo, specific benefits were shelter (0.7%), financial (13.2 %), food items (43.1%), mattress and blankets (40.8 %), whiles 2.8% mentioned others. In Glefe, 10.9 % indicated financial assistance, 43.8% said food items, 38.7% have received mattresses and blankets, and 6.6% indicated other assistance. In Alajo, 66% indicated that NADMO has provided assistances. Regarding the level of satisfaction with assistance provided by the institutions, 25% said Poor, 32% said average and 9% said good. In Glefe, 37% said poor, 27% said average, 4% said good and 4% said satisfactory.

THE Majority of respondents (85%) had poor view of settlement planning schemes actions of TCPD. Very few(4%) expressed higher perception of planning schemes, with 11% being neutral. Majority of the respondents (93%) had a lower perception HSD in their responsibility to construct proper drains to mitigate flooding problems, with 7% having a neutral opinion: they were not sure whose responsibility it was to construct drains.

Approximately 77% of the respondents had poor perception of the appropriateness of laws, policies and enforcement by all the relevant flood management institutions, with 19.5% being unsure (Table 4.1). The majority of the respondents (93%) had poor perception of demolition of built structures within flood plains and waterways as a strategy for flood risk management. It was considered reactive and wasteful. It has been suggested that how active a community engages in FRM depends on the institutional culture, shaped by organizations, stakeholders and society (Metz et al., 2010). According Figure…, the public generally has poor evaluation of the organizations in the delivery of their responsibilities. Delivery on long-term planning that would reduce exposure and prevent flood disasters scored lower marks in performance evaluation. This could be due to over-emphasis on crisis strategies that is dominated by rescue and relief activities (Label et al 2009a; Eckstein 2013),

Conclusions and recommended options for improvement

Ghana has adopted and ratified international conventions, agreements, policy instruments and paradigms, and recommended approaches and principles related to flood disaster risk management. However, established organizational structures and processes are not in complete alignment with recommended framework and principles. To a large extent the organizational structures and processes are not adequately designed to function according to the recommended principles and framework proffered for effective and successful operations.

Organizational arrangement established lacks the level of vertical and horizontal integration and coordination required for more effective and successful operations. NADMOs coordinating role is apparently week, especially at the sub-national level. Participatory processes are not comprehensive and deep enough to push a common agenda towards shared objectives. Connecting all actors and interests, including different local governance for a basin-wide management framework is lacking, hence the potential for flood risk transfer.

Knowledge and technology adoption relevant for developing effective strategies among the institutions is inadequate. Knowledge drives corresponding flood paradigm, hence the right knowledge and information. Hence, the need for fine-tuning and operationalizing their knowledge of IFRM is an important first step. With the adoption of the right innovative technologies, such as geo-information technologies, the implementation of relevant and appropriate mix of integrated flood disaster risk management strategies will be easier and more effective at all time and spatial scales. IFRM is dominated by response activities, with minimal attention devoted to disaster risk reduction. Thus, disaster management is more reactive. The public view of the public organizational performance is largely negative. They are more aware of disaster response activities reduction related ones. The lack of right balance in the implementation of recommended principles may have resulted in the poor evaluation by the public.

Options for improvement

The adopted international policy recommendations must be re-examined closely for a deeper understanding of the key policy framework and principles relevant for the context of present flood risk regimes.

The knowledge to drive the capacity to understand the problems of flood disaster risk and how they emerge is essential. The key concepts of flood risk must be well understood to the finest details to allow for the development of effective operational strategies. Institution must understand the resolutions of disaster risk concept, identify their indicators, and be able to measure them. In that case, they will be able to carry out operations on these.

Deepening vertical and horizontal integration and collaboration at all levels between relevant sectoral organizations is key. The roles of all actors should be clarified, and the relevance of their core mandate clearly linked to flood disaster risk management. Flood disaster risk objectives relevant to institutional core mandates should be mainstreamed in the respective institutions.

The coordinating role of NADMO should be critically re-examined. Whilst it could play an over-arching role in coordination and policy of all disasters, operational activities related to flood disaster such as protection, prevention, recovery and review should be handled by a specialized body with strong technical expertise.

There should be a strengthening of participatory processes to include a wide range of stakeholders, including communities. Institutions should assign specific roles that are relevant to the managing of disaster risk.

Public institutions whose activities are land-based, especially, land use planning, environmental and hydrological agencies at all levels should collaborate with traditional authorities in their operations for harmonized land disposal and planning schemes in order to minimize conflicts that undermine flood disaster risk prevention.

Organizations must adopt relevant information technologies. Geo-information technologies are important for flood disaster management since they have a diversity of functionalities that handle many operational activities, including complex decision-making.

The mixture of flood management activities must be reconfigured to place more emphasis on preventive actions to reduce exposure to flood disasters.

1.8: The Climate-Smart Integrated Flood Management Framework (CSIFM)

The methodological synergy detailed in this paper demonstrates the depth of evidence that could be provided through interdisciplinary methodological triangulation for an enhanced management of flood risk, particularly in rapidly changing contexts. The weakness of the conventional methodological divide between the social and geo-biophysical sciences that limit comprehensive evidence-based response to flood risk could be curtailed as demonstrated in our polycentric approach. This section focuses on the intersections and data flow of the methods, tools and applications for flood risk assessment towards bridging gaps between science and policy, and theory and practice in flood risk reduction and management. The agenda setting phase of the research methods was informed by (i) desk analyses and (ii) baseline and vulnerability studies spanning 2008 to 2014 on coastal urban floods, and established pathways for transdisciplinary data collection and analyses. The baseline studies were separately undertaken and the outcomes resulted in a harmonized framework (Figure 1), of socio-demographic and geo-biophysical origins herein referred to as the Climate-Smart Integrated Flood Management Framework (CSIFM). Thus flood hazard potentials of the study areas were established and households' vulnerability to floods and associated risks analyzed within the context of several sociodemographic (e.g. sex, education, ethnicity, wealth status) and geophysical parameters of households (e.g. elevation of household, materials for roofing and walls). That meant that there was need for adopting a combination of methods and also including more exciting and innovative approaches such as the townhall meetings brought enthusiasm to the discussions that could likely translate into transparency. The CSIFM therefore provides pathways for formulating research and policy questions that are demand-driven by cities which are institutionally trapped in responding to the challenges and the opportunities that flood risk might present to managers and the citizenry. The CSIFM therefore could be described as not terminal in character but provides opportunities for monitoring flood management plans and interventions and getting to review and appraise the options for response measures. Importantly, the CSIFM framework provides pathways for empowerment to pursue actions on adaptation, whilst enhancing further research, policy and adaptation solutions that bring about resilience building to flood risks through the bridging of the gaps between science and policy, and theory and practice.

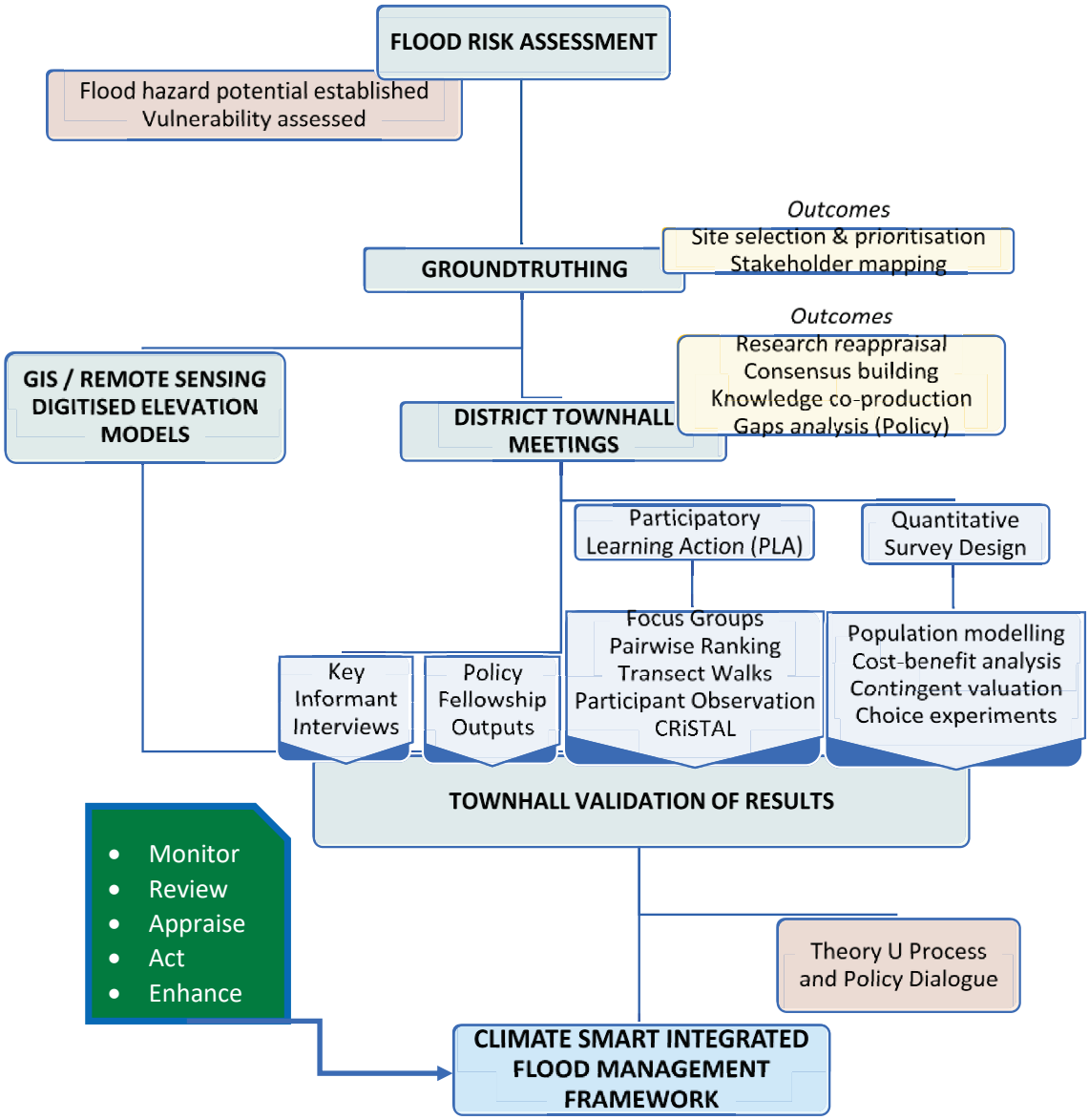


Figure 1. *The combined methods of polycentric origin approach, the processes and associated protocols including techniques and tools for assessing flood risks of GAMA and links to Climate-Smart Integrated Flood Management Framework (CSIFM).*

Site selection and underlying physical vulnerabilities

This was instrumental in identifying the relevant partners, key actors and levels of (i) responsibility they bear such as primary, secondary and tertiary to affect flood risk issues directly and (ii) remote and passive engagement in flood management and adaptation solutions. Therefore, the ground truthing brought understanding and consensus to the local-level perceptions on climate change and flood hazards, their impacts and response measures to current and potential future climatic risks.

Town hall meetings

The Town hall meetings involved the participation of stakeholders of flood management in the various districts. Participants came from public sector organizations such as the National Disaster Management Organization (NADMO), community development, environmental health, information, planning, the local lawmakers – the assembly, etc. and from civil society groups such as religious organizations and major livelihood groups, residents' associations and traditional authorities. The diversity of participants at Townhall meetings added much rigor and depth to the results of the study. Discussion at the meetings focused on the causes and impacts of flooding, response measures and challenges, looking into the future. The discussion of these thematic areas by both community members and flood management experts allowed shared learning that helped unearthed the nuances in knowledge and perceptions of flood risks. This approach allowed the co-construction of knowledge on flood risks from the populations that bear the brunt of the impacts, and flood management experts who have the technical expertise. In this way, consensuses of lay-persons and experts were established, ideological differences discussed, and the gaps in knowledge provided insights on the design of the research instruments. This aspect of the methodology ensured utmost community engagement and participation in the research, particularly because the meetings were facilitated by community members under the guidance of the research team. In addition, it afforded the research team the opportunity to explain the objectives of the study to the community, and to develop scenarios from stakeholder perspectives, similarly observed in the study of Tompkins et al. (2008).

Key inputs of parameters into quantitative and qualitative methods

The high response rate of households in the survey is attributed to strategies adopted such as organized mini community durbars to introduce the project and to solicit inputs and cooperation during the main study. During the listing exercise of households, besides, the physical chalking of the structures, detailed map-spotting, the exact address and full name of heads of households were obtained. The personal phone contact numbers of the heads of households or any responsible adult member of the household were documented. The acquisition of the geographic position reading of every household listed meant that information on households were digitized and could be revisited.

Participatory Learning Action (PLA) tools were administered through research site visits, informal meetings and workshops. Because population groups often acted differently to manage climatic risks depending on their priorities and how they are affected, the choice of focus group discussion accounted for the analysis of such experiences and opinions particularly by sex, age and gender. The use of pair-wise ranking and cross impact matrices approach provided opportunity to examine the general problems in the study area, in addition to the detailed issues of flood risks, within and across the different population groups. These techniques also helped to examine strategies that different population groups in the study communities use to address flood problems and the sustainability of these strategies. The CRiSTAL incorporated knowledge of the past, present and resilience building activities including outcomes of best adaptation options depending on location and space. Apart from understanding the vulnerabilities of human populations and their activities, CRiSTAL helped determine roles of adaptation related activities to livelihoods whilst looking into future options and the associated outcomes. CRiSTAL relies on a combination of primary information gathered through participatory methods (stakeholder consultations, project team discussions) and secondary information obtained from desk-based research.

Physical vulnerability assessment

The integrated analysis of spatio-temporal patterns and dynamics of the determinant variables of flood risk reveals the changes of risk, for locally targeted management decisions. Spatial analyses generated variables of flood hazard characteristics of depth, speed and overland extent of runoff water flow, which were the main driving functions of exposure. These spatial models of flood hazards provided an index for exposure. The sensitivity and adaptive capacity generated from the geo-referenced socioeconomic (WP1) and demographic data were spatially modelled as integrated spatial indices, with the sensitive index to generate the flood disaster risk index measures for different localities. Currently, existing data at suitable levels and formats of resolution and content is inadequate for a meaningful wider spatial flood risk analysis.

Inputs into key informant interviews for institutional analysis

Institutions play critical roles in adopting, formulating strategies, planning and implementing relevant benchmarks for the effective response to flood risks(Larsen et al., 2012). Ghana has adopted and ascribes to the principles of disaster risk management based on the Sendai Framework for Disaster Risk Reduction (SFDRR), which includes the additional mainstreaming of climate change issues into disaster risk reduction. Hence, the study assessed the level of existing institutional structures and processes against specific recommended principles and considerations for effective flood risk management. This comprised of institutional structural composition, coordination and integration; knowledge management, communication, technology and innovation and links with governance and participation of stakeholders. To measure the actual impacts of existing institutional arrangement, and validate the outcome of the engagements, key informant interviews helped determined the perceptions, experiences and knowledge of flood management. Thus, the institutional assessment of flood risks allowed for mutual verifications of the outcomes of the various methods from households to communities and districts through triangulation and improving the credibility of the conclusions drawn. The vertical cross-sectional analysis from the community level across national level institutions created awareness among a wider section of stakeholders and actors towards the integration of flood disaster risk management into all levels of physical planning. However, this is a potentially expensive and time consuming approach. The institution of the District Assembly Policy Fellows scheme as part of the methods was meant to bridge the gaps between science, policy and practice as the fellows were major change actors. A well-informed policy community is inevitable for building climate resilient societies and so change actors will be required to pursue such goal as they could help to shape the awareness of policy stakeholders to facilitate research into use concept at all levels.. Thus, the institutional fellows of the study facilitated information dissemination and communication using non-partisan approach to bring about change.

Public policy dialogue

The Theory U-Process employed various techniques that created learning space where individuals shared own experiences and how to collectively address an issue in an innovative manner. Some of the techniques deployed were presentations and discussion of personal

experiences and understanding of the issues, a sketch, drama, audio-visual and a sculpturing session. Participants were seated in groups of four or five, to allow for a more informal setting and cross-experience interactions. These various interventions allowed participants to personally connect to climate change and flood issues not in the traditional workshop setting that requires intellectual rigor but allowing space for personal and emotional attachment to the issues. This connection is considered critical for generating innovative solutions in a creative way for positive change as follows (a) generate innovative ideas of attaining the goal of a well efficient and effective coastal urban management, (b) create and intensify awareness about climate change and coastal urban flood disasters in national development efforts and (c) enhance the understanding of participants to facilitate and sustain a comprehensive and a targeted approach to addressing coastal urban issues. The U-Process in this research context thus incorporated new ways of learning towards enabling conditions that enhance innovation and creativity in leaders to manage flood risks.

COMMUNICATION STRATEGY

Managing socio-demographic change and climate induced flood risks in the Greater Accra Metropolitan Area (GAMA)

DRAFT

The Regional Institute for Population Studies,
University of Ghana, Legon

2017

Contents

1.0 PROJECT BACKGROUND

Globally, the challenges of population growth are compromising spatial planning in urban and peri-urban communities and cities. Haphazard development of human settlement such as building on waterways and green spaces as well as increased demand for housing and industries has exposed several residential sites especially that of people living in low-lying areas to increased flood risks.

Flooding is said to be the single most destructive type of natural disaster that strikes humans and their livelihoods around the world, according to the United Nations International Strategy for Disaster Reduction (UNISDR, 2002). Therefore, disaster risk reduction approaches in communities, have become increasingly important in societies as they face more complex and uncertain risks especially those from floods. In coastal environments such as the Greater Accra Metropolitan Area (GAMA) in Ghana, accelerated sea level rise has compounded flood risks leading to inundation of settlements and erosion of the shoreline. Recent floods in GAMA coupled with fatal deaths and injuries; damage to property, infrastructure and/or the environment; and the disruption of life and the functioning of the community also presents institutions and society as a whole with new challenges of adaptation solutions. However, not much leadership has been demonstrated in integrating climate resilience into city planning and flood management.

It is against this background that The Regional Institute for Population Studies (RIPS), University of Ghana with support from the International Development Research Centre (IDRC), Canada, is undertaking a three-year research project on "Managing socio-demographic change and climate induced flood risks in the Greater Accra Metropolitan Area (GAMA)." The project, which is being built under the umbrella of the "Cities Resilience Project," is built on the fifth assessment report (AR5) of the IPCC, which affirms high confidence in increased frequency of floods in coastal cities and the apparent disruptions of infrastructure that may occur.

The goal is to improve flood risks management in the city of Accra towards resilience building through integrated climate smart flood management framework and catalyzing evidence-based policy action. This is to be attained through measures including enhanced awareness among stakeholders of adaptation solutions to floods in the GAMA.

However, for such measures to succeed, stakeholder participation especially that of beneficiary communities is a mandatory pre-condition and the main success tool in ensuring such active participation is effective communication.

Effective communications strategies are recognized as essential components of flood risk management. Known as flood communication, it increases people's knowledge about flooding by providing appropriate and adequate information through various channels of communication.

It should however be noted that the effectiveness of flood communication in increasing individual-level and community responses are dependent on major elements as follows:

i.) The existence of effective partnerships between the expert information providers and the lay receivers;

ii.) Trust is key. It has been observed that working with people in flood prone communities helps to increase trust in the institution or agency providing the information, due to improved knowledge of flood protection processes as well as providing opportunity for input into local initiatives; and

iii.) The medium and mode of information. Research has shown that while the general public usually prefers a combined medium of local and national radio and television; older and less educated people preferred direct contact with authorities. The younger and more educated people preferred the social media platforms. In relation to the mode of presentation, studies indicate that information presented in a frequency format and for longer periods, are more effective in emphasizing the threats of a risk than those presented in shorter periods.

Generally, information sources and timing of messages are very important in flood communication. But equally important are the socio-economic and demographic characteristics of the population at risk such as education levels, ethnicity and gender.

Furthermore, adequate organizational structures for information acquisition, dissemination, storage and interpretation can assist members of communities to learn and adapt to changing conditions in their environments.

Effective communication is critical to securing audience appreciation and participation. Moreover, it has the potential to:

i. Raise the public profile of the project within the implementing zone; and
ii. Lead to effective advocacy with critical stakeholders

By combining contemporary communications techniques with traditional tools, the Strategy will enhance information gathering and sharing among implementing institutions and beneficiary communities. It will further enhance civil society involvement and thereby, result in high-level engagement and policy influence.

Development of appropriate strategies for risk communication is part of the overarching formulation of flood risk management. In developing risk communication strategies, key challenges identified from a further understanding of risk perception need to be considered:

1. Awareness of risk does not always lead to actions to reduce or mitigate risk.
2. People assume that flood control structures are “safe” with no need to take additional actions to mitigate risk.
3. Experience with floods matters and influences the actions that community members take to mitigate the impacts.
4. People will seek advice from friends, family, and neighbors on the determination of risk and actions to reduce flood risk.

5. Personalized risk assessment, based on experience and feelings, is more likely to motivate behavioral action than simply providing technical information about risks and consequences.

Understanding the above factors will ensure that risk communication messaging is able to overcome the barriers associated with communicating related flood risk.

2.0 INTRODUCTION

2.1 Situational Analysis

Accra, has known floods since the mid-1960s and the worst in recent times was in 2015, The GAMA has suffered such consequences in recent past as a result of many factors including poor planning and enforcement of laws in the city. These have been compounded by the impacts of climate change manifested through late onset of rains, which are also intense and stormy yet occurring within shorter time periods and thus, are able to disrupt life and businesses. Lack of climate sensitive planning modalities and failure to subject infrastructure designs to gender and climate change metrics are leading to social, economic, financial and environmental losses in the city, yet the extent of the monetary values of these losses are either unknown or underestimated due to the lack of both human and logistical supports to carry out such assessments and evaluations. The flood situation has been aggravated by the lack of collaboration and partnerships amongst various stakeholders from the public and private sectors in addition to poor policy processes.

Interventions to resolve flooding of the city of Accra have suffered several setbacks due partially to lack of scientific evidence and failure to engage research-into-use through relevant stakeholder participation. This has created several gaps in knowledge on how to sustainably manage floods and yet using indicators and tools that are climate sensitive through a climate smart integrated flood management framework which this intervention research will seek to achieve.

Furthermore, several barriers exist in delivering on adaptation solutions to flood risks in GAMA in developing indicators that are climate sensitive with the goal of instituting climate smart integrated flood management framework that drives city planning including policies and interventions to reduce annual losses attributed to floods.

Additionally, in Ghana's ambitious Intended Nationally Determined Contributions (INDCs) to the UNFCCC, developing and managing climate resilient infrastructure was one of the major focal areas for adaptation and thus underscoring the relevance of this project.

Efforts of policy, practice and civil society to address issues arising from climate change are challenged by lack of inter-sectoral collaboration, technocratic approaches, weakly integrated understandings of population dynamics, insufficient

use of evidence in decision making, and imbalances in community, civil and private sector input to decision-making.

The lack of gender sensitive indicators, poor land use planning and enforcement of laws, limited collaboration amongst stakeholders and general lack of awareness of planned adaptation still hang over attaining a resilient city goal in GAMA.
Besides, policy, planning, practice, and private interests in cities often reflect traditional development approaches (e.g. regional urban planning) that compounds flood risks because the unit of management is often zonal or regional beyond the reach of local dynamics.

In an attempt to fill these knowledge and intervention gaps, the Cities Resilience Project is intended to engage the policy community, civil society and private sector actors on integrating determinants and drivers of social-demographic change into climate resilient flood management.

The project emerged from and was built on the outcomes of previous studies undertaken at the Regional Institute for Population Studies (RIPS) at the University of Ghana that established that flooding was posing serious threats to different population groups, businesses and industry, settlements and infrastructure as well as the overall coastline and shorelines of Accra.

Thus, the previous studies have shown that flood risks come in three fold, namely heavy storms, surface runoff, and sea level rise with varied impacts on the communities in the city of Accra irrespective of social and demographic attributes of inhabitants which have been acknowledged by the Accra Metropolitan Assembly as needing further research intervention, hence demand-driven.

Of the several specific impacts ranging from inundations of settlements, displacement and destruction of property, impacts on infrastructure are said to be the highest in recent times. Such impacts on infrastructure range from the collapse of buildings, bridges, drainage networks, industry, market stalls to the houses of mostly the vulnerable with severe ripple effects on economic returns in the city of Accra.

The project will be undertaken in six districts within the GAMA and spread across the breadth and length of the region to represent all the issues and the adaptation solutions that have been identified.

List of Districts and selected Communities

DISTRICT	COMMUNITY
Accra Metropolitan Assembly (AMA)	Glefe
	Alajo
La Dade Kotopon Municipal Assembly (LaDMA)	South La
	Labone (Appapa)

Ledzokuku-Krowor Municipal (LeKMA)	Nungua
	Teshie (Abochie area)
Adentan Municipal Assembly (AdMA)	Ogbojo
	Adenta East (commandos)
Ashaiman Municipal Assembly	Tulaku
	Lebanon (downside)
Tema Municipal Assembly (TMA)	Comm. 1
	Tema New Town
Kpone Katamanso	Kpone
	Zenu

The project, which is research oriented will frame innovative adaptation solutions and means of implementation that seek to remove barriers to the adoption of research-into-use in flood prone areas through multi-criteria decision-making.

2.2 Project Focus Knowledge Management and Communication

The project document highlights the need to increase awareness through various channels including different forms of public consultations such as engaging policy makers and collating input through multi-stakeholder bottom-up approach.

It further outlines specific knowledge management and communication focus elements as follows:

1. Publication of research results in highly accredited open access journals and monographs targeting policy, science and development researchers locally and internationally, under the broad theme: "Climate Change, Population and the Development Planning Nexus including Adaptation Solutions for Flood Risk Infrastructure."
2. Exhibition and visualization to be mounted at programmes of other institutions especially the partners with partners' inputs and targeting the general population in communities, the public and private sectors and educational institutions, under the broad theme: "Flood risk management, institutional and behavioral change."

3. Development and production of policy briefs that will provide biannual updates and progress on project activities for the non-scientist reader and the overall literate community, under the broad theme: "Narrowing science – policy gaps, Climate change research into use (RIU) and development mainstreaming."

4. Creation of Policy Round table/Seminars/Colloquium as platforms for scientists and policymakers to brainstorm and deepen networking and impart knowledge under the broad theme: "Bridging the climate science and policy divide."

5. Develop and produce flyers and posters that presents visual versions of problems, solutions and project results to inform uneducated populations and create general public awareness on adaptation and flood risk management under the broad theme: "Flood early warning, forecasting and adaptation solutions."

6. Produce Contingency Manual targeting climate sensitive sectors and businesses on adopting climate smart adaptation solutions disaster management platforms nationally, the individual, households and communities, under the broad theme: "Participatory flood risk reduction."

7. Production of audio-visual documentaries as an information sharing tool targeting communities, managers, science and policy players on the process of the research and experiences of flood risks, under the broad theme: "Climate Smart Integrated Flood Management (CSIFM) emphasizing flood risks and development challenges and opportunities."

3.0 INTRODUCTION TO THE COMMUNICATION STRATEGY

The Communication Strategy serves as a guide for all information communication related activities of the project. It contains the identified targets, messages directed at them, the effective channels for reaching them and mechanisms for coordination, monitoring and evaluations, and measuring the impact of activities all in a bid to achieve the overall goal and objectives of the project.

It is important to point out that, changes to the plan can occur once actual implementation starts. By combining contemporary communications techniques with traditional tools, the Strategy will enhance information gathering and sharing among implementing institutions and beneficiary communities. It will further enhance civil society involvement and thereby, result in high-level engagement and policy influence, and thus, create a higher profile for the project.

The Development of appropriate strategies for communicating information on climate induced flood risks are key to the overall task of managing socio-demographic change and climate induced flood risks in the GAMA. The implementation of the strategies will contribute to the successful achievement of the project goals and objectives as well as enhance the visibility of project activities and outputs.

The strategy is divided into two for successful implementation:

3. Internal Communication Strategy that identifies the internal targets and how they will share information with and among each other.

4. External Communication Strategy targets audiences outside the implementing team.

3.1 Overall Project Goals:

Improve the management of flood risks in the city of Accra towards resilience building through integrated climate smart flood management framework and catalyzing evidence-based policy action.

General research objective

The overall research objective is to engage policy, civil society and private sector actors on integrating determinants and drivers of social-demographic change into climate resilient flood management, whilst supporting Ghana's INDCs to the UNFCCC on resilient infrastructure.

3.2 Objectives of the Strategy:

The Strategy seeks to achieve the following objective:

- Strengthen communication among key stakeholders

4.0 THE STRATEGIES

4.1 Internal Communication Strategy

The internal communication strategy seeks to ensure effective communication within the Project implementing team members to enhance their understanding of the project goals and objectives, issues and how to communicate these to their external publics in a consistent, deliberate and persistent manner. The goal is to make every project team member an informed communicator for the project.

Objectives

- Facilitate the sharing and exchange of information among team members.
- Communicate the progress, challenges, lessons in the implementation process with each other in a timely manner
- To keep all project implementing team members abreast of issues, events and implementing schedule.
- To ensure that all members play their respective roles for the attainment of the overall project objectives

Matrix of Internal Communication Strategy

Overall project goal	Objective of Comm. Strat.	Objective of Internal Comm. Strat.	Target audience	Channels of communication
Improve the management of flood risks in the city of Accra towards resilience building through integrated climate smart flood management framework and catalyzing evidence-based policy action.	Strengthen communication among key stakeholders	i.) Facilitate the sharing and exchange of information among team members. ii.)Communicate the progress, challenges, lessons in the implementation process with each other in a timely manner iii.)To keep all project implementing team members abreast of issues, events and implementing schedule. iv.)To ensure that all members play their respective roles for the attainment of overall project objectives	Implementing team members; Partners; Steering committee members; Project consultants; Secretariat	Meetings, minutes of meetings, emails, SMS, telephone calls, reports,

4.2 The External Communication Strategy

The External Communication strategy seeks to ensure effective communication to project beneficiaries' particularly local community members to empower them and build their resilience against climate induced floods.

Objectives

- To support effective flow of information
- Engage key stakeholders on current issues surrounding flood management

Matrix of External Communication Strategy

Project Objective	Communication objective	Objective of External Comm. Strat.	Target audience	Content to Communicate	Channels of communication
Improve the management of flood risks in the city of Accra towards resilience building through integrated climate smart flood management framework and catalyzing evidence-based policy action.	Strengthen communication among key stakeholders	i.)To support effective flow of information	Beneficiary audience -Traditional Authorities, -Opinion leaders, -Community Members -Farming/ Fishing groups, -Women/ Men/Youth groups. -Educational Institutions, -Religious Institutions (Churches/Mosques), -Disaster Volunteer Groups. -Health Centers -CBOs	i.) Community flood risk status ii.) What actions will improve their safety iii.) How they will receive the warning to implement those actions	Community durbars, workshops, forums, celebration of special days, meetings, roundtable discussions, publicity campaigns, district road show, radio & television discussions, statements by religious leaders/opinion leaders/traditional authorities, Media/publicity campaigns, information/education/communication materials including audio visuals, posters, flyers,
		ii.) Engage key stakeholders on current issues surrounding flood management	All the target audiences	People need to see the personal relevance of the warnings to their situations	information/education/communication materials including audio visuals, posters, flyers,
			Partners, collaborators and beneficiaries	Determine actions that are feasible for beneficiaries	Meetings, Partner rallies, Action Learning platforms, sharing of reports, emails, SMS, telephone calls

4.3 Messages for Target Audiences

Target audience	Audience specific messages	Overarching message
-Public institutions -Traditional Authorities, -Opinion leaders, -Community Members -Farming/ Fishing groups, -Women/ Men/Youth groups. -Educational Institutions, -Religious Institutions (Churches/Mosques), -Disaster Volunteer Groups. -Health Centers CBOs	**Before Floods** • Look out for signs that show possible pending floods • Report to health authorities any outbreak of diseases such as cholera and malaria. • Ensure that your family sleep under a mosquito net during such periods • Always stay tuned to media (radio, television) for flood related announcements • Do not litter to avoid coastal polluting • Do not build on water ways • Patch cracks on walls before rain sets in • Be observant and note the rising of the tides • Treat information on flood seriously • Resettle from flood areas if possible • Adhere to information on rain and floods **During Floods** • Report quickly to health facilities of any reptile bite for treatment and vaccination **After Floods** • Disinfect wells against flood pollutions •	i.)Take heed of the message issued. ii.) Be prepared to follow the advice and instructions of emergency response officials.

Implementing team members, partners & collaborators	• Learn and be abreast of flood related issues • Monitor weather and flood conditions to prepare and issue appropriate messages • Persuade people to take effective protective action once a warning has been issued • Let's use more locally relevant information so that people relate personally to warning messages, and know what to do for their own safety. • Reduce uncertainty in predictions, while providing enough time for effective action, • Recognize that public appreciation of numerical probability statements is understandably limited. • Provide effective warnings for flash flooding. • Improve methods to evaluate warning performance.	All hands on desk, join the team to save lives and property

5.0 MANAGING THE COMMUNICATION

Effective delivery of the Communications Strategy is dependent on management prioritization and commensurate human and logistical resources. It is vital that Communications is seen as a central function in the project implementation and its role to the attainment of overall project goal be valued in the light of the following:

- Communications resource should be used strategically and tactically, with it being central to everything being done.
- Communications should be considered right from the outset of each initiative.
- Communications thinking needs to be further encouraged with a focus on pro-activity and creativity.
- A strong communications presence needs to be established in pilot areas to augment other project related work being done.

6.0 MEASURING IMPACTS (MONITORING & EVALUATION)

Measurement of the results of communication will be built into communication activities at various levels, using tools such as:

- Track response to informational materials through a feedback mechanism including contacts for further information, comments and suggestions from readers, opinion polls, etc
- Increase in social media followers, their feedback and comments
- Assessment of media interest reflected by number of articles published, radio and television discussions
- Service level assessment
- Conduct impact assessment surveys to track whether the public/pilot communities have been influenced or engaged as intended and what the result is
- Conduct customer satisfaction surveys.

Note: Results from these activities will inform the implementing institutions about the progress and impact of communications. It will further enable the making of informed decisions as to whether to continue the implementation of scheduled activities or re-design new ones.

7.0 COORDINATION

7.1 Knowledge Management and Organizational Collaboration

Knowledge sharing has become part of the way the flood management operates; new processes to encourage the capturing and sharing of knowledge are being built into core activities. Knowledge management will make information more easily accessible to key stakeholders and communications will make that process easier by packaging and developing information outputs.

7.2 Scaling Up and Scaling Out

Communications will support the project in scaling up and scaling out its work. As well as increasing the output and use of communication products, active research will be needed to understand how best to deploy communication strategies in support of scaling up and out activities.

8.0 RISK MANAGEMENT

Communication is necessarily a public enterprise, with consequent reputational risks, especially in dealing with difficult issues.

Communications risk management

Risk	Action
Striving for high visibility attracts critical attention	Emphasize the importance of flood management in public communications over the importance of institutions
Partners actions/inactions compromise project profile	Collaborate with other partners at the highest level to develop an equitable compromise between partners consolidation and project visibility
News articles published with incorrect or misinterpreted information	**Preventative**: Establish cordial relations with media that enables journalists crosscheck for accuracy before publication of feature articles **Remedial**: request the right of response, letter to the editor, publication of correction, etc.
Inadequate resources to meet communication demands	Prioritize communications work against a clear and tested set of criteria
Digital divide discriminates against local communities	Adopt the most suitable means of communication for the audience so that the less well-connected can benefit

9.0 ACTION PLANS TO IMPLEMENT THE STRATEGY

9.1 Introduction:

The Strategy makes communication an integral part of the flood management process and is fundamental to achieving the significant development impact that the funding agencies and development partners are demanding. To implement the strategy successfully will require the following:

- A management and institutional recognition of the contribution that communication can make to implementing the project and its outputs to stakeholders;
- A commitment to assigning budgetary allocation to communication activities, to allow partners to achieve clear outcomes and impact from their work; and
- The Project Secretariat should keep track of all project communication activities carried out by partners (including potential partners) through the establishment of a Flooding Communication Data-base.

In order to successfully implement the strategy, the project must ensure that the communication plan has to be:

- Proactive – taking the lead in reaching out to audience;
- Consistent – there should be uniformity and consistency in message delivery by implementing institutions; and
- Coordinated – timing and phasing of activities to maximize impact and reach in tandem with other project related communication activities.

9.2 Details of the Action Plans

Key Objective 1: To support effective flow of information

Audiences: - Academia, Traditional Authorities, Opinion leaders, MMDAs, Community Members, Farming/Fishing groups, Women/Men/Youth groups, Educational Institutions, Religious institutions (churches and mosques), Disaster Volunteer Groups, -Health Centers, public institutions, traditional rulers, CBOs, Media

Core Activity	Action Plans	Time frame	Estimated Cost	Responsibility
Raise awareness of flood generally, the related risks and adaptation & mitigation actions	1. Produce target relevant specific Information Education and Communication materials that can empower them through participatory development and testing of risk communication material Including the following: i.) Posters, brochures, ii.) Radio jingles iii.) Radio presenter messages iv.) Radio discussions v.) Special messages from distinguished at least five identified personalities including local community members vi.) Produce and mount billboards at appropriate sites vii.) Develop video clips on related issues and solutions 2.Recommend creation of a multi-stakeholder Forum for information sharing that could include: i. Annual flood awareness week, ii. Community flood road shows iii. Support the replication in other project Districts of on-going Citizenry Engagement Platform in Adentan Municipality	To be decided	Yet to be determined	1.Project implementing team/Secretariat/Steering committee 2. Consultancy to develop and produce all IEC materials including posters, flyers, jingles, audio visuals
Disseminate simple communication products directly to specific target groups	1. Produce and assemble simplified communication products such as posters and FAQs. 2. Distribute products to targeted stakeholders 3. Flash messages on Community Radios 4. Utilize social media and SMS initiatives			

Funding Source: Unknown				
Expected Outcome: Well informed and empowered audiences who are able to use flood risk information to reduce flood impacts				
Expected Output: Increased community initiatives to adapt to floods and reduce impacts				

- **Objective 2:** Engage key stakeholders on current issues surrounding flood management

Audiences: Relevant public institutions, MMDAs, private sector, NGOs/CSOs/CBOs, traditional rulers and local communities, research and academia and media

Core Activity	Action Plans	Time frame	Estimated Cost	Responsibility
Lobby target audiences particularly MMDAs & private sector in flood management	1. Round Table discussions aimed at providing insight into how the process fits into their political/administrative goals and objectives/agenda 2. Prepare and present policy briefs and updates to target audiences	To be decided	Yet to be determined	Implementing team/partners/ Secretariat
Adopt concept for knowledge-sharing approach	1. Develop a database of all organizations/institutions involved in flood management (including likely partners who can facilitate the process) 2. Investigate and report on status of communication flow, knowledge sharing and learning opportunities among partners 3. Based on report recommendations develop a structure for information and experience exchange as well as learning and partnership activities among these partners 4. Pilot and demonstrate knowledge sharing and learning activities			Implementing team/partners/ Secretariat Consultancy

Facilitate media advocacy and outreach programmes on flooding	1.Develop media contact plan which outlines the most desired and influential media outlets for targeted, and proactive contacts for publicity 2. Create, maintain and constantly update media data base, which records reports filed when contacts are made. This will be used as a guide for making proactive contact with journalists with the aim of generating more coverage. 3. Organize media briefings and one-on-one sessions journalists on floods 4. Organize field trips and study tour to project sites for selected media persons			Secretariat/ Consultancy
Funding source:Unknown				
Expected Outcome: Institutionalized and well-coordinated structure for knowledge sharing and learning activities that enhances overall flood management **including enhancing resilience**				
Expected Output: Policy briefs, quarterly updates, reports that are generated following activities				