

# **Climate change resilience in urban mobility. Accra, Ghana.**

## **End of project popular science description**

### **Introduction**

Flooding of the urban roads because of high-intensity rain is common in Accra. Increased levels of flooding affect mobility practices and livelihood strategies by isolating residents and hampering access to work places, markets, schools and services. These disruptions to the daily trips essential to maintaining a livelihood and the general vulnerability of the transport system are often overlooked in discussions about urban sustainability.

The objectives of the Climaccess project are to provide a comprehensive interdisciplinary understanding of a) the physical, climatic and human factors that produce increased levels of urban flooding, b) the implications of flooding for daily intra-urban mobility and livelihoods, and c) integration of novel methods for spatial analysis to guide informed decision-making to reduce flood-induced mobility disruptions and increase the resilience of the urban transport system.

The project applied qualitative, quantitative, and spatial analysis methods. The results are based on extensive stakeholder interviews, community meetings, and surveys with more than 1000 respondents in four peripheral neighbourhoods. The surveys aimed to provide new insight into the relatively unexplored area of the mobility patterns of residents in peripheral urban areas and the impacts of flooding.

Further, the project aimed to develop and apply novel spatial analysis methods for modeling and mapping the flood propensity of urban locations and identify flood locations that potentially hamper daily mobility at different scales. A setup was implemented that integrated drone/Lidar-based elevation data with a satellite-based elevation model and other geodata, including a digital road network and population data.

### **Results**

Our results show that residents in Accra's peripheral neighbourhoods depend on a high degree of mobility. Daily mobility is crucial for people's livelihoods, life opportunities, health, wellbeing, spiritual needs and social networks. Our surveys in four areas, Adenta, Glefe, Santa Maria and Pokuase, show that over half of all adults travel outside the neighbourhood more than four times per week for work purposes alone, with an average road-distance of more than 10 km between home and work. Flood-induced mobility disruption is a highly commonplace experience. Overall, 87% of the residents in the four surveyed peripheral areas have experienced some form of mobility disruption due to heavy precipitation within the past year.

Mobility disruptions are frequently caused by the impacts of heavy precipitation on local "dirt" roads and the corresponding inundation of lower-lying road segments. Under-dimensioned bridges and culverts may divert water to surrounding areas, and solid waste often blocks the free flow of water and undermines the effectiveness of culverts. There is a general lack of comprehensive roadside drainage and roads commonly channel significant volumes of surface run-off, while actions of individual plot owners often contribute to road erosion.

While much focus has recently been put on Climate Change as a driver of increased flooding, the results show that other factors also play an essential role. The rapid urban growth of recent years has increased the severity of flooding, partly because natural wetlands and temporarily waterlogged areas are converted to urban use, often restricting the natural flow and ability to absorb water. Our analyses show strong evidence that unplanned and undesirable development due to ineffective land ownership and administration is a significant cause of perennial floods. The interplay between urban management,

planning practices, land-use zoning and residents' housebuilding practices is, therefore, an essential to understanding the reasons for increased urban flooding in Accra. Our findings also indicate that the purpose of identifying mitigation strategies is not well served by including relatively few voices of academics and politicians in the debate. The muted voices with significant lived experiences are equally essential in the planning, designing and implementation of flood interventions.

The spatial analysis results show the location of areas with high flood propensity across the city and projected depth for different rain event scenarios. More detailed flood models were created for selected neighbourhoods. Further, the study applied extensive spatial analysis of the road network and population distribution. Based on this analysis, the project has produced several maps indicating "hotspot" locations of both high flood propensity and importance for urban mobility on different scales. A focus was also on mapping emergency responders' facilities and route choices in cases of critical flood events. Overall, the results indicate a general lack of redundancy in the road system in terms of providing alternatives to flooded routes and that local flooding can significantly influence mobility levels.

The project findings have been published in several scientific papers and additional technical reports that can be linked from the project web site. The web site also provides access to some of the published maps. A map booklet was produced to distribute among stakeholders in Accra. The capacity for continued research within the field has been enhanced by the project for all involved partners by the fruitful scientific discussions among all team members as well as the PhD students. PhD students have benefitted from research stays at the University of Copenhagen and PhD courses. Further, the project has facilitated the procurement of equipment, which is now available for researchers for drone-based data acquisition, spatial analysis, survey campaigns etc. in future research activities.

### **Conclusions**

Identifying hotspots for mobility disruptions and neighbourhood isolation is fundamental for creating more resilient urban transport systems. Mapping of critical flood locations using GIS-based modelling and analysis techniques is able to guide informed decision-making concerning measures to reduce the frequency and severity of disruptions. However, for sustainable solutions related to the urban flooding/mobility nexus, the results also underscore the vital link between urban development practices and flood vulnerability, and that solutions partly lie in the realm of more effective spatial planning and management of the urban expansion process. It is the opinion of all project partners that the interdisciplinary collaboration within and across the work packages, and working with local authorities, agencies, departments and other stakeholders in the study sites offered great insights into the challenges at hand and the possible solutions to the problems, using a variety of tools.

### **Recommendations**

The outcome of the project was debated intensively by stakeholders at the final dissemination workshop in Accra, and it is recommended that researchers continue to play a role as mediators between stakeholders with different viewpoints and as facilitators of continued dialogue towards addressing the challenges identified by the project. At the governance level, there is a need for inclusive planning processes that involve all stakeholders, including citizens. Transparency and accountability are also essential in ensuring that the community's needs are met, and that resources are used effectively and efficiently. It follows from the research and discussions that more effective enforcement of planning and area restrictions will be necessary to counteract the adverse effects of the present urban expansion and densification processes. Efforts are also needed to reduce the vulnerability of the road system, including improving the quality of local roads, providing alternative routes and outlets, and securing more effective coordination of the currently fragmented efforts for improving drainage facilities.