

## EXECUTIVE SUMMARY

This work focuses on quantifying the waste generation after flood events in Abidjan, the capital city of Cote d'Ivoire. Its relevance lies in the major issue of recurring floods that affect this high-potential city every year during the rainy season. Literature review findings indicate that the principal causes of floods in places like Abidjan are a mix of natural events and anthropogenic actions: heavy rainfalls and river overflow exacerbated by inadequate infrastructure, city planning, and uncontrolled urbanization.

Actions have been taken to tackle this issue in West Africa, but no research on flood waste quantitative models was found for Abidjan and similar cities in neighbouring countries. Thus, in the first part of this study, a regression model using a deterministic approach was developed in RStudio to predict the waste generated after any flood event in the city of Abidjan. Due to the extreme scarcity of relevant data, the objective was more on providing an example of a quantitative methodology that can be used to assess flood waste generation in Abidjan.

As the core part of building a deterministic regression model is to select the appropriate parameters, numerous parameters from previous research studies on flood waste in modelling in the world were gathered. Then, the feasibility of collecting data related to these parameters for the case of Cote d'Ivoire was assessed, resulting in a shortlist of features. The best parameters and the number of features needed were further evaluated using multiple runs with different combinations of parameters and certain performance metrics like VIF (Variance Inflation Factor). Additionally, because the flood waste (dependent variable of the model) generated in Abidjan after each historical flood event recorded was not registered, a special section was dedicated to its estimation using five different methods.

As a result, ten parameters were shortlisted: waste amount, population, area, urbanization ratio, number of households, amount of precipitation, GDP per area, hourly maximum rainfall, wind speed, and altitude. The five methods used for quantifying the waste amount after each historical event recorded in Abidjan provided a large range. Four of those methods were based on datasets from Thailand and Korea, and one of them was based on actual data from Abidjan. That data was derived from the Red Cross reports after their investigations on the Ivorian territory. Finally, the regression model with the highest adjusted  $R^2$  of 0.75 had four features. Compared to other studies, the results for the metrics obtained are much higher, and that is probably due to slight overfitting issues. The posterior Bayesian updating results were derived from using the deterministic method results as prior for the mean and standard deviation of the distribution, i.e: the prior knowledge about the parameters.

Regarding the environmental assessment, the focus was on estimating the space required for temporary disposal of the flood waste and addressing the discharge of heavy metals contained in that waste. For the space required, the first section (The Model part) permitted finding the flood waste composition: construction and demolition debris, and consumer durables. Since that estimation was in terms of mass, the waste density was used to derive the total flood waste volume from the estimated mass. For the heavy metals, the lack of data was also an issue. Thus,

the list of heavy metals to focus on was decided based on the Basel Convention regulations, and research articles about heavy metals usually found in the potable source of water in Abidjan. The results were that the minimum volume range required as space for the flood waste was estimated to be 200-1400 m<sup>3</sup> for a municipality. The principal heavy metals present in the flood waste were found to be copper, lead, steel, mercury, nickel, zinc, and aluminum. For the total amounts of flood waste every year, aluminum accounted for 95% of the heavy metals, and sensible metals like lead and mercury accounted respectively for 2ppm and 0.0021ppm. These small numbers compared to the limits advised by international standards indicated that there was no significant concern about the disposal of the heavy metals contained in the flood waste.

For future work, it will be mandatory to have much more access to real data from Abidjan. This could be achieved through surveys of local/government authorities and fieldwork. The existing data could also be enhanced by new data augmentation algorithms provided by the advancements in Artificial Intelligence. This would allow the use of advanced machine learning algorithms like neural networks for the prediction of flood waste in Abidjan. More importantly, incentives must be created in Cote d'Ivoire to generate more interest from the research community in this matter.