

CCE AWARDS 2016

An improved method
for planning protection
infrastructures against
natural disasters caused
by climate change in Haiti





Combining engineering, hydrology and social economy to develop an improved method for planning infrastructures to protect communities against natural disasters in the context of climate change

Summary

AECOM was commissioned by the Ministry of Agriculture, Natural Resources and Rural Development (MARNDR) to conduct preliminary studies for flood-protection infrastructure investments for five watersheds in Haiti. AECOM put forward an innovative technique combining engineering, hydrology and social economy to identify, assess, design and prioritize future infrastructures that will meet the needs of local communities, while providing the best protection against natural disasters and limiting impacts on the environment, all in the context of climate change.



Social and/or Economic Benefits

In its latest report on climate change, the Intergovernmental Panel on Climate Change (IPCC) predicts that droughts and major tropical cyclones will intensify and that heavy precipitations during hurricanes will be more frequent in the Caribbean.

Haiti is located in the Caribbean and often subject to a variety of environmental stresses such as flooding, droughts, hurricanes, and earthquakes; it is also one of the most vulnerable countries in terms of climate change when considering both the risks of physical impacts and the environmental and socio-economic factors that aggravate the situation.

In Haiti, the loss of vegetation cover is an ecological disaster that has persisted for nearly a century. The reduction in forest cover, from 60% in 1923 to less than 2% nowadays, has had considerable impact on soil erosion and water retention during heavy precipitations. As such, flooding frequency and their spatial impact have increased in the valleys, where most of the population and the infrastructures critical to the Haitian economy are located.

To face the growing threat of these natural catastrophes, Haiti implemented a flood-prevention program (Natural Disasters Mitigation Program or PMDN) to fund, plan and

build or upgrade flood-protection infrastructures that will prevent risks and reduce economic and social losses in the most affected areas; these are aimed to protect and sustain existing infrastructures, such as Artibonite irrigation scheme, roads and bridges, public institutions (schools, hospitals), etc. Driven by an innovative approach, AECOM identified, located, and prioritized investments in flood- protection infrastructures for five watersheds that cover roughly 2,400 km², or 9 % of the Haitian territory. The proposed works consist of a wide-range of constructions such as several kilometers of retaining and gabion walls, 200 dykes and sills in gabion, 330 micro-dams and 4,500 gully check-dams. These works will control flooding, protect crops and rural activities, public infrastructures and most importantly avoid casualties, prevent income and material losses for the local communities. Moreover, these works improve the quality of life of the riverside populations who feel better protected against natural disasters and promote investment in the communities. Lastly, the works implemented in the watersheds allow for the development of new crops, strengthening of the agroforestry sector and the introduction of animal husbandry, which promote household income diversification and increase community resiliency to natural disasters.





Technology Transfer

Various techniques have recently been designed to determine flooding damage curves by taking into account climate change. However, these curves can only be valid for specific environments and protection works in a given country, for example in Canada; unfortunately, they are not available in Haiti. To address this shortcoming, AECOM adapted the technique specifically for Haiti, enhanced certain parameters and transferred it to the MARNDR. To do so, AECOM trained 25 Haitian surveyors to collect engineering, sociological, economical and hydrological data, based on spatial analyses required to compute flooding damage curves. With this technique, data gathering is much more precise, less time-consuming and more economical compared to traditional techniques used to estimate flooding impact.

AECOM also trained the local communities by introducing them to the most efficient techniques (PMDN, stage 1) to prevent flooding by involving them in the decision-making process. To further support the MARNDR engineers, AECOM provided them with technical specification sheets to ensure critical knowledge is being transferred to them to implement preventive flooding and erosion measures.

This simple, but precise decision tool designed by AECOM will help the MARNDR engineers assess economic losses elsewhere in other watersheds affected by climate-change and flooding events, and effectively identify the priority measures and intervention sites.

Environmental Benefits

Environment quality in the territories covered in this study are highly affected by soil degradation, floods or droughts, and loss of vegetation cover that have direct negative impacts on the quality of life of the local populations. These cumulative impacts are often worsened by extreme climate events. The infrastructures proposed by AECOM under this project will have considerable positive impacts on the environment.

Indeed, the works planned in the upstream areas of the watersheds will reduce gully formation on steep slopes by limiting the devastating impact of water on bare soils. Moreover, these works will trap sediments and protect against silting of the economical infrastructures (dams, reservoirs, irrigation canals) located downstream, and preserve natural resources (rivers, estuaries). The proposed works will efficiently protect infrastructures located on the riverbanks, such as roads and irrigated perimeters that can be damaged or destroyed by bank erosion, scouring, and landslides.

Furthermore, water-harvesting structures such as small dams and hill-side impoundments yield many environmental benefits such as the improvement of water table refill and access to water resources needed by communities to grow perennial crops, which in turn will help stabilize soil and reduce erosion. Other indirect environmental benefits include flora and fauna diversity and abundance.



Lastly, the project increases environmental awareness of stakeholders and local communities by demonstrating the benefits of the protective works and by disseminating sound agricultural and agroforestry practices.



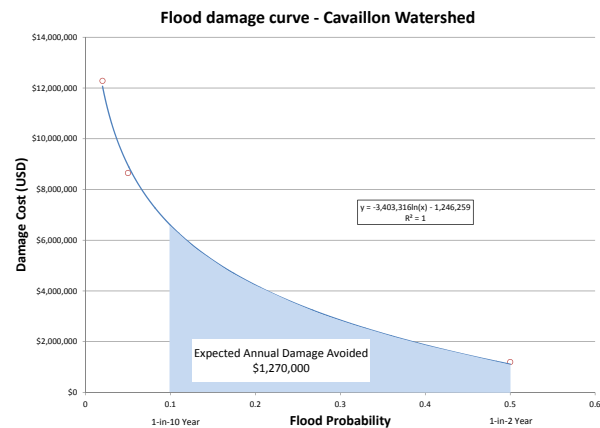
Within a short six-month timeframe, AECOM experts had to adapt the damage curves to the Haitian context and propose precise measures to be implemented on a territory of some 2,400 km².



Complexity

AECOM guided the MARNDR in the technical and financial assessment of flood-protection infrastructures requested at the local community level. We also assisted the MARNDR in justifying the selected infrastructures to the Inter-American Development Bank based on rigorous social and economic premises. Within a short six-month timeframe, AECOM experts had to adapt the damage curves to the Haitian context and propose precise measures to be implemented on a territory of some 2,400 km².

The tight timeline and the location of the watersheds across the country presented several considerable challenges for AECOM. First, the traditional hydraulic modeling approaches used to compute the extent of flooding are not suitable due to the lack of critical historical hydrological and rainfall data, as well as insufficient detailed and accurate topographic data. As flooding has long-lasting negative impacts on agricultural parcels, urban, and rural infrastructures, as well as on the victims, AECOM designed an approach that combines engineering (notably hydrology) and socio-economics to estimate the probability and the impact of flooding events and to compute the corresponding damage curves. To reach this objective, AECOM surveyed 1,200 households to gather data on damages and extent of flooding during the last hurricanes and tropical storms. A unique technique for household sampling, based on the overlaying of several GIS layers (land use, built density and flooding risks) was used which maximized the quality of the database by improving the selection of targeted surveyed households throughout the territory.



The area under the curve represents the Expected Annual Damage for a given site where protection works are proposed to reduce the cost of flooding.

Meeting Client's Needs

Through the PMDN, the MARNDR intends to build sustainable flood-protection works that will best reduce the socio-economic and environmental impacts of catastrophes while promoting a greater involvement of local communities in the selection of these works and ensuring efficient use of the invested funds.

The mandate, fulfilled on time and within budget by AECOM, highlighted the ingenuity, adaptability and strong commitment of our team throughout the project, and the great collaboration with the client. We met the client's needs by offering a high-quality action program.

Moreover, AECOM exceeded its mandate by providing the MARNDR with new decision-making tools to prioritize investments for flood-protection infrastructures for future use in other watersheds. Indeed, the innovative techniques developed in this project can be applied to the rest of the country and enable the MARNDR to make sound funding decisions in the future. These tools, based on an innovative approach combining engineering and socio-economics, improve preventive measures and risk management. Stronger empowerment of the local communities and their effective support ensures that they will more readily embrace the implementation of the program, so that the direct benefits of the infrastructures are sustainable.

The success of this project opens up new opportunities for the Haitian government in the allocation of both human and financial resources that benefit the local communities and the environment.





The project put forward the ingenuity, adaptability and strong commitment of our team throughout and the great collaboration with the client.

About AECOM

AECOM is built to deliver a better world. We design, build, finance and operate infrastructure assets for governments, businesses and organizations in more than 150 countries. As a fully integrated firm, we connect knowledge and experience across our global network of experts to help clients solve their most complex challenges. From high-performance buildings and infrastructure, to resilient communities and environments, to stable and secure nations, our work is transformative, differentiated and vital. A Fortune 500 firm, AECOM had revenue of approximately \$18 billion during fiscal year 2015. See how we deliver what others can only imagine at aecom.com and [@AECOM](https://twitter.com/AECOM).