Model Based Evaluation of Structural Measures Impact on the Inundation Area of Wadi Driven Flash Floods,.Case study of Wadi Dahab, Sinai Peninsula, Egypt

M Moura Mikhaeil[1,*], Gerald Corzo[2], and Islam Abou El-Magd[3]

[1]Civil Engineering Dept., Faculty of Engineering, Delta University for Science and Technology, Mansoura - Gamasa - The International Coastal Road, Egypt
[2]Dept. of Hydroinformatics and Knowledge management, UNESCO-IHE Institute for Water Education, Delft, P.O. Box 3015, 2601, The Netherlands
[3]Environment Dept., National Authority for Remote Sensing and Space Science (NARSS), Cairo, Egypt
[*]Corresponding author

Email: mora_moheb@yahoo.com

"Wadi is a dry riverbed that can discharge large water volumes after heavy rainfall either to the coastal or the desert plateau" (Kantoush, 2015). Flash floods in a desert region are one of the most disastrous natural hazards globally for the following reasons: Firstly, the heavy rain events in arid regions are rare and even if it happens, not all dry streams become full. As a negative consequence, people start constructing their own properties in the flood vulnerable zone. Then, when a flash flood comes across the old dry streams, it washes away everything. That is exactly what happened during the last disastrous event in Egypt, November 2015. Secondly, the flash flood in Sinai is suddenly generated on the top of the mountains rapidly down to the flat area so it brings not only water from rainfall but also debris with boulders and huge dangerous rocks.

Wadi Dahab is one of the major attraction sites for touristic activities in Egypt that contributes to the local economy, however, it is subjected to sever flash flood events. This research aimed at exploring the possibilities of developing mitigation measures for preventing flood damages in Wadi Dahab. Complementary to the city plan, three mitigation scenarios were proposed 1) historical scenario (2010) which proposed 7 dams and 3 reservoirs; 2) actual situation scenario (2014) which proposed 8 dams and 5 reservoirs; and 3) future planning scenario which proposes building three new dams, three artificial lakes and two retention walls.

Two hydrodynamic models were used; MIKE 21 and LISFLOOD-FP. MIKE 21 model was built to simulate the flash flood events. In order to obtain rational results, the model needed a lot of modification to its bathymetry. That resulted in searching for another model. According to university of BRISTOL website (2015), the main target behind designing LISFLOOD-FP is to solve a complex topography. LISFLOOD-FP model was used to generate the flood extent for each scenario.

The study area has a particular characteristic which makes it more difficult to study than the other Wadi systems. Wadi Dahab has a very low infiltration. Igneous rocks cover the largest area of the basin. Their permeability is very small then the water which is generated by the rainfall and floods cannot be well drained. That leads to an increasing of the runoff during the flash flood event. As a consequence, 50% of the rainwater can drain to the mouth of Wadi Dahab causing devastating flash floods (OMRAN et al., 2011). The infiltration rate was taken into consideration while LISFLOOD-FP model was built. It was uniformly distributed all over the domain and had a value of 0.000000352778 ms-1. The affected residential area was estimated based on a comparison with land use data. The economic loss was calculated based on the value of the buildings in Dahab city.

Overall, the current mitigation measures are not sufficient to assure the safety of the city against the flash floods. More structural measures are recommended.

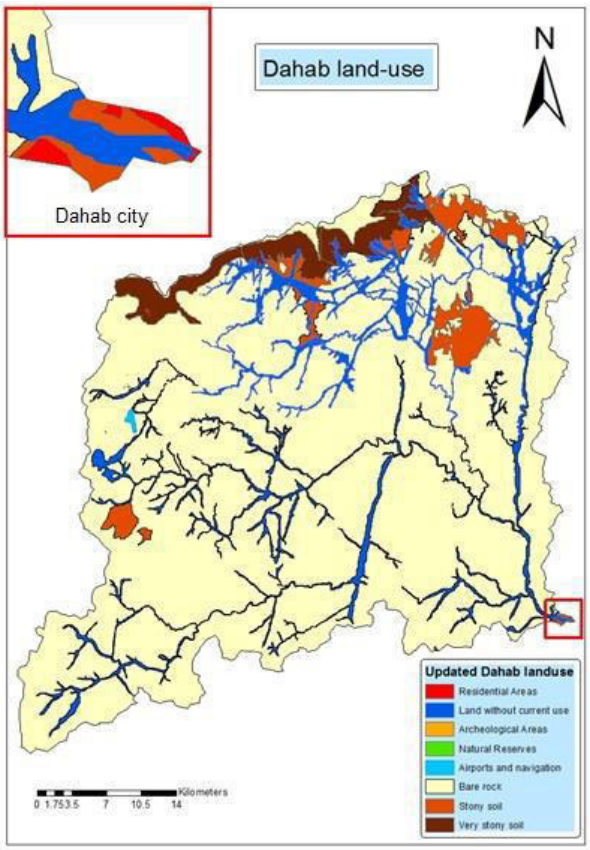

Figure 1 Land-use map of Wadi Dahab.

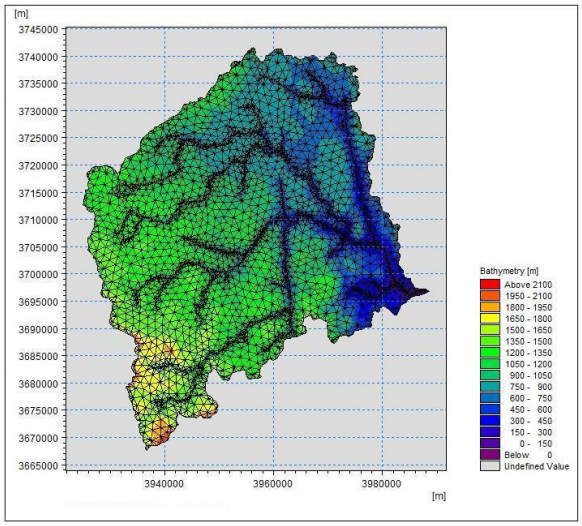

Figure 2 The mesh of Wadi Dahab, adopted by the author. This mesh was created using MIKE ZERO to be an input to MIKE 21 model. The inundated area of Wadi Dahab was the expected output after adding a heavy rainfall event to the model.