

Integrated Management of Flash Flood in Wadi System of Egypt: Disaster Prevention and Water Harvesting

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1. Intro and Background

UN-Habitat reported that recently the Arab region was affected by more than 270 disasters during 30 years, causing in more than 150,000 deaths and affecting approximately 10 million people (UN-Habitat, 2012). These disasters are mainly flash floods and droughts. A Flash Flood is defined as a rapid developed flood in just a few minutes or hours of excessive rainfall without visible signs of rain, or an accident like a dam or levee break. Egypt is one of arid and semiarid Arabian countries that faces flash flood in the coastal and Nile Wadi systems. Wadi is a dry riverbed that can discharge large water volumes after heavy rainfall either to the coastal areas or the Nile/desert plateau. Recently, Flash Floods are extensively occurred in Egypt, several flood events occurred in Sinai Peninsula, the Eastern desert Wadi, the Red Sea such as Safaga, El-Nakhiel, El-Abadi, and Upper Egypt

such as Asiat, Sohag, Qena, and Aswan as shown in Figure 1. Some records about such severe floods affected Egypt from 1975 to 2014 with an estimated total economic damage of approximately 1.2 billion USD/year. Flash floods in these Wadis are produced by convective cloud mechanisms at the beginning or end of the summer and winter, as warm air masses that produce heavy rainfall associated with thunderstorms as they are pushed over the Red and Mediterranean Seas. Additionally, floods can occur over a local small Wadi area, affecting the neighborhood or community as was the case in 1992 and 1994, or the entire basin, such as the floods of 1996 and 2010, which affected not only the Egyptian Red Sea coast but also the Sinai Peninsula. However, such floodwater is an important source of water to develop and create a new sustainable communities in some of potential Wadis.

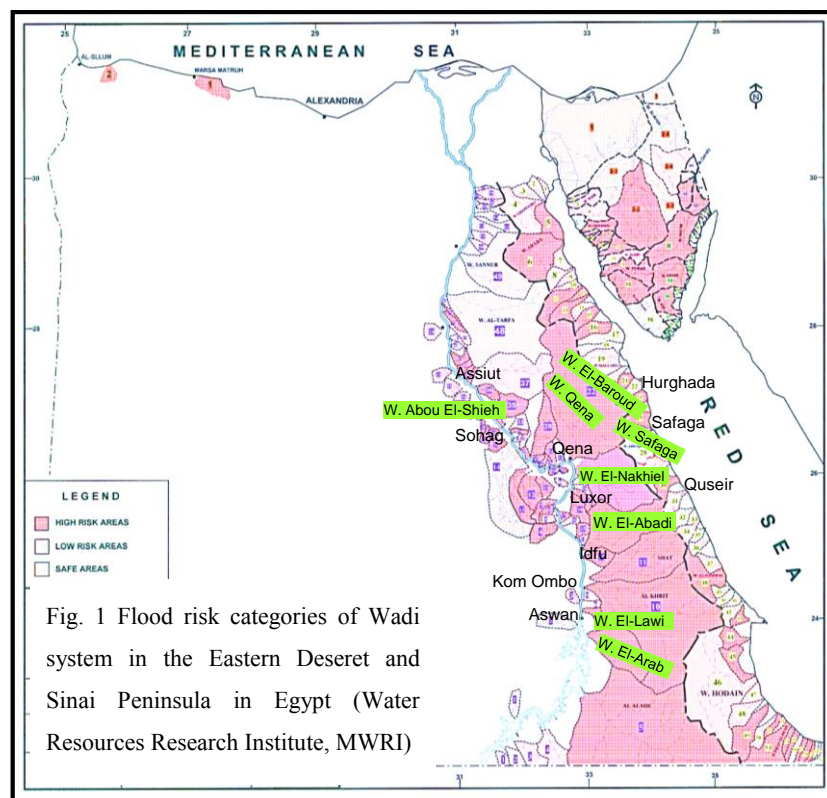


Fig. 1 Flood risk categories of Wadi system in the Eastern Desert and Sinai Peninsula in Egypt (Water Resources Research Institute, MWRI)

For many agricultural, rural and urban areas in Egypt, Wadi hydrology has a great impact on people security of life. Floods, although infrequent 2 or 3 times every decade, can be extremely damaging and represent a threat to life as well as property. Due to climate change impacts, such threats are likely to increase. In Egypt most of practicable routes for highways roads and other infrastructures are constructed across Wadi. Rapid increase of population, urbanization, economic and touristic developments has pushed people for construction in high disaster risk zones such as on Wadi's flood plain.

In Egypt several measures are adopted to mitigate the flood as a combination of obstacle dams, and detention dams at upstream and artificial lakes at downstream leads to a better issue of flood retention and groundwater recharge. A group of Kyoto University and Japanese companies made a preparatory field investigations for several Wadi in Egypt, between 22nd to 29th of November 2014, for facts findings and selecting the type of suitable integrated flash flood measures and their design criteria.

2. Flash Flood Potential, Mitigation and Harvesting

In the arid region flash flood are in fact common, but their occurrence and processes is poorly understood. Until today, no comprehensive proper protection from flash floods proposed for Wadi system in Egypt. There is an urgent need to mitigate and utilize floodwater as a new supply to sustain a minimum water resources base in rural desert areas. The present research focuses on developing a strategic methodology (Fig. 2) for evaluating Wadi flash flood potential, mitigation, and floodwater resource management as well as a rainfall-runoff simulation model. The flood mitigation measures is by constructing of flood retention structures such as dry dam by using innovative Japanese updated technology developed by Japan Dam Engineering Center (JDEC).

3. Methodologies

A physical-based distributed hydrological model and remote sensing data as well as GIS technique have been integrated to simulate flash floods in arid regions. Hydro-BEAM (Hydrological River Basin

Environmental Assessment Model) which was first developed by Kojiri, et al. 2002, and it was also adopted as Hydro-BEAM-WaS (Hydrological River Basin Environmental Assessment Model Incorporating Wadi System) by Saber et al. 2010, to be applicable at Wadi system in arid regions. It is used as physical-based model with remote sensing data which is calibrated with Global Precipitation Climatology Center data to overcome the lack of data in such areas.

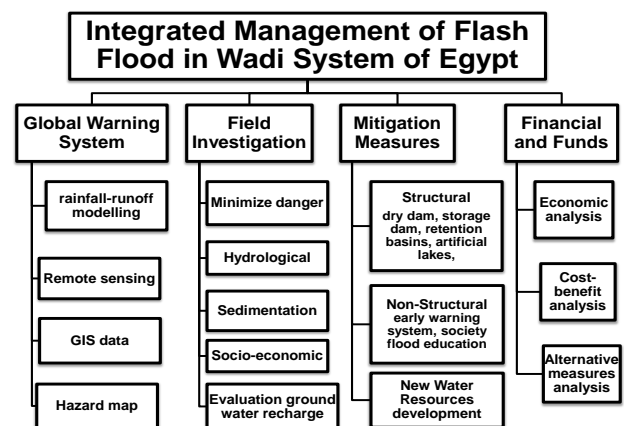


Fig. 2 Flash flood project methodology and prevention strategic management approaches.

4. Conclusions

The present research try to weave together ideas drawn from field survey, hydrological simulation and integrated information in a GIS environment to develop Wadi flood risk areas. In order to suggest suitable sites for building dams in a potential Wadis as W. El-Abadi, and highly probable sites for recharging water will be clarified. As shown in Fig. 2, structural and non-structural mitigated measures are proposed that could modify the damage susceptibility and alleviate the vulnerability of the flash flood. Further, fully assessment of flood potential through several rainfall-runoff analysis and discharge forecasting techniques will be conducted. The Wadi's new residents, touristic developments and power plants investors generally lack direct experience with flash flood hazards. Therefore, to provide investors and decision makers of Egypt with highly accurate up-to-date digital information and a permanent database that could help in selecting cost effective measures for assessment and mitigation of potential Wadis for future developments projects. An optimal utilizations of floodwater resources for sustainable development in these potential Wadis are provided.