The FRIEND/Nile Project:

Flow **R**egimes from **I**nternational **E**xperimental and **N**etwork **D**ata (FRIEND) of the Nile Basin

Flood Frequency Analysis Component (FFAC)

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Background

The FRIEND/Nile project is one of the major UNESCO projects to strengthen and enhance the research cooperation between Nile basin countries for a better understanding of hydrological regimes of Nile basin. The FRIEND/Nile Project is a Fund In Trust Project funded by the Government of Flanders for a duration of 4 years starting November 2001, and aims also at enhancing the capacity building and networking for Nile countries.). Four research themes are supported by the project, namely: Flood Frequency Analysis (FFA); Rainfall-Runoff Modeling (RMM); Droughts and Low Flow Analysis; and Sediment Transport and Watershed Management (STWM

Partners involved:

The project is executed by UNESCO Cairo Office and implemented by namely:
The Water Resources Research Institute of Egypt,
UNESCO-Chair in Water Resources of Sudan,
University of Dar Es Salaam of Tanzania,
University of Nairobi of Kenya, and
The Ministry of Water Resources of Ethiopia.

Flood Frequency Analysis Component (FFAC)

The Flood Frequency Analysis Component is one of the four research components of the FRIEND UNESCO-FLANDERS Science FUND IN TRUST PROJECT. This component was coordinated by the Water Resources Research Institute of the National Water Research Center of Egypt and assisted by the theme researchers from the participating Nile Basin countries and the resource persons from Belgium.

The major objectives of the FFA component

Can be summarized as follows:

- Obtaining relationships between flood peaks and their corresponding return periods on both single and regional;
- Develop design procedures for flood estimation at the gauged and ungauged catchments on regional basis;
- Produce the regional flood frequency curves, and define the hydrological regions.

This will serve to improve designs of hydraulic structures along or across streams; planning flood plain adjacent to a stream; designing storage works for irrigation, water supply, and flood control.

The output the of the FFAC research activities:

- Flood Frequency Curves for single sites,
- Regional Flood Frequency Curves for a homogenous region,
- Using GIS techniques for estimating the geometric characteristics,
- Application at ungauged basins.

Methodology:

Harmonized methodology and procedures of at-site and Regional Flood Frequency Analysis (RFFA) have been applied by all theme researchers of the participating countries. The analysis consisted of data Processing and models applications. The data acquisition for the FFA has been carried out by each theme researcher of the participating countries which are: Egypt; Sudan; Tanzania; Ethiopia and Kenya. Three models have been used to carry out the technical research activities. The first approach was the Flood package developed by Institute of Hydrology, UK. The second approach was the Flood Frequency Analysis developed by Cairo University, Egypt. The Third approach was the Extreme value analysis (Q–Q) Plot developed by the Flemish Counterpart.

Constraints Faced Research Activities:

Topographic; land use; soil type and digital elevation maps with a proper resolution are not available. These maps are helpful to obtain the chatchment characteristics which are the main parameters in the RFFA.

Findings and Lessons Learned

- Enhanced knowledge transfer and exchange among Flemish and Nile countries experts;
- Trust, confidence, mutual trust and understandings have been developed among the research team of the FFA component which enables the exchange of data among the different countries. This is an important issue in the cooperation in the field of Flood Frequency Analysis;
- Enhanced methodologies and promoted relevant flood analysis practical research; Introduce new ideas for the application of the GIS procedures in the RFFA is recommended.

Proposed Future studies in the regionalization analysis

- Extraction of catchment characteristics:
  - based on DEM: percentage in different slope classes
  - based on land cover map (Africover data): percentage of urban, percentage of agricultural land and percentage of forest,
  - based on soil type map: percentage of sand, percentage of loam and percentage of clay.
- Implementing slope, land use and soil type characteristics;
- Update analysis of MAF vs. catchment characteristics;

- Mean annual rainfall (MAR) should also be re-defined and used in the context of the duration in which the flood peaks are observed;
- Comparison between peak over threshold and annual maxima methods (for some selected stations);
- Estimation of the flow duration frequency (QDF)-relationships (with different time scales);
- More advanced homogeneity tests and uncertainty analysis on regional curves.

Related Events and FFA Workshops:

- The first workshop for Flood Frequency Analysis was organized in Cairo, Egypt on 11-16 November 2001. A detailed work plan and budget were prepared for this component.

- The second Flood Frequency Analysis Workshop was held in Cairo, Egypt, on 1-3 April 2003. The main aims of the meeting was to review the progress in implementing the activities of the component and prepare the second year Work plan, list of planned activities and their expected dates. Moreover, deliverables of each FFA theme researcher were identified. Also, a group of free FFA software were compiled on a CD and distributed to the FFA theme researchers. The workshop was covered by the media.

- The third workshop took place in Sharm El-Shiekh, Egypt on 29th of November to 2nd of December 2003. The research teams of the Flood Frequency Analysis (FFA) component in Egypt, Sudan, Kenya, Tanzania, and the Flemish counterparts have participated in this workshop and presented their technical reports on regional analysis for the different regions of the Nile Basin. A number of working group sessions were carried out where FFA experience has been exchanged among the FFA researchers. Problems with data shortage and inconsistencies in the approach presented by the different countries were identified and discussed. Procedures for harmonizing the methodology of the regionalization analysis has been outlined and approved. The third year work plan and activities was also identified.

- The fourth workshop was held in Borg El Arab, Egypt on 22-24 June 2004. The progress in implementing the FFA research activities was reviewed and adopted on a regional Flood Frequency Analysis, in addition to prepare a detailed list of activities for each FFA theme researcher. Proposed new methodologies for the regionalization analysis were discussed. Moreover, encountered problems for conducting Regional Flood Frequency Analysis (RFFA) in the different countries were reviewed and identified.

• The fifth workshop took place in Nairobi, Kenya in the period 26th to 29th of November. The implemented regional frequency analysis in the participating countries was presented, reviewed and discussed. GIS visualization of the results for the whole Nile basin was introduced. The USGS-DEM raw data of the whole area of the Nile Basin with resolution of 90m×90m was distributed to all FFA themes researchers. GIS manipulation of the DEM data was guided by the Flemish counterpart to extract more physiographic parameters for the enhancement of the regionalization analysis. Some statistical homogenous regions within the Nile basin were defined. The workshop participants identified the framework and time schedule of the FFA technical papers to be presented in the Final FRIEND/Nile International Conference as an output of the FFA Component during the first phase of the FRIEND/Nile project. It was agreed that a total of five FFA papers will be prepared for the November 2005 conference Future research activities were defined for each of the research theme researcher.

• Finally, the sixth workshop was held in Khartoum, Sudan in the period 25-30 July 2005. The implemented research activities of the FFA component in Kenya, Tanzania, Sudan, Ethiopia and Egypt were presented and discussed. Improvement in the preparation of the technical papers to be presented in the Final FRIEND/Nile International Conference was recognized in all countries. The participants discussed and reviewed thoroughly all papers. The Flemish counterparts presented their comments on each technical paper. Intensive working group sessions were conducted to finalize the papers and to adopt the reviewers' comments. The papers were totally finalized and reviewed during the workshop. The workshop participants identified the framework and time schedule of finalizing the rest of the FRIEND/Nile papers. Also, the outlines of the annual progress report for the fourth year of the FFA component were discussed and reviewed by the research team of the FFA component. Moreover, the outlines of the conference agenda and schedule of activities were discussed and reviewed.