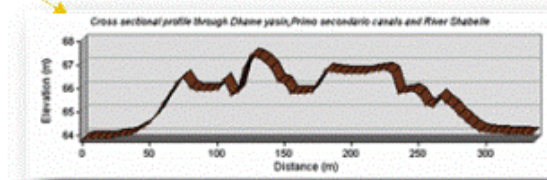
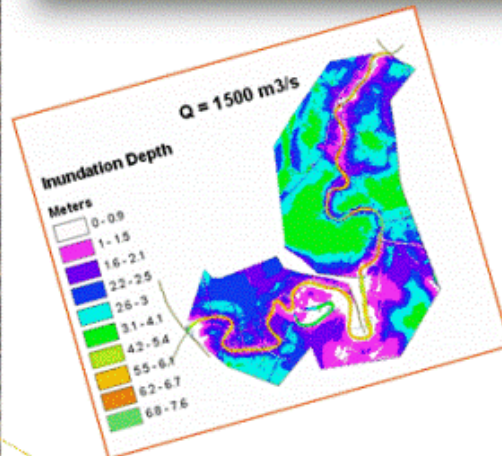
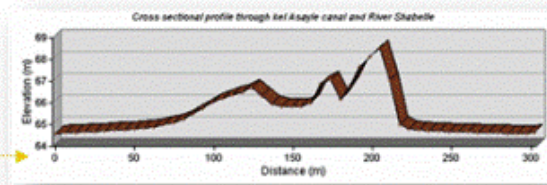


Hydraulic Analysis of Rivers Juba and Shabelle in Somalia



Basic Analysis for Irrigation and Flood Management Purposes

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Executive Summary

Water resources management of the Juba and Shabelle Rivers involves two major issues, namely flood management and irrigation water supply. The high floods in the Juba and Shabelle Rivers is both a boon and a curse for the people living in the riverine areas. The high floods deposit much needed nutrients in the flood plains as well as provide opportunities for flood recession cultivation. On the other hand, uncontrolled flood water destroys infrastructures and inundates scarce cultivated land and settlements. The continuing deterioration of the flood control and river regulation infrastructure, coupled with unregulated settlement in flood plains and the recent practice of breaching river embankments to access water for wild flood irrigation, have increased the vulnerability of these communities to progressively smaller peak flows.

So far, any meaningful flood protection and preparedness works have been hampered by the unavailability of accurate topographical and geo-morphological data of the two rivers. The available topographical maps with 20m contour intervals were insufficient to undertake any river analysis including flood plain delineation. Thus, the aerial photography data with 25-50 cm vertical accuracy (digital terrain model- DTM) now available at SWALIM have enormous potential to address these issues.

There is also considerable potential for irrigation development from the two rivers. It is estimated that up to 265,000 ha of land could be irrigated in these two basins if the pre-war irrigation infrastructure were brought back into operation.

A study on hydraulic behaviour of the two rivers and their hydrology to support flood forecasting and water resources information management for irrigation purposes was thus needed. Basic analyses dealing with the hydrological and hydraulic behaviour of the Juba and Shabelle Rivers have thus been undertaken. The analysis and information product derived in this study will also be used in the Juba and Shabelle River Atlas SWALIM is preparing¹.

The main outcomes of this study are thus the following:

- Determination of the general hydraulic characteristics of the two rivers
- Estimation of water availability and water balance at key locations

Catchment Characteristics: Upper parts of the catchments of the two rivers lying mostly in Ethiopia contribute most of the flows in the Juba and Shabelle Rivers in Somalia including floods generated by high intensity rainfall in the upper catchments. Hence, drainage basin morphology described by standard indices was derived from the 30m and 90m DEM² available for the whole catchment. Sub-basins of major tributaries were delineated and key catchment characteristics such as the areas and perimeters, hypsometric curves, shape factors/elongations, etc were derived.

¹ An outline (table of contents) and major GIS layers of the River Atlas of the Juba and Shabelle River were prepared as part of this study using SWALIM's past work and data from the Digital Aerial Photography carried out in January 2008. The Atlas will cover a general description of the rivers, hydrological and hydraulic regime and the orthophotos with contours, names of major towns, settlements, infrastructure, etc.

² Only derived products from 30m DEM are available with SWALIM.

Hydrological and Hydraulic Characteristics : Based on the “Water Resources Assessment of Somalia” prepared under SWALIM Phase-II (GCP/SOM/045/EC), the hydrological features of the Juba and Shabelle River basins were further elaborated including identification of the catchments with special focus on flood hydrology and irrigation water demand. Information and data on river hydraulics and available water for releases for irrigation and flood diversion were assessed.

Aerial Photography Products: The aerial photographs and the relevant DTM were analysed to extract the following geo-morphological, topographical and hydraulic features.

- (i) Geo-morphological characteristics of the rivers;
- (ii) Cross-sections of the rivers (perpendicular to the flow paths) at relevant intervals including the sections upstream and downstream of the gauging stations, bridges, barrages and, other control structures,
- (iii) Mapping of irrigation off-takes along the river course (locations, invert levels); Longitudinal profiles and cross sectional data for primary irrigation canals and barrages that are covered by the aerial survey³.

River Hydraulics: Theoretical rating curves, bank full conditions and preliminary flood inundation studies in key locations were derived using the HEC-RAS model and HEC Geo-RAS software. The 25cm and 50cm vertical accuracy DTM available from the Aerial Survey was used for this purpose. It should be noted that the bank full conditions should be reliable as the channel hydraulics can be modelled using 1-dimensional river hydraulic models like HEC-RAS. This would however not be accurate for the flood plains as a 2-Dimensional hydraulic model would be required. This was not carried out in this study.

Flood Inundation Mapping: Basic flood inundation mapping at two flood prone locations – Jammame Reach in Juba River and Jowhar Reach in Shabelle was illustrated using the HEC RAS results with further processing using HEC Geo-RAS.

Irrigation Diversions and Water Balance: Irrigation water requirements for general cropping patterns followed in the Juba and Shabelle river areas were derived using FAO CROPWAT software. Mapping of irrigation off-takes along the river course using the aerial photographs and derived DTM were initiated in this study. The off-take levels and the dimensions and profile of the canals can be analysed to derive the capacity of the canals and discharge diverted by these canals in various seasons. This can be used to calculate the water balance of the river at different locations. As the area coverage of the two rivers is quite large, only major diversion canals were mapped.

³ Mapping of the hydraulic structures and canals will be included in the SWALIM River Atlas

Glossary of Somali Terms

<i>Deshek</i>	Flood-diversion techniques used for delivering flood water for irrigation purposes
<i>Dyer</i>	October to November, minor wet season
<i>Gu</i>	April to June, major wet season
<i>Hagaa</i>	July to September dry and cool season
<i>Jilal</i>	Dry season from December to March
<i>Webi</i>	Perennial Stream

List of Abbreviations

BCM	- Billion Cubic Meters
CP	- Cropping Pattern
CROPWAT	- Crop Water Requirement Software of FAO
EC	- European Commission of the European Union
FAO	- Food and Agriculture Organization of the United Nations
DEM	- Digital Elevation Model
DTM	- Digital Terrain Model
Geo-RAS	- GIS Processor for HEC-RAS
HEC-RAS	- Hydrological Engineering Centre River Analysis System Model of USACE
SRTM	- Shuttle Radar Topography Mission
SWALIM	- Somalia Water and Land Information Management Project of FAO
USACE	- United States Army Corps of Engineers

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