ECOHYDROLOGY AND CLIMATE CHANGE SCIENCE: A CHALLENGE AND OPPORTUNITY IN UNDERSTANDING THE NILE BASIN SYSTEM

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ABSTRACT

The Nile River system is regarded as one of the most important ecohydrological systems of the world. Although the freshwater carried by Nile accounts a very small fraction of the volume of water compared to Amazon (2%), Mississippi (15%) and Mekong (20%) Rivers, its diverse ecological richness, history, mosaiced landscape and land-cover makes it unique and a valuable resource to the basin countries. The basin is the home of over 160 million people in 10 countries providing basic livelihoods for the agriculture, fishing, tourism, recreation, power generation and domestic water supply. Despite the rich resources, the basin is also characterized by limited knowledge on the ecohydrology of the basin. Studies have shown that, the river system has shown a fluctuation of seasonal and annual flows and in some watersheds a decline in dry season flows across the basin. This is mainly driven by impacts of the erratic and unpredicted changes in climate variables, undesirable changes in land-use on hydrologically and hydraulically sensitive segments of the river system. Ecological stress on the natural resources such as vegetation, soil and water is significant from the ever increasing demand for tillable land by the increasing population and also from lack of watershed management. Given the trend in demand for resources (water, land and soil), extreme climatic events and climate change will make sustenance challenging. Some predict the worst is yet to come, unless we take active measures and adapt to the changes.

Taking active measures to understand the ecohydrological system of the Nile Basin and the impacts of natural climate variations and climate change land-water system of the Nile will require a sustained study. The land-use and climate changes are the major drivers that lead to the decline and variability of river flows. Although these changes alter the hydrology in many ways, they are also interrelated and influence one

anther in a fashion poorly understood. Partitioning the changes in water fluxes attributed to changes in land-use and climate shift is not yet fully explored.

The interactions of the hydrology, ecology and the dynamic climate are one important aspect of the bigger picture worth researching. Eco-hydro-climatology is an approach to understand the interaction of the three fields of science for better mapping of fluxes, response of vegetation to fluxes, impacts of climatic variables on the hydrology and vegetation patterning and vice versa. This approach will be unique in that it addresses the underlying problems surrounding the interaction and causation. This effort will require systematically gathered scientific data on the landscape cover, biotic resources and also well monitored hydrometrological data of the basin.

Despite its contribution to the Nile flow system, the Blue Nile River basin suffers from little or incomplete data covering the hydrologic and hydraulic aspects of the river and streams. Studies are either limited to large scale flow analysis or incomplete. Scattered information on hydrology of tributaries and other water bodies, which are equally important for flow sustenance, is also limited. The resilience of the systems to shocks of land use alterations, precipitation variability in timing and volume, changes in air temperature, sediment fluxes to Lake Tana are not understood. Programs that promote sustainable water and land use practices are not perceivable. Watershed management and water use policies that encourage community participation, promote environmental education, and empower regional offices to monitor, protect and manage water resources and support scientific studies are vital. On the science front, understanding of the upper portion of the basin is an effort long overdue.

Another challenge is the scale mismatch among the ecology, hydrology and climate science. The close interaction and relationship of the three fields in shaping the hydrological and ecological landscapes of the basin will necessitate exploring the possible interactions and correlation at different spatial and temporal scales. Understanding the water flux of the basin at a river basin scale will require upscaling field/ecological scale processes and downscaling climatic process which are at regional scale or higher. Aggregation and disaggregation of parameters on the other hand suffer from uncertainty and can also result in error propagation.

The opportunities in the eco-hydro-climatological approach are the ability of remote sensing tools in providing various information at different spatial and temporal scales. Although the role of current remote sensing techniques decrease as we go from regional to field or from climatological to ecological scales, various techniques of down and upscaling techniques have proven to provide reliable information. In the Nile basin this approach will suffer from the absence of field scale experiments and research undertakings that help understand the fundamental processes which govern the movement of water and nutrients in the atmosphere-soil-water interface.