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Hydrology of Nile River Basin in the Era of Climate Changes

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Editorial

Nile River has traditionally been considered the world's longest river, but its discharge is relatively low compared to the world's other large rivers. Within the hydrological cycle, Nile River links the land with water bodies such as lakes, wetlands, and Mediterranean Sea. Geographical features of Nile basin are diverse to include snow-capped and forested mountains, extensive wetlands, and barren deserts. Nile basin includes climates ranging from the high rainfall of tropical rainforests to arid desert conditions. Nile River water movement is important to the natural environment and to people. Nile River Basin includes all the land from the headwaters to the mouth that drain to a river. Life within the Nile River Basin depends on variation in river structures and processes that vary in space and time. All River processes longitudinally (along the length of a river channel), laterally (across a river channel), and vertically (from the river bottom to the surface) are significant to the hydrological regime and habitat types of a river.

Hydrology of the River Nile is influenced by both climate and geography throughout the basin. In the main River Nile, the discharge depends on the flow patterns of river tributaries. Water flows within the basin depend on rainfall and climate patterns; hydraulic characteristics of channels, lake, and wetlands; vegetation; and human influences such as dams. The total discharge of the River Nile is low compared to other large rivers. Main quantity of rainfall falling within the Nile basin is lost due to evaporation, seepage, and overflow into wetlands. Approximately half the water entering the Sudd is lost to overbank spillage and evapotranspiration. Highlands of Ethiopia and Eritrea and the Equatorial Lakes Plateau are two main sources of most water in the River Nile. The Ethiopian and Eritrean highlands leads to seasonal discharge in the Blue Nile, Atbara, and Sobat Rivers those sources are responsible for the annual Nile flood and contribute about 85% of all the water in the Main Nile. Equatorial Lakes Plateau water flows through the vast wetlands of the Sudd via the Bahr el Jebel. The Equatorial Lakes Plateau contributes a smaller but more consistent year-round supply of water to the River Nile compared with the Ethiopian and Eritrean highlands.

The Nile River basin includes an area of approximately 3 million km^2, and includes all the land-mountains, plains, cities, agricultural land, and arid regions - that drains to the Nile River. The Nile watersheds or smaller basins (known as sub-basins) included within the basins of larger streams or rivers. The Blue Nile basin, with an area of about 324,000 km^2, includes the sub-basins of its two major tributaries, the Dinder (16,000 km^2) and Rahad (8,200 km^2), also the Lake Tana sub-basin (17,000 km^2), and the basins of all other tributaries that flow into the Blue Nile. Linkages between upstream and downstream ecosystems and watersheds provide a useful unit for managing most Nile environmental systems from headwaters to the river mouth at the Mediterranean Sea.

Nile River system can be divided into three sections from the headwaters to the river delta: The upper river basin is characterized by steep gradients and erosion processes that contribute to downstream sediment transport. Streams are often include waterfalls, and generally have little floodplain. Basins and banks are more likely to be forested and shaded from the sunlight. Middle River section of a river system is characterized by gentler slopes, a larger river channel, wider floodplain, and greater degree of river meandering than in the upper river basin. A balance between erosion and deposition occurs in this section of the river. Lower River and Floodplain section of a river system (extending to the delta) exhibits a very low slope, perhaps changing by only approximately ranges from 10 to12 centimeters in elevation over 1 kilometer of river channel length. This zone is influenced mainly by deposition, but localized erosion and local reworking of the sediments may also occur. At Khartoum to Aswan, both Blue Nile and White Nile are flowing together, over 1,880 km through the desert. At Aswan, the waters of the Main River Nile are impounded by Aswan Dam in the enormous storage reservoir. Between 1912 and 1982, average annual discharge of the River Nile at Aswan was 84.2 billions of cubic meters of water per year (10^9 m^3/year). Downstream of Aswan Dam, the River Nile flows through a relatively narrow valley. Some barrages and structures have been constructed for much utilization such as irrigation, ecological, hydropower and navigation purposes. North of Cairo, the River Nile divides into two branches, the Rosetta and Damietta.

Nile river delta is the area where the mouth of the river flows into the Mediterranean Sea. Before building Aswan Dam, the Nile River flooded every year during late summer. The floods brought high water and natural nutrients and minerals that annually enriched the fertile soil in Nile delta; this had made the Nile delta ideal for farming since ancient times. Now, Nile delta contains a mix of fresh and saline waters depending on the level of river flow and sea tides.

The hydrological regime of a river, as well as the landscape and organisms that depend on it are severely affected by human activities, including agriculture, irrigation, and removal of forest cover, dam building, and water transfers. Construction of several dams within the Nile basin has changed the hydrology of the River Nile, the ecosystems, and human activities within the basin.

The Nile River Basin suffers changing climate, so design and pilot adaptation options at basin level should be addressed. In the community level, the Nile Basin region have always responded to climate variability by changing practices of water management, cropping patterns, and livestock. Sovereign strategies are unlikely to build sustainability of livelihoods and ecosystems to manage the climate change. The vulnerability of the Nile Basin region is deteriorated by poverty, disease, conflict and a low adaptive capacity. The Nile River Basin States should identify and evaluate best practice adaptation options to climate change induced water stress in the context of national adaptation priorities and climate change response strategies.

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