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Lessons from the Nile about rivers and society

The Holocene flooding and sedimentation history of the Nile illustrates how fluvial geomorphology has long influenced human society.

A lush, green avenue cutting through what is now the world's largest desert, the floodplains of the Nile have been a centre of civilization for thousands of years. The river provided easy transport while floods supplied nutrients conducive for agriculture, while also presenting a recurring hazard to settlements. The Nile river system, connecting Lake Victoria to the Mediterranean, has been buffeted by profound regional hydroclimate changes since the start of the Holocene epoch 11.7 thousand years ago. Research in this issue of *Nature Geoscience* details how shifting flooding and sedimentation regimes resulting from these hydroclimatic changes affected economic and social structures.

During the North African Humid Period — which extended from a few thousand years before the start of the Holocene to about six thousand years ago — global climatic conditions caused the African monsoon to deliver increased precipitation across the Saharan region. While this made some previously arid areas more amenable to people, the higher rainfall had the opposite effect in the Nile Valley. Cecile Blanchet and colleagues found, by analysing a sediment core collected in the Mediterranean off the Nile delta, that wetter conditions in the drainage basin during the peak of the humid period led to more frequent and often more severe summer flooding. This may explain evidence for a pause in long term human habitation and agriculture in the Nile Valley until the return of more regionally arid conditions[1].

Using data from a transect of sediment cores collected near Luxor, a study by Jan Peeters, Angus Graham and colleagues found that a

distinct change in sedimentation followed the end of the North African Humid Period in the Egyptian portion of the Nile Valley. In this sector, the Nile had been cutting down through underlying bedrock since the start of the Holocene, but they found that this incision largely ceased around 4,000 years ago as drier conditions set in across North Africa. Subsequently, sediment began to build up and floodplains expanded laterally. The authors suggest this would have impacted agricultural–social systems as the extent of arable land expanded and river channels stabilized and were reduced in number. The cultural landscape was also impacted as elevated river terraces — which being relatively protected from flooding had been a locus of temple and settlement building — were gradually buried by floodplain sediments[2].

Shifting fluvial conditions in the Nile Valley also had direct impacts on the placement of the largest monuments constructed by the ancient Egyptians. For example, a recent analysis[3] of geophysical evidence showed that a large group of pyramids near Giza located far from the modern channel were actually built along an old, now abandoned and buried branch of the Nile. Interestingly, many of these pyramids were built during the Old and Middle Kingdoms between about 4.6 and 3.7 thousand years ago, mostly preceding the transition from incision to floodplain expansion and river channel consolidation indicated in Peeters et al.

The evolution of the Nile has continued to impact civilizations along it into modern times, but increasingly humans themselves — in addition to climate — are driving these changes. Since the mid-20th century, the Nile has undergone another regime shift as human capacity to reshape and engineer the river has grown. The construction of the Aswan Dam in the 1980s and the Grand Ethiopian Renaissance Dam in the 2010s severely curtailed water and sediment flows. Such projects have delivered hydropower and irrigation benefits to different parts of the Nile drainage basin, but exacerbated political and economic strain as countries negotiate over management of limited water resources[4].

The Nile is just one example of floodplains with long historical links to past societies that now face accelerating impacts under human development[5]. Prominent examples are the Mekong River in southeast Asia, where commercial sand extraction is causing rapid and likely irreversible hydrological impacts[6], as well as the Yellow River in China, where civil engineering projects alongside rapid urbanization are curtailing sediment flows[7]. The sedimentary and archaeological records of both river systems show a long history of shaping human history along their banks that may offer insights as global environmental change accelerates.

History shows how the evolution of river systems shaped human civilizations as the climate shifted through the Holocene — both positively and negatively. With climate warming and the anthropogenic influence on rivers increasing, it is critical we understand the interactions and feedbacks between societies and the rivers that sustain them.

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