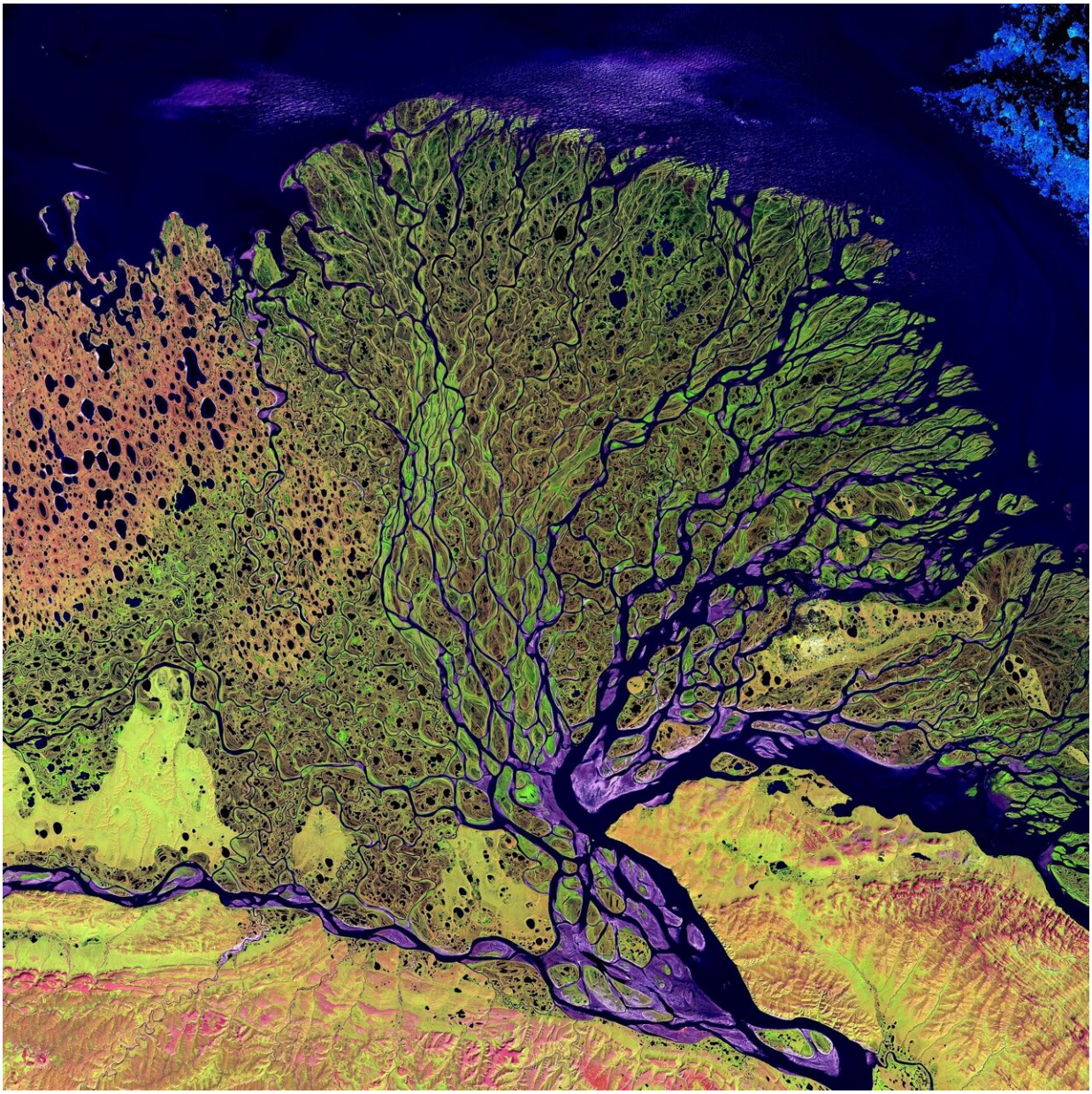
Coastal river deltas threatened by more than climate change, study shows

November 20 2023



Credit: Pixabay/CC0 Public Domain

Worldwide, coastal river deltas are home to more than half a billion people, supporting fisheries, agriculture, cities, and fertile ecosystems. In a unique study covering 49 deltas globally, researchers from Lund University and Utrecht University have identified the most critical risks to deltas in the future. The research shows that deltas face multiple risks, and that population growth and poor environmental governance might pose bigger threats than climate change to the sustainability of Asian and African deltas, in particular.

"We can clearly show that many risks are not linked to climate. While climate change is a global problem, other important risk factors like land subsidence, population density and ineffective governance are local problems. Risks to deltas will only increase over time, so now is the time for governments to take action," says Murray Scown, associate senior lecturer, Lund University Center for Sustainability Studies, and lead author.

Collapse of delta environments could have huge consequences for global sustainable development. In the worst-case scenario, deltas could be lost to the sea; other consequences are flooding, salinization of water, which affects agriculture, coastal squeeze, and loss of ecosystems.

The study, published in *Global Environmental Change*, looked at five different IPCC scenarios for global development in 49 deltas all over the world, including famous deltas such as the Nile, Mekong, and Mississippi, but also more understudied deltas such as the Volta, Zambezi and Irrawaddy deltas.

The research identifies possible risks to deltas stretching 80 years into

the future. The researchers based their analysis on 13 well-known factors affecting risk in deltas and drew upon unique models to identify which of these risks are most likely to endanger different deltas in the future. Risk factors include increasing population density, urban development, irrigated agriculture, changes to river discharge, land subsidence and relative sea-level rise, limited economic capacity, poor government effectiveness, and low adaptation readiness.

Population density, land subsidence and ineffective governance are high-risk factors

The analysis shows that there are some risks that are more critical to deltas than others—in all of the five future scenarios. These include land subsidence and relative sea-level rise, population density, ineffective governance, economic capacity, and cropland use.

For some deltas, physical risks are especially pronounced. Land subsidence is, for example, the highest risk factor for the Mekong delta in Vietnam. Extreme sea levels are among the most concerning risk factors for deltas in China, on the Korean peninsula, and in the Colorado (Mexico) and Rhine (Netherlands) deltas.

In the Nile (Egypt), Niger (Nigeria), and the Ganges (Bangladesh) deltas, it is increasing population density that is of most concern under certain scenarios. For other deltas, it is the lack of economic capacity and government effectiveness to manage risks, for example in the Irrawaddy (Myanmar) and Congo (Angola and Democratic Republic of the Congo) deltas.

"Analyzed all together, we can see that the Asian mega-deltas are at greatest risk, with potentially devastating consequences for millions of people, and for the environment. They are under pressure from population growth, intense agricultural land use, relative sea-level rise,

and lagging adaptation readiness," says Murray Scown.

Local and global approaches and a mixture of hard and soft adaptation can mitigate risks

"Instead of sitting back, governments need to think long-term, and put plans in place to reduce or mitigate risks. In the Mekong delta, for example, the Vietnamese government is making strong efforts to restrict future groundwater extraction in the delta to reduce land subsidence and salinization," says Philip Minderhoud, assistant professor at Wageningen University and Research.

The researchers highlight that a mixture of hard ("gray") and soft ("green") adaptation approaches will be required to manage and mitigate delta risks. They include both hard infrastructures, like sea walls to stop the sea inundating the delta, and soft approaches using nature-based solutions.

One example is the Dutch experience of creating room for the river in the Rhine delta, by lowering floodplains, relocating levees, and using spaces that are allowed to flood for grazing. Initiatives to build up delta surfaces by allowing rivers to flood and deposit sediment on the delta to maintain elevation above sea level are also promising, notes Frances Dunn, assistant professor at Utrecht University.

"By looking at the deltas together, like we have in this study, we want to highlight what can happen on a global scale if we do not address delta risk both on a local and global level. The study can also complement studies on individual deltas, and identify efforts needed [that are] connected to less studied deltas such as the Saõ Francisco or Volta delta," says Maria Santos, professor at the University of Zurich.

More information: Murray W. Scown et al, Global change scenarios in coastal river deltas and their sustainable development implications, *Global Environmental Change* (2023). DOI: 10.1016/j.gloenvcha.2023.102736

Provided by Lund University