

Going with the flow

How climate and land use affect river sediments

By Markus Bernards

In search of some experience in the tropics, it was in Togo that geography student Jürgen Runge first set foot on the African continent. A somewhat bumpy start developed into a great affection for Central and West Africa. Today, Runge is Director of the Centre for Interdisciplinary African Studies at Goethe University Frankfurt and, together with partners in the region, conducting research above all on landscape development, river sediments and climate change.

When Jürgen Runge arrived in Togo in 1983, he was obliged to go to bed hungry. At that time, the future African studies scholar had just passed his intermediate exam in geography and wanted to do an internship in a tropical country; his professor in Giessen had sent him to West Africa. It was only with some difficulty that he had managed to find the guest house of the *Deutsche Gesellschaft für Technische Zusammenarbeit* (GTZ, now GIZ). Darkness had fallen very quickly, the night watchman

was already on duty, the guest house empty, and somewhere chickens were clucking. It was a little eerie. Still, he met a member of the GTZ staff inside, who merely called out to him, however, that she was very sorry, but they had completely forgotten that he was supposed to arrive that day. Dripping with sweat, only moderately fluent in French and without Google Maps – there would be no internet for another ten years – Runge spent his first night in the tropics.

Today, Jürgen Runge is Professor for Geoecology and Physical Geography at Goethe University Frankfurt, with a special research focus on Sub-Saharan Africa, and Director of the Centre for Interdisciplinary African Studies. The first, rather gloomy evening in West Africa is long behind him, and the “culture shock” has given way to a great affection for Africa. “The next day, the staff introduced me to the localities, and today, when I’m sitting on the plane on my way to Togo, I look forward to the kebabs from the woman around the corner,” smiles Runge.

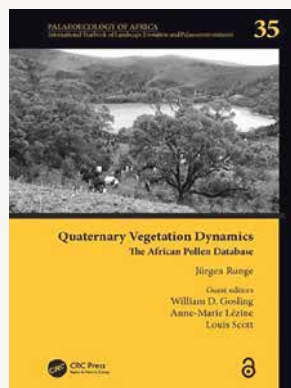
Mining sand from riverbeds like here in the Mò River in Central Togo also increases erosion.
Photo: Jürgen Runge



Charcoal, which these women are carrying to the market, is the most important energy source in West Africa for cooking.
Photo: Michele Burgess, alamy.de

Prehistoric pollen

Pollen grains stay preserved in organic sediments for a long time. Because they are of very different shapes, they can be assigned to the plants that once released them. This makes it possible to characterise the features of past landscapes, for example whether they were closed forests or open grassland. Pollen also reveals changes in biodiversity and substantiates how vegetation responds to climatic changes and human activities. In the 35th volume of “Palaeoecology of Africa”, published for the first time as open access, new environmental data from the lower latitudes and extensive synthetic overviews are presented that provide an insight into vegetation dynamics during the most recent epoch of Earth’s history, the Quaternary, which spans the past 2.6 million years. During this epoch, cold and warm periods alternated around the globe, and towards the end of this period humans increasingly began to use the land, changing ecosystems as they went. The book’s objective is to give a better understanding of how and why vegetation changed in the past by making comparisons with the present in order to better predict future changes in vegetation and thus landscapes.



Publishers: Jürgen Runge (Goethe University Frankfurt), William D. Gosling (University of Amsterdam), Anne-Marie Lézine (CNRS, Paris) and Louis Scott (University of the Free State, Bloemfontein). CRC Press/Routledge, Leiden, Netherlands. 2021 Open Access: <https://www.routledge.com/Palaeoecology-of-Africa/book-series/POA>



Geographer Tignoati Kolani examines alluvial sediments from the Keran River, a tributary in the Oti River Basin.
Photo: Jürgen Runge



From his six-month internship, during which he mapped lowlands to document possible areas for vegetable cultivation, he brought soil samples back to Germany and showed them to geomorphologist Professor Jürgen Hövermann in Göttingen, who held the sand sealed in plastic bags up to the light and exclaimed: “Hell and damnation, that looks like desert sand!” That was ultimately incorrect, they were “normal” erosion sediments from the slopes. “But with that he motivated me because finally someone was showing a scientific interest in what I’d brought back from Togo,” says Runge. He moved to Göttingen, where he completed his doctoral degree after his studies and continued to devote himself to Togo and other African countries, and primarily to how tropical rivers shape landscapes over time.

Research in the riverbed

In the spring of 2022, Jürgen Runge had just returned from another research visit to Togo, where he and his colleague Dr Laldja Kankpénandja from the University of Kara had studied river sediments: a basic research project where the scientists are looking at sediment structures to understand how rivers develop in the tropics. Runge: “The rivers there often erode only a minimal amount of material because of today’s low gradient; we call these peneplains. The sediments near the surface and the soil are eroded and deposited elsewhere over a very long period of time, that is, 60, 80 or 100 million years. To compare: the Middle Rhine Valley formed in the past 800,000 years, meaning that the Loreley Rock – from the perspective of geological history – is comparatively young.”

In March, at the end of the dry season in West Africa, the rivers carry scarcely any water and the sediments are clearly visible. However, the intense heat really got to the researchers: when the sun is high in the sky, the thermometer can easily climb to 40 degrees. Runge: “We get up early and leave our quarters at five o’clock in the morning. It gets light at six, and

then we can study the alluvial sediments in detail for a few hours before it gets unbearably hot at around noon.”

The river sediments also reveal when and how the climate changed in the past – through pollen grains, for example, which can be preserved in organic sediment deposits and are so different in shape that they can be assigned to different plant species (see box, p. 104). Palaeoecology is the term used for this specialist field in the reconstruction of past ecosystems. A research group, in which Jürgen Runge led a subproject, studied the “First Millennium Crisis” in the middle of the first millennium BCE in Nigeria and Cameroon, together with soil scientists, archaeologists and archaeobotanists. It can also be seen from the sediment layers that the climate of equatorial Africa became far drier within a relatively short period of time. Runge reports: “We can tell from the pollen in the sediment layers that the vegetation changed at that time and the rainforest disappeared in many places.” This had an impact on the migratory movements of the people living there at that time because the impenetrable rainforest had become sparse savannah, across which they could advance southwards more easily. This can still be seen today in the way Bantu language has spread throughout large parts of central and

Jürgen Runge examines geological structures near Dfalé in the Kara Region, Togo.
Photo: Tignoati Kolani



ABOUT JÜRGEN RUNGE

Jürgen Runge, born in 1962, studied geography, soil science, geology and botany in Giessen as well as geography, botany, tropical agriculture and forestry in Göttingen, where he graduated in physical geography. He earned his doctoral degree at the same university in 1989 and his postdoctoral degree (habilitation) in 2000 at Paderborn University with a thesis on Central Africa. In the same year, he was appointed at Goethe University Frankfurt as Professor for Geoecology and Physical Geography with a regional focus on Sub-Saharan Africa. From 2007 to 2010, he worked as a project manager for the Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ, now GIZ) in the Central African Republic. In 2003, he was founding director of the Centre for Interdisciplinary African Studies, which, after some interruptions, he has now headed again since 2013. Jürgen Runge organises summer schools and workshops to train forestry and environmental experts (<https://www.giz.de/akademie/en/html/59600.html>), whose task it is to ensure sustainable forest management in the Congo Basin.

jrunge@em.uni-frankfurt.de

southern Africa, as Bantu originally stemmed from present-day Nigeria north of the tropical rainforest. Runge believes that this “ecological determinism” is at least highly probable.

When rivers shape the landscape

Later, the rainforest spread out again, and today it is human-induced climate change that is causing it problems. Applied research on the consequences of climate change and land use by the growing population in West Africa, that is, sustainability research, is Runge’s second research pillar. Here, he is working together with his Frankfurt team in a network of scientists from Benin, Burkina Faso, Cameroon, Côte d’Ivoire and, of course, Togo. They are studying how transport links can be designed so that they are ecologically sustainable, how uncontrolled land use or charcoal production are abetting the savannah’s encroachment into the forest, or

how yam, maize, rice, millet and pearl millet cultures behave under changing rainfall.

The rivers also react sensitively, as Runge knows: “Land use and charcoal production are shrinking the forest from the edges. This is indeed slightly less dramatic in Central Africa than in Brazil, where vast areas of the rainforest are being systematically chopped down. But here, too, the forest is diminishing and can retain less water as a result.” Together with the impact of battering raindrops no longer slowed down by a dense

canopy of leaves, soil erosion is increasing, and the rivers sweep the soil away with them in the form of suspended particles. The outcome: “Rivers are becoming much wider, which can be seen now and again at bridge foundations from the colonial era that are eroded. At the same time, the suspended particles form new islands in the riverbed. Large areas of agriculturally productive land are carved up and unusable for food production.” This means that reservoirs have to be dredged more frequently. Elsewhere, excessive sand mining for construction by the population can increase fluvial erosion in riverbeds.

sustainable use of forest and savannah ecosystems in the Congo Basin, has taken up the cause of protecting the forest, which is so important for soil conservation. It needs trained forestry and environmental experts, and Runge, in cooperation with the *Deutsche Gesellschaft für Internationale Zusammenarbeit* (GIZ) and other partners, organises summer schools for COMIFAC lecturers, in which scientists from numerous West and Central African countries are involved. The aim is to preserve the important biodiversity and the large carbon dioxide storage capacity above all of the tropical rainforest.

More students from Africa!

The topic of climate change makes it clear once again how much Europe and Africa are in fact dependent on each other. For this reason, Runge would like to see much closer exchange between Germany and the countries of the African continent. “We still have room for improvement at Goethe University Frankfurt too,” says Runge. “Of our 45,000 students, only perhaps 500 are from Africa, most of them from the Maghreb. Yet Sub-Saharan Africa has an enormous wealth of inquisitive and educated young people. Should they all go to China or Malaysia?”

But German students today are also rather hesitant about spending a few months alone in Central or West Africa for an internship or to write a thesis, without their professor as “travel guide”. But only in this way can you get to know people, culture and nature, says Runge. “The infrastructure is not so good in many places, and sometimes you simply get stuck somewhere for days and can’t move on with your journey. But I think it’s great when you’re then often invited into local communities’ homes and can see how they live. Video conferences are not enough to really make contacts. You need to be able to shake hands, sit down to a meal together or have a beer. It’s always a bit chaotic, you have to go along with that, but you also decelerate a lot down there.” Perhaps this is precisely what makes West and Central Africa so appealing. ●

IN A NUTSHELL

- Sediment layers in central and west African rivers show that there was a distinct dry season in equatorial Africa around 2,500 years ago, during which large parts of the rainforest gave way to savannahs.
- When the tropical forest shrinks due to charcoal production or conversion to agricultural land (and possibly in future as a result of climate change), erosion increases.
- The training of foresters and environmental experts by the Commission of Central African Forests aims to contribute to the preservation of the rainforest and its sustainable use.

The author

Dr Markus Bernards
 bernards@em.uni-frankfurt.de
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Sustainable forestry protects against erosion

The Commission of Central African Forests (COMIFAC), a supranational body for the sus-