RICE POLDERS IN THE ACID SULFATE SOILS OF THE BOLANHAS IN THE MANGROVES OF GUINEA-BISSAU

R.J. Oosterbaan and J. Vos

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1. Introduction

The Rice Polders Reclamation Project in Guinea Bissau started in August 1977 under difficult conditions: the country had recently gained its independence, its infrastructure had been badly damaged during the preceding struggles, and the build-up of local technical staff was still in its infancy.

Guinea Bissau used to be an exporter of rice, but the difficulties created by its struggle for independence resulted in shortages of this staple food, which could only be overcome by the import of large quantities of the product.

The production of rice in small polders, formed in what were once mangrove forests, has long been a traditional practice in Guinea-Bissau. The country's authorities therefore felt that if some technical assistance could be provided, this production could be resumed and possibly increased. A request for such assistance was made to the Dutch government, who agreed to provide the assistance under a bilateral aid project. Although the projects has not yet achieved its aims, it is felt that if efforts are continued for a sufficiently long time – say five or ten years more – good results can be expected. The reasons for this optimism will be explained below.

2. Rice polders (bolanhas)

The rice polders (the *bolanhas*, pronounce as bolanya's) are located in a coastal region, 50 km or more wide. The region is intersected by numerous sea-arms and salt-water creeks, in between which are the higher lying mainland tongues, consisting of lateritic materials. Along the borders of the creeks, mangrove trees grow abundantly. The pattern of creeks, mangroves and land-tongues appears on a map as a complicated interlocking jigsaw puzzle (Figure 1.)

The mangrove soils, marine clays, lie above mean sea level but below the high tidal level. There is a tidal difference of about 4 m.

Following an old tradition, the people construct dikes, 1.5 to 2 m high, along the creeks so that the land behind the dikes is no longer invaded by seawater at high tide. The land that thus falls dry is cleared of mangrove vegetation – the wood being used for housing construction or for cooking the daily meals. After several years of soil ripening and desalinization, the empoldered land is ready for rice cultivation (Figure 2).

Dike construction is extremely laborious, being done entirely by hand. The work proceeds under muddy conditions with the seawater coming in twice a day. The maintenance of the dikes, locally called *ouriques*, is no simple matter either: there is a constant erosion hazard from the high waters, burrowing animals and also from the decay of organic matter in the clay of the dike body.

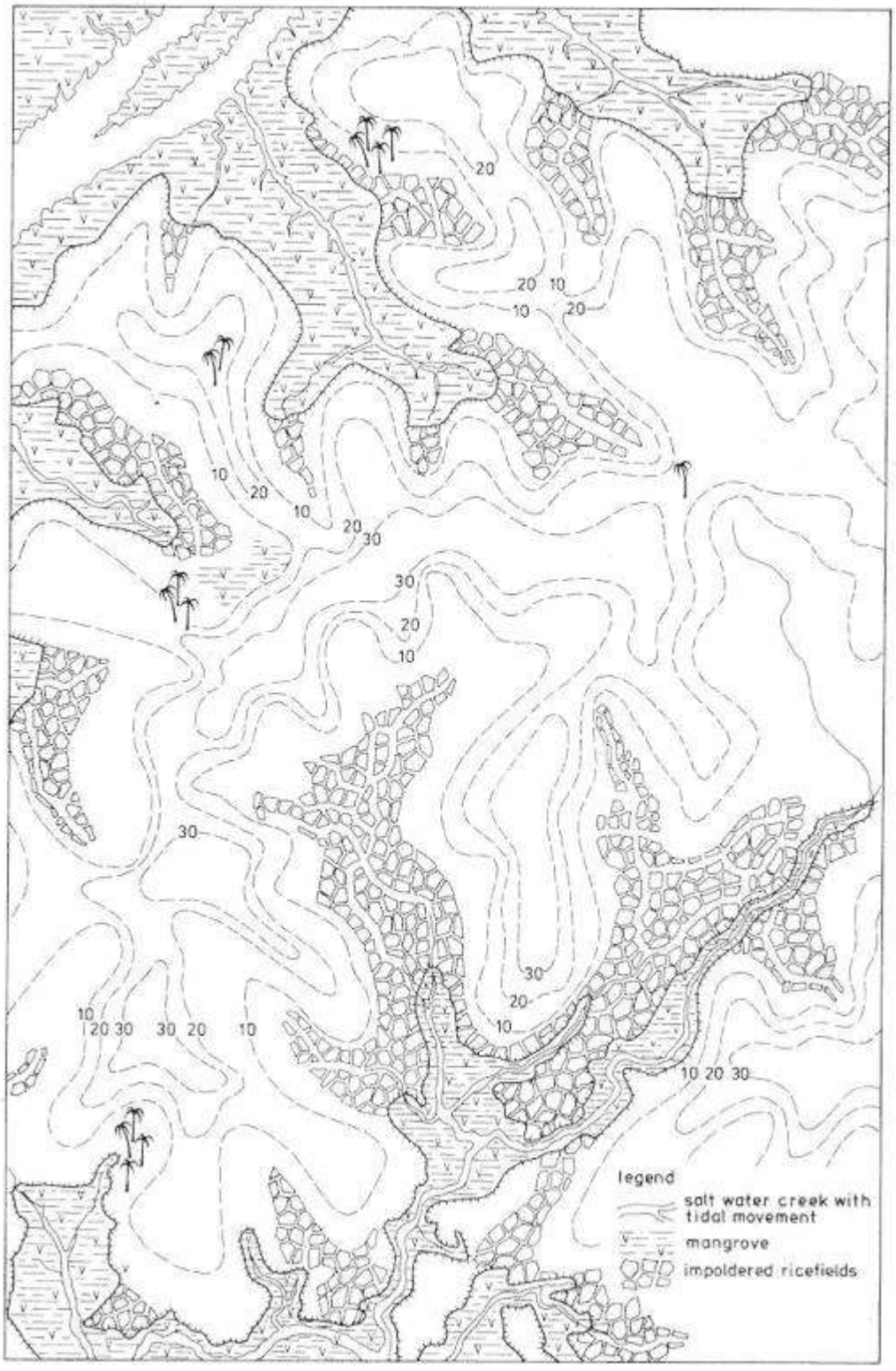

Figure 1 Coastal region with salt-water creeks, mangroves and rice polders (bolanhas).

Figure 2. Empoldered land (bolanha) ready for rice cultivation

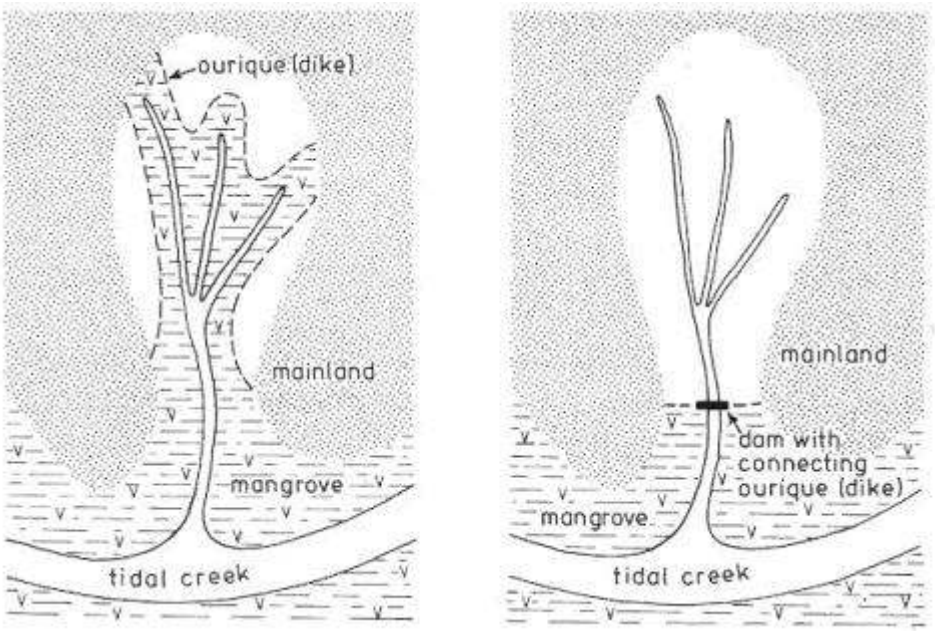

Figure 3. Scheme of casting dams across the smaller creeks to reduce the ouriques

3. Dam construction

In recent years, a program of casting dams across the smaller creeks has been introduced. In this way, the number and length of the *ouriques* required can be considerable reduced (Figure 3). The dam material is laterite, a much stabler material than clay (Figure 4).

Figure 4. Dam made of laterite.

Originally, bulldozers were used to do the work, but a far more efficient of earth moving is by trucks and loaders. It is one of the major accomplishments of the Rice Polders Reclamation Project that all agencies involved in dam construction within the project have now incorporated the truck-and-loader method in their works.

After ne land has fallen dry, many years pass before it is brought into cultivation. The reasons for this long delay are not precisely known, but the may be one or more of the following:

1. – The mangrove vegetation dies slowly, and cutting the dead trees and clearing the land is a laborious operation
2. – Soil ripening and desalinization is a long process
3. - There is a shortage of labor
4. – The marketing system is not well developed, so there is little incentive to produce more rice
5. – Seed is in short supply
6. – There may be settlements of different tribes along the mangrove and they need time to come to an understanding.

4. Rice cultivation

Rice cultivation in the coastal polders is entirely dependent on rainfall. Average annual rainfall varies from 1500 mm in the north of the country to 2500 mm in the south. In dry years, rainfall may be 500 mm less than average. The rainy season extends from June to October, rainfall in the other months is negligibly small. In the last decades, rainfall has tended to be less than average, which does not encourage the local population to plant more rice.

Within a rice polder, small bunds of about 30 cm height divide the area into compartments of irregular shape and size (Figure 5). The shape and size depend on the topography and the micro-relief. Within the compartments, the soil is formed into ridges on which the rice is planted (Figure 6), At the end of the dry season, the

bolanhas are deliberately flooded with sea water at high tide for weed control and possibly as a cure to soil acidity (Figure 7).

Figure 5. The parcels are separated by bunds and have irregular size and shape

Figure 5. Rice is planted on ridges

Figure 7. After harvest, sea-water is permitted to enter the bolanha *for weed control and to improve the soil acidity caused by the presence of sulfuric acid. An* ourique *is visible at the right.*

As soon as sufficient rain has fallen to make the soil workable (it has been thoroughly desiccated and hardened in the dry season) the ridges are heightened with soil from the gullies/furrows in between. The heightening is necessary because the ridges are eroded each year by the rainstorms occurring during the growing season. The rice cultivation proper begins in August, the months with the highest rainfall (at an average of roughly 20 mm/day).

5. Drainage, soil acidity, and water management

When rainfall is particularly intense, the excess water in the compartments finds its way to depressions in the field and collects in the creeks, which formerly carried sea water but now serve as fresh water drains. The drainage water is led out of the *bolanha* through culverts under the *ouriques*. The culverts, locally known as *canoas,* are traditionally made of hollow tree stems and are provided with a valve to prevent the entry of salt water.

It is not known to what extent poor internal drainage in the *bolanhas* causes yield damage. This will be a field study in the project for the years to come. In the past, attention was mainly focused on the reclamation of new land, but it is now imperative that more attention than before be paid to agricultural improvements in the existing *bolanhas*, including proper soil and water management. Yield per ha are low (500 to 1000 kg) and it should be possible to double the yields with relatively simple measures.

As can be expected in mangrove soils, acidity problems develop soon after empolderment. These soils are rich in pyrite, which upon exposure to air, is oxidized

and transformed into sulfuric acid. In newly reclaimed bolanhas, pH values of the soil drop to 3 at the end of the dry season, but rise again during the rainy season.

Soils in the older *bolanhas*, however are not or only slightly acid (pH = 6, reference: Balanço de 1979, Annual Report of the Department of Agricultural Hydrology and Soils, Guinea Bissau). It appears that a combination of rainfall, cultivation practices, sufficient surface drainage, and occasional flooding with seawater can cure the acid sulfate problem.

6. Conclusion

Guinea Bissau, with at present approximately 100 000 ha of rice land, cultivated at low investment levels, has a great potential for boosting its rice production. Interesting developments are taking place. They deserve encouragement and support.